Broadband Data Collection

Data Specifications for Provider Infrastructure Data in the Challenge, Verification, and Audit Processes

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Table of Contents

1 Mobile Provider Infrastructure Data 1
1.1 Mobile Provider Base Station Location and Height 4
1.2 Mobile Provider Base Station Carriers 6
1.3 Mobile Provider Base Station Loading 10
1.4 Mobile Provider Speed Test Invalidity Data 13
1.5 Mobile Provider Band-specific Coverage Maps 17
1.6 Mobile Provider Site-specific Coverage Maps 19
1.7 Mobile Provider Transmitter Monitoring Software Data 20
1.8 Mobile Provider Link Budget Parameters 22
1.9 Mobile Provider Hexagon - Base Station - Link Budget Association Data 32
2 Fixed Provider Infrastructure Data 35
2.1 Fixed Wireline Provider Infrastructure Data 36
2.1.1 Fixed Wireline Distribution Hub Locations 37
2.1.2 Fixed Wireline Access Node Locations 38
2.2 Fixed Wireless Provider Infrastructure Data 40
2.2.1 Fixed Wireless Propagation Model Details 40
2.2.2 Fixed Wireless Link Budget Parameters 42
2.2.3 Fixed Wireless Base Station Location and Height 48
2.2.4 Fixed Wireless Base Station Carriers 49
2.2.5 Fixed Wireless Base Station Loading 52
2.3 Satellite Provider Infrastructure Data 56
2.3.1 System Information 56
2.3.2 Space Station Orbital Shell Information 57
2.3.3 Satellite System Link Budgets Parameters 59
2.3.4 Satellite System Capacity Information 63

Change Log

Revision	Date	Comments
1.0	2022-03-09	Initial release.
1.1	2023-01-31	Update to Physical Cell ID field in Mobile Provider Base Station Carriers table in Section 1.2.
1.2	2023-03-07	Added Mobile Provider Speed Test Invalidity Data, Mobile Provider Site-specific Coverage Maps, and Mobile Provider Transmitter Monitoring Software; performed general cleanup and confirming edits throughout.
2.0	2023-11-30	Expanded scope of and renamed document; added discussion of Mobile Audit requests; added Mobile Provider Link Budget Parameters and Mobile Provider Hexagon - Base Station - Link Budget Association Data; added Fixed Provider Infrastructure Data section. This document replaces document formerly titled "Date Specifications for Provider Infrastructure Data in the Mobile Challenge and Mobile Verification Processes."
2.1	2023-12-21	Added Section 2.3 on Satellite Provider Infrastructure Data.
2.2	2024-02-20	Incorporated reporting for DSL / Copper (technology code 10) infrastructure into Section 2.1.

1 Mobile Provider Infrastructure Data

Mobile broadband service providers whose coverage data have been cognizably challenged must submit either the results of on-the-ground mobile speed tests or infrastructure information to rebut the challenge or else concede the challenge. Mobile broadband service providers that are the subject of an inquiry as part of the Commission's verification process must submit either the results of on-the-ground mobile speed tests or infrastructure information. Regardless of which type of data is submitted in response to a challenge or verification inquiry, the Commission may subsequently require the provider to submit additional information if needed to ensure an adequate review, including but not limited to either infrastructure or mobile speed test data (to the extent not the option initially chosen by the provider) or data collected from network transmitter monitoring systems or software (to the extent available in the provider's network). Mobile broadband service providers that are the subject of an inquiry as part of the Commission's audit process must submit infrastructure information.

The specifications for the infrastructure data files listed below are provided in Sections 1.1 through 1.9. These data must be submitted in the specified file format in the BDC system via file upload. Mobile broadband service providers submitting these data must provide certifications to the accuracy of the data.

Section	Data Name	Applicable Responses	Description / Notes
1.1	Mobile Provider Base Station Location and Height	Mobile Challenge Mobile Verification Mobile Audit	Infrastructure information on all the base stations included in the propagation modeling used to generate the coverage maps for a mobile broadband service provider in the area subject to challenge or verification inquiry, in tabular format.
1.2	Mobile Provider Base Station Carriers	Mobile Challenge Mobile Verification Mobile Audit	Infrastructure information on all the carriers (i.e., antennas) deployed on each base station included in the propagation modeling used to generate the coverage maps for a mobile broadband service provider in the area subject to challenge or verification inquiry, in tabular format.
1.3	Mobile Provider Base Station Loading	Mobile Challenge Mobile Verification Mobile Audit	Infrastructure information on the cell loading measured for the carriers for each base station included in the propagation modeling used to generate the coverage maps for a mobile broadband service provider in the area subject to challenge or verification inquiry, in tabular format.

Section	Data Name	Applicable Responses	Description / Notes
1.4	Mobile Provider Speed Test Invalidity Data	Mobile Challenge	Information on the challenger speed tests that the provider asserts are invalid for one of several defined reasons, in tabular format. *- Note: Providers may optionally submit these data alongside base station infrastructure data in response to a challenge.*
1.5	Mobile Provider Band-specific Coverage Maps	Mobile Challenge	Coverage map with polygon GIS (geographic information system) data indicating the extent of a mobile service provider's service using a given technology for a particular spectrum band. *- Note: Providers are required to submit these data where speed test invalidity data submitted in response to a challenge assert a device lacks support for a required spectrum band.*
1.6	Mobile Provider Site-specific Coverage Maps	Mobile Challenge	Coverage map with polygon GIS (geographic information system) data indicating the extent of a mobile service provider's service using a given technology for a particular spectrum band. *- Note: Providers are required to submit these data where speed test invalidity data submitted in response to a challenge assert a base station site outage.*
1.7	Mobile Provider Transmitter Monitoring Software Data	Mobile Challenge Mobile Verification Mobile Audit	Information on mobile device speeds recorded from information collected by the base station transmitter indicating mobile broadband service in the area subject to challenge or verification inquiry, in tabular format. *- Note: Providers may optionally submit these data in addition to speed test data or infrastructure data, but these data are insufficient by themselves for a response to a challenge, verification inquiry, or audit request.*
1.8	Mobile Provider Link Budget Parameters	Mobile Verification Mobile Audits	Parameters and values included in all link budgets used in the propagation modeling that generated the coverage maps for a mobile broadband service provider in the area subject to verification inquiry or audit request, in tabular format.

Section	Data Name	Applicable Responses	Description / Notes
1.9	Mobile Provider Hexagon - Base Station - Link Budget Association Data	Mobile Verification	Optional associations between hexagons, base stations, and link budgets used to provide mobile service in sample-selected hexagons for the area subject to verification inquiry, in tabular format. *- Note: Providers may optionally submit these data when submitting speed test data in response to a verification inquiry in order to reduce the number of speed tests required.*

The requirements in this document do not constitute binding FCC rules; rather, this document provides guidance on the requirements governing the binding FCC data collection rules and explains how to make the required filings in the system. The rules governing the BDC (formerly known as the Digital Opportunity Data Collection) can be found in 47 CFR § 1.7004 *et seq.*

The FCC's Office of Economics and Analytics may publish updates to this document prior to the initial BDC filing window and in advance of subsequent BDC filing windows. In addition, instructions for biannual BDC submissions, a User Guide to the BDC system, and other materials will be made available prior to the initial BDC filing window on the FCC's Broadband Data Collection website at https://www.fcc.gov/BroadbandData/filers.

A Word about Header Rows:

When uploading files in the BDC System, users must include the header specified below for each upload file, and its characters must match what is specified in this document. File templates that include the specified header rows will be made available for download from the FCC's website at a later date.

A Word about Required Fields:

In the file specifications below, all of the fields are required. In certain specified cases, the value for a field can be left null. However, the field (or column) must still be included in the file; if it is not, the user will receive an error message from the BDC System.

1.1 Mobile Provider Base Station Location and Height

This file must contain the records for each base station used to model mobile broadband coverage. The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Field Name	Header	Data Type	Example	Description / Notes
Site ID	site_id	String	VA0128	Unique site ID, assigned by the filer, for the base station to which this data record applies. - *Value length must be less than 256 characters.*
Latitude	latitude	Decimal (10,7)	38.903692	Geographic coordinate latitude of the base station in decimal degrees using WGS-84 coordinate reference system. - *Must be a minimum of 6 and a maximum of 7 decimal digits.*
Longitude	longitude	Decimal (10,7)	-77.009676	Geographic coordinate longitude of the infrastructure in decimal degrees using WGS-84 coordinate reference system. - *Must be a minimum of 6 and a maximum of 7 decimal digits.*
Height of Base Station	site_height	Decimal (5,1)	150.0	Height of the base station site above-mean-sea-level (AMSL) in meters - *Value must be greater than or equal to -100 and less than or equal to 6500.*
Model ID	model_id	String	ITM-1A	Unique identifier for the propagation model used to generate the coverage data for the base station. - *Value must correspond to a model_id value in the Mobile Propagation Model Details file submitted as supporting data in the biannual BDC collection.*
Morphology	morphology	Enumerated Integer	2	Code, taken from the list below, indicating the morphology of the area for which coverage is modeled from the base station. - *Value must be one of the following codes:* *1 – Urban* *2 – Suburban* *3 – Rural*

Field Name	Header	Data Type	Example	Description / Notes
Number of Sectors	number_of_ sectors	Integer	3	Number of base station sectors *- Value must be greater than 0 and less than or equal to 12.*
Backhaul Medium	backhaul_medium	Enumerated	50	Code, taken from the list below, indicating the type of technology used for backhaul at the base station. *- Value must be one of the following codes:* *10 – Copper Wire* *40 – Coaxial Cable / HFC* *50 – Optical Carrier / Fiber to the Premises* *60 – Geostationary Satellite* *61 – Non-geostationary Satellite* *70 – Unlicensed Terrestrial Fixed Wireless* *71 – Licensed Terrestrial Fixed Wireless* *72 – Licensed-by-Rule Terrestrial Fixed Wireless* *0 – Other*
Backhaul Capacity – Incoming	backhaul_capacity_ incoming	Decimal (8,3)	10.0	One-way provisioned capacity of backhaul link incoming to the base station, in Gbps, given the capabilities of the existing hardware. *- Value must be greater than 0.*
Backhaul Capacity – Outgoing	backhaul_capacity_ outgoing	Decimal (8,3)	10.0	One-way provisioned capacity of backhaul link outgoing from the base station, in Gbps, given the capabilities of the existing hardware. *- Value must be greater than 0.*
Backhaul Latency	backhaul_latency	Integer	10	Backhaul Service Level Agreement latency in milliseconds (round-trip). *- Value must be greater than 0.*

1.2 Mobile Provider Base Station Carriers

This file must contain the records of each carrier (i.e., antenna) used in each sector of the mobile provider's base stations, as identified in the corresponding Mobile Provider Base Station Location and Height data file. The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Field	Header	Data Type	Example	Description / Notes
Site ID	site_id	String	VA0128	Unique site ID for the base station with which the carrier/antenna is associated. *- Value must correspond to a site_id value in the Mobile Provider Base Station Location and Height file.* *- Value length must be less than 256 characters.*
Sector ID	sector_id	String	A	Unique sector ID for the sector of the site / base station to which this data record applies. This is sometimes recorded as a suffix to a Site ID, such as VA0128-A, but filers should enter only the suffix here.
Cell ID	cell_id	String	32193025	Mobile broadcast cell identifier matching the cell_id value that devices on the network record.
Physical Cell ID	pci	Integer	503	Physical cell ID for downlink synchronization, which is created from PSS (Primary Synchronization Signal) and SSS (Secondary Synchronization Signal). *- Value may be null if the technology is 3G.* *- Value must be greater than or equal to 0 and less than or equal to 503 if the technology is 4G LTE.* *- Value must be greater than or equal to 0 and less than or equal to 1007 if the technology is 5G NR.*

Field	Header	Data Type	Example	Description / Notes
Height of the Sector	sector_height	Decimal (5,1)	60.0	Height of the antenna sector above-ground-level (AGL), in meters. *- Value must be greater than or equal to 0 and less than or equal to 1000.*
Azimuth	sector_azimuth	Decimal (4,1)	120.0	Azimuth of the antenna sector orientation, in decimal degrees. *- Value must be greater than or equal to 0 and less than 360.*
Sector Down Tilt - Electrical	sector_down_tilt_ electrical	Decimal (3,1)	2.0	Electrical down-tilt angle of the sector antenna, in decimal degrees. *- This field may be null.* *- Value must be greater than or equal to -90 and less than or equal to 90 if not null.*
Sector Down Tilt - Mechanical	sector_down_tilt_ mechanical	Decimal (3,1)	6.0	Mechanical down-tilt angle of the sector antenna, in decimal degrees. *- Value must be greater than or equal to -90 and less than or equal to 90.*
Downlink EIRP	effective_ isotropic_ radiated_power	Decimal (4,1)	27.5	The total maximum effective isotropic radiated power level (EIRP) of the transmitter, in decibel-milliwatts (dBm), including multiple transmitting antennas ports *- Value must be greater than or equal to 0.*
Downlink MIMO Configuration	mimo_ configuration	String	4x2	The deployed downlink MIMO (multiple-in multiple-out) antenna technology (e.g., 2x2, 4x4, 8x4, etc.). *- Value may be null if not applicable.* *- Value must be in valid matrix format: "<numeric>x<numeric>", if not null, and each numeric value must be an integer greater than 0.*

Field	Header	Data Type	Example	Description / Notes
Antenna Make and Model	antenna_model	String	PCS-06515-0DH	The make and model of the antenna deployed. If multiple antennas are used at a particular Site ID, then each should be entered as a separate record.
Technology Code	technology	Enumerated Integer	501	Integer code, taken from the list below, indicating the technology standard used by the channel/carrier described in this record. *- Value must be one of the following codes:* *310 – 3G (CDMA-based)* *320 – 3G (GSM-based)* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)* *406 – 4G LTE (3GPP release 13)* *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*
Link Budget ID - Downlink	downlink_ link_budget_ids	String	VA1238DL_IV_7Mbps; VA1238DL_OD_7Mbps	List of all downlink link budgets, separated by a semicolon, that are used to generate the coverage data from the identified base station carrier for the technology in the sample-selected cell. - Value may include either a single link_budget_id or multiple link_budget_id values separated by semicolons. - Each semicolon-delimited value must match to a valid downlink link_budget_id value in the Mobile Link Budget Parameters file.

Field	Header	Data Type	Example	Description / Notes
Link Budget ID - Uplink	uplink_ link_budget_ids	String	VA1238UL_IV_1Mbps; VA1238UL_OD_1Mbps	List of all downlink link budgets, separated by a semicolon, that are used to generate the coverage data from the identified base station carrier for the technology in the sample-selected cell. - Value may include either a single link_budget_id or multiple link_budget_id values separated by semicolons. - Each semicolon-delimited value must match to a valid downlink link_budget_id value in the Mobile Link Budget Parameters file.
Downlink Link Budgets for Carrier Aggregation	downlink_carrier_ aggregation_link_ budget_ids	String	VA1238DL, VA353DL	List all downlink link budgets, separated by a comma, that are deployed in carrier aggregation with this RF carrier. *- Value may be null if downlink carrier aggregation is not used for this RF carrier.* *- Each value must correspond to a valid downlink link_budget_id value in the Mobile Link Budget Parameters file and to a valid downlink_link_budget_id value associated with a separate record in the Mobile Base Station Carriers file*.
Uplink Link Budgets for Carrier Aggregation	uplink_carrier_ aggregation_link_ budget_ids	String		List all uplink link budgets, separated by a comma, that are deployed in carrier aggregation with this RF carrier. *- Value may be null if uplink carrier aggregation is not used for this RF carrier.* *- Each value must correspond to a valid uplink link_budget_id value in the Mobile Link Budget Parameters file and to a valid uplink_link_budget_id value associated with a separate record in the Mobile Base Station Carriers file*.

1.3 Mobile Provider Base Station Loading

This file must contain records of cell loading measurements for cell sites used to offer mobile services, as identified in the corresponding Mobile Provider Base Station Carriers file. The measurements must be for a one-week period in 15-minute intervals, not just for a single point in time. For more information, see paragraph 78 of the *Mobile Technical Requirements Order* at https://www.fcc.gov/document/fcc-releases-bdc-mobile-technical-requirements-order.

The file must be in Comma Separated Value (CSV) format and match the specifications provided in the table below. All values are required unless otherwise indicated.

Field	Header	Data Type	Example	Description / Notes
Site ID	site_id	String	VA0128	Unique site ID for the base station to which this data record applies. *- Value must correspond to a site_id value in the Mobile Provider Base Station Carriers file.* *- Value length must be less than or equal to 256 characters.*
Sector ID	sector_id	String	A	Unique sector ID for the sector to which this data record applies, created by adding a suffix to the site ID. *- Value must correspond to a sector_id value in the Mobile Provider Base Station Carriers file.*
Cell ID	cell_id	String	32193025	Mobile broadcast cell identifier matching the cell_id value that devices on the network record. *- Value must correspond to a cell_id value in the Mobile Provider Base Station Carriers file.*
Timestamp	timestamp	Datetime	2021-12-15T09:15:00-05:00	Timestamp of the time at which the cell loading data measurement began. *- Value must match valid ISO-8601 format including seconds and timezone offset, e.g.: YYYY-MM-DD[T]hh:mm:ss±hh:mm*
Duration	duration	Integer	900	Duration of the measurement interval, in seconds. *- Value must be greater than or equal to 60 and less than or equal to 900.*

Field	Header	Data Type	Example	Description / Notes
Technology Code	technology	Enumerated Integer	501	Integer code, taken from the list below, indicating the technology standard used by the channel/carrier described in this record. *- Value must be one of the following codes:* *310 – 3G (CDMA-based)* *320 – 3G (GSM-based)* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)* *406 – 4G LTE (3GPP release 13)* *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*
Downlink Bandwidth	downlink_ bandwidth	Decimal (6,2)	10.0	Total bandwidth of the downlink RF carrier used for the deployed service, in MHz. If using TDD, enter the entire bandwidth of the TDD carrier. *- Value must match the channel_bandwidth value for the corresponding downlink link budget in the Mobile Link Budget Parameters file of the link budget identified in the Mobile Provider Base Station Carriers file for this site and sector.*
Downlink Bandwidth Use	downlink_ bandwidth_use	Decimal (6,2)	5.2	Average amount of bandwidth of the downlink carrier that is carrying user traffic during the measurement interval, in MHz. *- Value must be less than or equal to value for downlink_bandwidth.*
Downlink Throughput	downlink_ throughput	Decimal (8,2)	30.90	Average downlink throughput of network traffic for the cell during the measurement interval, in megabits per second (Mbps). *- Value must be greater than or equal to 0.*

Field	Header	Data Type	Example	Description / Notes
Downlink Cell Loading	downlink_ cell_load	Decimal (3,2)	0.52	Total calculated downlink cell loading percentage during the measurement interval. *- Value must be equal to (<downlink_bandwidth_use> / <downlink_bandwidth>).*
Uplink Bandwidth	uplink_ bandwidth	Decimal (6,2)	10.0	Total bandwidth of the uplink RF carrier used for the deployed service, in MHz. If using TDD, enter the entire bandwidth of the TDD carrier. *- Value must match the channel_bandwidth value for the corresponding uplink link budget in the Mobile Link Budget Parameters file of the link budget identified in the Mobile Provider Base Station Carriers file for this site and sector.*
Uplink Bandwidth Use	uplink_ bandwidth_use	Decimal (6,2)	10.0	Average amount of bandwidth of the uplink carrier that is carrying user traffic during the measurement interval, in MHz. *- Value must be less than or equal to value for uplink_bandwidth.*
Uplink Throughput	uplink_ throughput	Decimal (8,2)	6.70	Average uplink throughput of network traffic for the cell during the measurement interval, in megabits per second (Mbps). *- Value must be greater than or equal to 0.*
Uplink Cell Loading	uplink_ cell_load	Decimal (3,2)	1.0	Total calculated downlink cell loading percentage during the measurement interval. *- Value must be equal to (<uplink_bandwidth_use> / <uplink_bandwidth>).*
Average Cell Users	cell_users	Decimal (8,3)	43.2	Average number of active radio resource control channel users connected (e.g., RRC-connected users in LTE) to the cell during the measurement interval. *- Value must be greater than or equal to 0.*

1.4 Mobile Provider Speed Test Invalidity Data

Mobile service providers may optionally choose to identify challenger speed tests that the provider asserts are invalid. This file contains the records of challenger speed tests that the challenged mobile service provider asserts are invalid consistent with its infrastructure data. The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Field	Header	Data Type	Example	Description / Notes
Test ID	test_id	String	1643422599	Unique identifier assigned to the challenger speed test.
Test Metric	test_metric	Enumerable	D	Test metric / component of the challenger speed test that should be considered invalid. *- Value must be one of the following codes:* *U – Upload Test Metric* *D – Download Test Metric* *X – Both Upload and Download Test Metrics* *- Value must be X if category_code value is 3, 6, or 8.*
Device Type Allocation Code	device_tac	String	35142059	8-digit Type Allocation Code of the device. *- Value is required and may not be null if category_code value is 2 or 3.* *- Value may be null if category_code value is 1, 4, 5, 6, 7, or 8.*

Field	Header	Data Type	Example	Description / Notes
Invalidity Category Code	category_code	Enumerable	3	Code identifying the category of provider response to invalidate the challenger speed test. *- Value must be one of the following codes:* *1 – Extenuating Circumstances Caused Abnormal Service* *2 – Device Does Not Support Required Spectrum Band (e.g., n41)* *3 – Device Does Not Support Required Technology (e.g., 5G-NR)* *4 – Uncommon Special Event Caused Abnormal Service* *5 – Cell Loading Exceeded Modeled Assumptions* *6 – Device Used Service Plan That Resulted in Slowed Service* *7 – Device Used was Roaming* *8 – Device Used by MVNO Customer*
Cell ID	cell_id	String	32193025	Mobile broadcast cell identifier matching the cell_id value of the corresponding base station carrier to which the device was or should have been connected. *- Value may be null if category_code value is 6, 7, or 8.* *- Value must correspond to a cell_id value in the Mobile Base Station Carriers file if not null.*

Field	Header	Data Type	Example	Description / Notes
Unsupported Technology Code	unsupported_ technology_code	Enumerable	500	Technology used by the base station carrier / network that is not supported by the device used to conduct the test from one of multiple values. *- Value must be one of the following codes if not null:* *300 – 3G* *400 – 4G LTE* *500 – 5G-NR* *901 – Carrier Aggregation* *902 – MIMO* *0 – Other* *- Value is required and may not be null if category_code value is 3.* *- Value must be null if category_code value is 1, 2, 4, 5, 6, 7, or 8.*
Unsupported Spectrum Band	unsupported_ spectrum_band	String		Spectrum band used by the base station carrier / network to provide the coverage maps that is not supported by the device used to conduct the test. *- Value is required and may not be null if category_code value is 2.* *- Value must be null if category_code value is 1, 3, 4, 5, 6, 7, or 8.* *- Note: the reported band value corresponds to the Operating Bands tables as follows:* *- 4G LTE: 3GPP TS 36.101 section 5.5* *- 5G-NR: 3GPP TS 38.101 table 5.2-1*
Event Start Timestamp	event_start_ timestamp	Datetime		Timestamp of the time at which the extenuating circumstances or uncommon special event began. *- Value must match valid ISO-8601 format including seconds and timezone offset if not null, e.g.: YYYY-MM-DD[T]hh:mm:ss±hh:mm* *- Value is required and may not be null if category_code value is 1 or 4.* *- Value must be null if category_code value is 2, 3, 5, 6, 7, or 8.*

Field	Header	Data Type	Example	Description / Notes
Event End Timestamp	event_stop_ timestamp	Datetime		Timestamp of the time at which the extenuating circumstances or uncommon special event ended. *- Value must match valid ISO-8601 format including seconds and timezone offset if not null, e.g.: YYYY-MM-DD[T]hh:mm:ss±hh:mm* *- Value is required and may not be null if category_code value is 1 or 4.* *- Value must be null if category_code value is 2, 3, 5, 6, 7, or 8.*
Cell Loading	cell_loading	Decimal (4,1)		Measured cell loading factor for the serving cell during the special event (percentage of maximum capacity). *- Value is required and may not be null if category_code value is 4 or 5.* *- Value may be null if category_code value is 1, 2, 3, 6, 7, or 8.*
Explanation	explanation	String		Short narrative explaining the justification for invalidating the identified challenger speed test.

1.5 Mobile Provider Band-specific Coverage Maps

Mobile service providers may choose to include separate maps for each spectrum band in response to a challenge or verification inquiry. These data can be submitted in addition to speed test or infrastructure response data but are insufficient to constitute a response on their own. The maps should represent broadband availability for a particular technology in accordance with the same parameters required for the biannual collection of mobile broadband availability coverage maps.

These coverage maps must contain GIS data with polygon geometries and associated data attributes in a supported GIS data format (e.g., ESRI Shapefile, ESRI FileGDB, GeoJSON, Geopackage). They must be in one of the GIS file formats supported by the BDC System: ESRI Shapefile, ESRI FileGDB, GeoJSON, or Geopackage. The required fields and specifications for the data attributes for these GIS data files are provided in the table. All values are required.

Specifications for the data attributes for these GIS data files is described in the table below:

Field	Data Type	Example	Description / Notes
brandname	String	Acme Wireless	Name of the entity or service advertised or offered to consumers.
technology	Integer	500	Code for the technology used for the deployed service. *- Value must be one of the following codes:* *300 – 3G* *400 – 4G LTE* *500 – 5G-NR*
downfreq	Decimal	707.0	Unrounded center frequency, in MHz, of the downlink carrier used for the deployed service. If using TDD, enter the center frequency of the TDD carrier.
downbwidth	Decimal	10.0	Bandwidth, in MHz, of the downlink RF carrier used for the deployed service. If using TDD, enter the entire bandwidth of the TDD carrier.
upfreq	Decimal	737.0	Unrounded center frequency, in MHz, of the uplink carrier used for the deployed service. If using TDD, enter the center frequency of the TDD carrier.
upbwidth	Decimal	10.0	Bandwidth, in MHz, of the uplink RF carrier used for the deployed service. If using TDD, enter the entire bandwidth of the TDD carrier.
mindown	Float	7.0	Minimum download speed for modeled coverage, in Mbps.
minup	Float	1.0	Minimum upload speed for modeled coverage, in Mbps.
minsignal	Integer	-110	Minimum signal strength for modeled coverage from --50 to --130 dBm in 10 dB increments. *- Value represents predicted RSSI signal strength when technology value is 300 (i.e., 3G) or predicted RSRP signal strength when technology value is 400 or 500 (i.e., 4G LTE or 5G-NR).*

Field	Data Type	Example	Description / Notes
environmnt	Enumerated Integer	1	Integer code indicating whether the area is modeled to have coverage when the user equipment is in an outdoor stationary environment only or in both in-vehicle mobile and outdoor stationary environments. *- Value must be one of the following codes:* *0 – Outdoor stationary only* *1 – In-vehicle mobile and outdoor stationary*

1.6 Mobile Provider Site-specific Coverage Maps

Mobile service providers may be required to include separate maps for each base station site in response to a challenge where the challenged provider has identified certain speed tests as invalid due to an outage. These data can be submitted in addition to speed test or infrastructure response data but are insufficient to constitute a response on their own. The maps should represent broadband availability for a particular technology in accordance with the same parameters required for the biannual collection of mobile broadband availability coverage maps.

These coverage maps must contain GIS data with polygon geometries and associated data attributes in a supported GIS data format (e.g., ESRI Shapefile, ESRI FileGDB, GeoJSON, Geopackage). They must be in one of the GIS file formats supported by the BDC System: ESRI Shapefile, ESRI FileGDB, GeoJSON, or Geopackage. The required fields and specifications for the data attributes for these GIS data files are provided in the table. All values are required.

Specifications for the data attributes for these GIS data files is described in the table below:

Field	Data Type	Example	Description / Notes
brandname	String	Acme Wireless	Name of the entity or service advertised or offered to consumers.
technology	Integer	500	Code for the technology used for the deployed service. *- Value must be one of the following codes:* *300 – 3G* *400 – 4G LTE* *500 – 5G-NR*
cell_id	String		Mobile broadcast cell identifier matching the cell_id value of the corresponding base station carrier to which the device was or should have been connected.
mindown	Float	7.0	Minimum download speed for modeled coverage in Mbps.
minup	Float	1.0	Minimum upload speed for modeled coverage in Mbps.
minsignal	Integer	-110	Minimum signal strength for modeled coverage from -50 to -130 dBm in 10 dB increments. *- Value represents predicted RSSI signal strength when technology value is 300 (i.e., 3G) or predicted RSRP signal strength when technology value is 400 or 500 (i.e., 4G LTE or 5G-NR).*
environmnt	Enumerated Integer	1	Integer code indicating whether the area is modeled to have coverage when the user equipment is in an outdoor stationary environment only or in both in-vehicle mobile and outdoor stationary environments. *- Value must be one of the following codes:* *0 – Outdoor stationary only* *1 – In-vehicle mobile and outdoor stationary*

1.7 Mobile Provider Transmitter Monitoring Software Data

Mobile service providers may optionally choose to submit other data in support of its response, including device speed data recorded from base station transmitter monitoring software. This file contains the records of device speeds measured from the provider's transmitter monitoring software consistent with its infrastructure data. The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Field	Header	Data Type	Example	Description / Notes
Test ID	test_id	String	1599236609	Unique identifier used by the transmitter monitoring software to differentiate mobile speed test measurements.
Site ID	site_id	String	VA0128	Unique base station site ID for which this record applies. *- Value must correspond to a site_id value in the Mobile Base Station Location and Height file.* *- Value length must be < 256 characters.*
Latitude	latitude	Decimal (10,7)	38.903692	Geographic coordinate latitude of the geolocated device in decimal degrees using WGS-84 coordinate reference system. *- Value must have minimum precision of 6 decimal digits.*
Longitude	longitude	Decimal (10,7)	-77.009676	Geographic coordinate longitude of the geolocated device in decimal degrees using WGS-84 coordinate reference system. *- Value must have minimum precision of 6 decimal digits.*
Horizontal Accuracy	horizontal_ accuracy	Numeric	7.8	Horizontal accuracy of the location, radial, in meters measured from the transmitter.
Test Metric	test_metric	Enumerated	D	Test metric of the mobile speed measurement recorded by the transmitter monitoring software. *- Value must be one of the following codes:* *D – Download* *U – Upload*
Timestamp	timestamp	Datetime	2021-03-08T09:02:42-05:00	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*
Duration	duration	Integer	4997185	Duration that the test metric took to complete in microseconds.

Field	Header	Data Type	Example	Description / Notes
Bytes Transferred	bytes_ transferred	Integer	97382448	Measured total amount of data in bytes that the test metric transferred.
Bytes per Second	bytes_sec	Integer	19487461	Measure number of bytes per second that the test metric transferred.
Device Type Allocation Code	device_tac	String	990012	6-digit Type Allocation Code of the device measured by the transmitter monitoring software.
Technology	technology	Enumerated Integer	500	Technology standard of the network to which the mobile speed test was connected from one of multiple values. *- Value must be one of the following codes:* *300 – 3G* *400 – 4G LTE* *500 – 5G-NR*
Received Signal Strength Indication	rssi	Integer	-57	Measured Received Signal Strength Indication (RSSI) in dBm of the cell.
Reference Signal Received Power	rsrp	Integer	-92	Measured Reference Signal Received Power (RSRP) in dBm of the cell. *- Value is not available on 3G networks and may be null for 3G tests.* *- Note: this value represents the SS-RSRP for 5G-NR tests and the Channel-specific Reference Signal (CRS) for 4G LTE tests.*
Reference Signal Received Quality	rsrq	Integer	-12	Measured Reference Signal Received Quality (RSRQ) in dBm of the cell. *- Value is not available on 3G networks and may be null for 3G tests.* *- Note: this value represents the SS-RSRP for 5G-NR tests and the Channel-specific Reference Signal (CRS) for 4G LTE tests.*
Signal to Interference and Noise Ratio	sinr	Integer	21	Measured Signal to Interference and Noise Ratio (SINR) of the cell. *- Value is not available on 3G networks and may be null for 3G tests.* *- Note: this value represents the SS-RSRP for 5G-NR tests and the Channel-specific Reference Signal (CRS) for 4G LTE tests.*
Channel Quality Indicator	cqi	Integer	11	Measured Channel Quality Indicator (CQI) of the cell. *- Value may be null for 3G tests.*

Field	Header	Data Type	Example	Description / Notes
Spectrum Band	spectrum_ band	Integer	66	Spectrum band used by the primary cell. *- Value may be null for 3G tests.* *- Note: the reported band value corresponds to the Operating Bands tables as follows:* *- 4G LTE: 3GPP TS 36.101 section 5.5* *- 5G-NR: 3GPP TS 38.101 table 5.2-1*
Spectrum Bandwidth	spectrum_ bandwidth	Numeric	15.0	Total amount of spectral bandwidth used by the primary cell in MHz.
Absolute Radio-Frequency Channel Number	arfcn	Integer	66786	Measured absolute physical RF channel number of the cell.

1.8 Mobile Provider Link Budget Parameters

Mobile service providers must provide link budget parameter data when submitting mobile infrastructure data in response to a verification or audit request. This file contains records of each mobile link budget in Comma Separated Value (CSV) format matching the specification provided in the table below. All values are required unless otherwise indicated.

Field	Data Type	UL Example	DL Example	Description / Notes
link_budget_id	String	VA1238UL	VA1238DL	Unique identifier to identify the link budget. *- Value length must be ≤ 256 characters.*
link_direction	Enumerated String {1}	U	D	Direction of the link budget described in this record. *- Value must be one of the following codes:* *U – Uplink* *D – Downlink*

Field	Data Type	UL Example	DL Example	Description / Notes
technology	Enumerated Integer	501	501	Technology standard used by the link budget described in this record from one of multiple values. *- Value must be one of the following codes:* *310 – 3G (CDMA-based)* *320 – 3G (GSM-based)* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)* *406 – 4G LTE (3GPP release 13)* *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*
duplex_scheme	Enumerated String {1}	F	F	Duplex scheme used in the link budget from one of two possible values representing either Frequency Division Duplexing or Time Division Duplexing (including CSMA/CA). *- Value must be one of the following codes:* *F – FDD* *D – TDD*
allocation_ratio	String	2:1	2:1	Downlink to uplink time allocation ratio, e.g., “2:1”, if duplex_ scheme is= TDD. This parameter is not applicable for FDD. *- Value must be null if duplex_scheme value =is “F”* *- Value must match valid ratio format: "<numeric>:<numeric>", if not null, and each numeric value must be an integer > 0.*

Field	Data Type	UL Example	DL Example	Description / Notes
morphology	Enumerated Integer	2	2	Indicates the morphology of the area used in the link budget using one of multiple possible values. *- Value must be one of the following codes:* *1 – Urban* *2 – Suburban* *3 – Rural*
propagation_ conditions	Enumerated Integer	0	0	Integer code, taken from the two options below, indicating the propagation conditions used in the link budget. *- Value must be one of the following:* *0 – Outdoor stationary* *1 – In-vehicle mobile*
target_speed	Decimal (7,2)	3.0	35.0	Target user speeds of the link budget in Mbps. *- Value must be > 0 for any technology for link budgets used to generate mobile voice availability data.* *- Value must be 0.2 or 0.05 when link_direction value is "D" or "U", respectively, and when technology value is 310 or 320 (i.e., 3G) for link budgets used to generate mobile broadband availability data.* *- Value must be 5 or 1 when link_direction value is "D" and "U", respectively, and when technology value is 401, 402, 403, 404, 405, 406, or 407 (i.e., 4G LTE) for link budgets used to generate mobile broadband availability data.* *- Value must be either 35 / 7 or either 3 / 1 when link_direction value is "D" or "U", respectively, and when technology value is 501, 502, or 503 (i.e., 5G-NR) for link budgets used to generate mobile broadband availability data.*

Field	Data Type	UL Example	DL Example	Description / Notes
modulation_scheme	String	16-QAM 2/3	16-QAM 2/3	Modulation and coding scheme to deliver the target user speed of the link budget. *- Value must match a valid modulation scheme format: "<string> <numeric>/<numeric>", and each numeric value must be an integer > 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
antenna_configuration	String	1x8	4x2	Typical deployed antenna configuration (I.e., number of transmit ports by number of receive ports). NxM format: Number of Tx ports at transmitter x Number of Rx ports at receiver in a particular direction (UL or DL). For example, if the base station has 4 Tx / 8 Rx ports and if the UE has 1 Tx / 2 Rx ports, antenna_configuration should be: Uplink: 1x8. Downlink: 4x2. *- Value must match a valid matrix format: "<numeric>x<numeric>", and each numeric value must be an integer > 0.* *- Value must be "1x1 for downlink or uplink link budgets when technology value is 310 or 320 (i.e., 3G) or when the technology does not otherwise support MIMO.*
operational_frequency	Decimal (9,3)	1860.0	1940.0	Center frequency of the operational carrier in MHz. *- Value must be > 0.*
channel_bandwidth	Decimal (6,2)	10.0	10.0	Total bandwidth of the operating channel in MHz. *- Value must be > 0 and ≤ 1000.*
total_subcarriers	Integer	600	600	Total number of subcarriers for the channel (i.e., resource element). *- Value may be null if provider does not use OFDM/OFDMA technology.* *- Value must be > 0 if not null.*

Field	Data Type	UL Example	DL Example	Description / Notes
subcarrier_spacing	Decimal (8,3)	15.0	15.0	Subcarrier (or resource element) spacing / bandwidth in KHz. *- Value may be null if provider does not use OFDM/OFDMA technology.* *- Value must be ≥ 15 and ≤ 240 if not null.*
cell_load	Decimal (3,2)	0.5	0.5	Cell loading factor (both own cell and neighboring cells) percentage. *- Value must be ≥ 0.5 and ≤ 1.*
required_subcarriers	Integer	72	200	Number of required subcarriers to deliver the target user speeds. *- Value must be null for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).* *- Value must be ≥ 0 if not null.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
required_sinr	Decimal (4,2)	0.00	4.00	Required signal to interference and noise ratio to deliver the target speeds in dB. *- Value must be ≥ -20 and ≤ 50.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
spectral_efficiency	Decimal (7,2)	1.00	1.70	Required spectral efficiency to deliver the user speeds at the cell edge in bps / Hz. *- Value must be > 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
total_tx_power	Decimal (5,2)	23.00	30.00	Total transmitter power for the cell including multiple transmitters in dBm. *- Value must be > 0.*

Field	Data Type	UL Example	DL Example	Description / Notes
total_tx_losses	Decimal (4,2)	0.00	2.00	Total losses in the transmitting path from the amplifier to the antenna in dB. *- Value must be ≥ 0 and ≤ 10.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
tx_antenna_gain	Decimal (4,2)	-1.00	16.00	Transmitting antenna gain in dBi. *- Value must be ≥ -20 and ≤ 40.*
total_eirp	Decimal (4,2)	22.00	60.00	Total maximum effective isotropic radiated power in dBm including multiple transmitting antennas ports. *- Value must be ≥ 0 and ≤ 80.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
eirp_per_subcarrier	Decimal (5,2)	3.42	32.22	Maximum effective isotropic radiated power (including multiple transmitting antennas) per subcarrier in dBm. *- Value must be equal to (<total_eirp>) for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).* *- Value must be ≤ min([<total_eirp>, (<total_eirp> - (10*log(<total_subcarriers>)) + 3)]) for downlink link budgets where the total_subcarriers value is not null (i.e., the provider uses OFDM/OFDMA technology).* *- Value must be ≤ min([<total_eirp>, (<total_eirp> - (10*log(<required_subcarriers>)) + 3)]) for uplink link budgets where the total_subcarriers value is not null (i.e., the provider uses OFDM/OFDMA technology).* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*

Field	Data Type	UL Example	DL Example	Description / Notes
rx_antenna_gain	Decimal (4,2)	16.00	0.00	Receiving antenna gain in dBi. *- Value must be ≥ -20 and ≤ 40.*
total_rx_losses	Decimal (4,2)	2.00	0.00	Total losses in the receiving path from the antenna to the receiver in dB. *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.* *- Value must be ≥ 0 and ≤ 10.*
rx_noise_figure	Decimal (4,2)	2.00	10.00	Noise figure of the receiver system in dB. *- Value must be ≥ 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
rx_sensitivity	Decimal (5,2)	-130.21	-118.21	Receiver sensitivity in dBm per subcarrier. Should be calculated after the receiver's antenna *- Value must be < 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
thermal_noise_power	Decimal (5,2)	-173.98	-173.98	Thermal noise power density in dBm per Hz, typically –173.98 dBm/Hz. *- Value must be < 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
thermal_noise_ power_per_subcarrier	Decimal (5,2)	-132.21	-132.21	Thermal noise power in dBm per subcarrier. *- Value must be equal to (<thermal_noise_power> + 10*log(<channel_bandwidth>)) for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).* *- Value must be < 0.*

Field	Data Type	UL Example	DL Example	Description / Notes
total_noise_power_per_subcarrier	Decimal (5,2)	-130.21	-122.21	Total (thermal & noise figure of receiver) noise power in dBm per subcarrier. *- Value must be equal to (<thermal_noise_power> + 10*log(<channel_bandwidth>) + <rx_noise_figure>) for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).* *- Value must be < 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
fading_std_deviation	Decimal (4,2)	8.00	8.00	Standard deviation of the log-normal signal slow fading in dB. *- Value must be > 0.*
cell_edge_probability	Decimal (3,2)	0.9	0.9	Desired percentage probability of receiving the signal at or above the receiver sensitivity at the cell coverage boundary. *- Value must be ≥ 0.9 and ≤ 1.*
fade_margin	Decimal (4,2)	10.25	10.25	Signal slow fading margin in dB required to deliver the desired cell edge reliability. *- Value must be > 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
head_body_loss	Decimal (4,2)	0.00	2.00	Typical signal loss at the operating frequency in dB due to head and/or body obstruction. *- Value must be ≥ 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*

Field	Data Type	UL Example	DL Example	Description / Notes
interference_margin	Decimal (4,2)	3.00	5.00	Additional signal loss in dB due to interference from adjacent cells due to cell loading. *- Value must be ≥ 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
penetration_margin	Decimal (4,2)	0.00	0.00	Additional signal loss in dB due to surrounding obstructions when the receiver is inside a vehicle. *- Value must be ≥ 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
other_losses	Decimal (4,2)	0.00	0.00	Any other unaccounted signal losses in dB. *- Value may be null.* *- Value must be ≥ 0 if not null.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget if not null.*
freq_selection_gain	Decimal (4,2)	0.00	0.00	Dynamic frequency selection gain in dB. *- Value must be ≥ 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*
multi_cell_diversity_gain	Decimal (4,2)	2.00	2.00	Multi-cell switching or macro-diversity gain in dB. *- Value must be ≥ 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*

Field	Data Type	UL Example	DL Example	Description / Notes
other_gains	Decimal (4,2)	0.00	0.00	Other unaccounted gains in dB. *- Value may be null.* *- Value must be ≥ 0 if not null.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget if not null.*
total_margins	Decimal (4,2)	11.25	15.25	Total net margins in dB. *- Value must be ≥ 0.*
mapl	Decimal (5,2)	136.39	139.18	Maximum allowable path loss of the link in dB. The value of mapl should be calculated after the receiver's antenna *- Value must be > 0.*
minimum_signal_ strength	Decimal (5,2)	-132.96	-106.96	Minimum required signal strength in dBm per subcarrier at the receiver to deliver the specified performance targets (e.g., RSRP for 4G LTE). The LTE/5G-NR RSRP value should be based on the provider's design of the transmitting Reference Signal(s) EIRP via a physical antenna port or multiple antenna ports. *- Value must be < 0.* *- Value for this field must have a corresponding explanation / rationale in the Mobile Link Budget Parameters Rationale file for each link budget.*

1.9 Mobile Provider Hexagon - Base Station - Link Budget Association Data

Mobile service providers may optionally choose to provide associational data identifying the base station and link budget(s) used to provide coverage for sample-select hexagons, along with base station loading data, when submitting mobile speed tests in response to a verification request. The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Field	Header	Data Type	Example	Description / Notes
H3 Cell ID	**h3_cell_id**	String	882aa84811fffff	Identifier for the H3 hexagonal cell selected for the provider to submit speed test data as part of the verification request. - *Value must correspond to an H3 hexagonal cell selected for sampling as part of the mobile verification request*. - *More details about the H3 geospatial indexing system can be found at https://h3geo.org/*
Site ID	**site_id**	String	VA0128	Unique base station site ID for which this record applies. - *Value length must be < 256 characters.*
Sector ID	**sector_id**	String	A	Unique sector ID for the sector to which this data record applies, created by adding a suffix to the site ID. - *Value length must be < 256 characters.*
Cell ID	**cell_id**	String	32193025	Mobile broadcast cell identifier matching the cell_id value that devices on the network record.

Field	Header	Data Type	Example	Description / Notes
Technology	**technology**	Enumerated Integer	501	Technology standard used by the identified base station carrier described in this record from one of multiple values. *- Value must be one of the following codes:* *310 – 3G (CDMA-based)* *320 – 3G (GSM-based)* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)* *406 – 4G LTE (3GPP release 13)* *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*
Downlink Link Budget IDs	**downlink_ link_budget_ids**	String	VA1238DL	List of all downlink link budgets, separated by a semicolon, that are used to generate the coverage data from the identified base station carrier for the technology in the sample-selected cell. *- Value may include either a single link_budget_id or multiple link_budget_id values separated by semicolons.* *- Each semicolon-delimited value must match to a valid downlink link_budget_id value in the Fixed Link Budget Parameters file.*

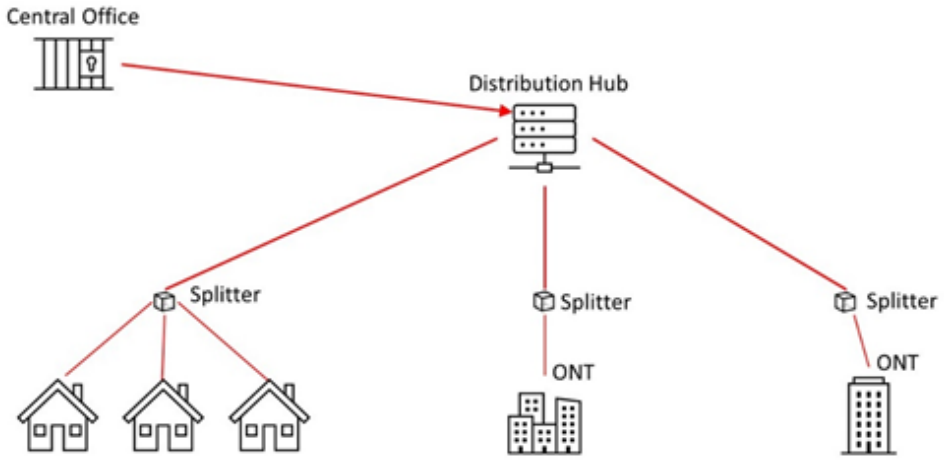
Field	Header	Data Type	Example	Description / Notes
Uplink Link Budget IDs	**uplink_ link_budget_ids**	String	VA1238UL	List of all uplink link budgets, separated by a semicolon, that are used to generate the coverage data from the identified base station carrier for the technology in the sample-selected cell. *- Value may include either a single link_budget_id or multiple link_budget_id values separated by semicolons*. *- Each semicolon-delimited value must match to a valid uplink link_budget_id value in the Fixed Link Budget Parameters file*.

2 Fixed Provider Infrastructure Data

Fixed broadband service providers may be required to generate and submit to the Commission infrastructure information as part of certain processes within the Broadband Data Collection. For example, providers that avail themselves of the waiver to the Professional Engineer certification requirement are required to maintain such information and submit it to the Commission upon request. In addition, providers may be required to submit such data to verify their availability data. The specifications for the infrastructure data files are provided in Sections 2.1 through 2.3 and vary based on the technology that the provider uses to offer service. These data must be submitted in the specified file format in the BDC system via file upload.

2.1 Fixed Wireline Provider Infrastructure Data

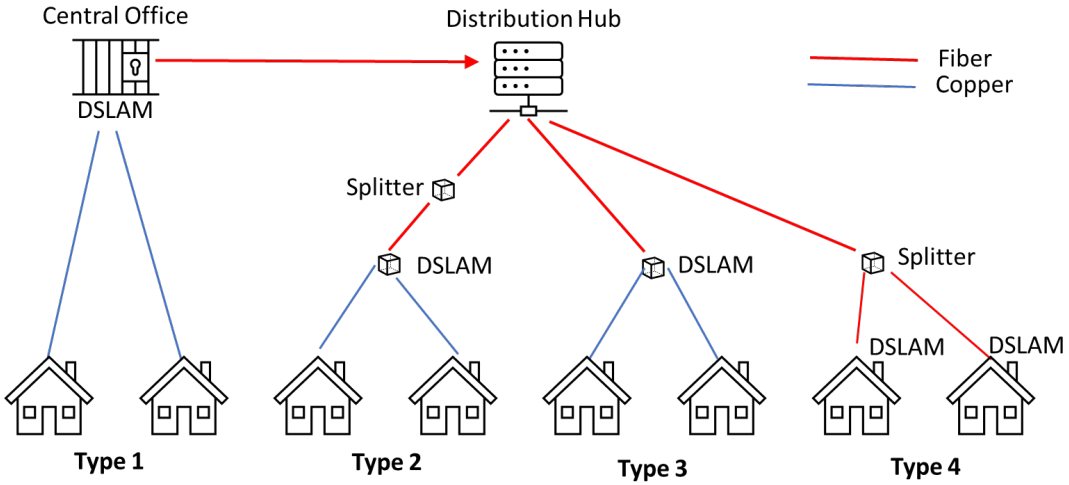
Cable and Fiber



Wireline Access Topology: Optical Carrier / Fiber-to-the-Premises, Coaxial Cable / HFC

The typical network hierarchy can be described as having three layers: access, distribution, and core. The illustration above depicts a common optical network topology. The splitter is the first aggregation point that serves individual locations. We refer to those as the access nodes. The distribution hub is the second aggregation point and combines traffic from several splitters. Hybrid-fiber coax (HFC) cable systems and some fiber systems use different terminology, but the three-tiered traffic aggregation structure is the same.

Copper / DSL



Copper / DSL Access Topologies

Copper / DSL services can have a slightly different topology than other wireline technologies because they are delivered over copper by a DSLAM with availability dictated by the distance from the DSLAM to the customer premises. There are several types of DSLAMs that can be

located in several places in the network and have a broad range of performance parameters. The various DSL topologies are consistent with the three-layer hierarchy with the permutations listed below and shown in the figure above:

- **Type 1** – Multiple DSLAMs are in the ISP central office and should be defined as an Access Node. The same location should also be defined as a Distribution Hub.
- **Type 2 & 3** – The DSLAM is the access node.
- **Type 4** – The DSLAM is the CPE, and the hierarchy is the same as for other wireline access.

In each version, the maximum distance from the DSLAM to a subscriber must be specified.

The data described below may be required in certain instances from fixed broadband service providers that report service using a wireline technology.

Section	Data Name	Description / Notes
2.1.1	Fixed Wireline Distribution Hub Locations	Infrastructure information on the distribution hubs used to provide the wireline service that the fixed broadband service provider reports in the relevant area, in tabular format.
2.1.2	Fixed Wireline Access Node Locations	Infrastructure information on the access nodes used to provide the wireline service that the fixed broadband service provider reports in the relevant area, in tabular format.

2.1.1 Fixed Wireline Distribution Hub Locations

Field Name	Header	Data Type	Example	Description / Notes
Hub ID	hub_id	String	CHG13074A	Unique identifier, assigned by the filer, for the distribution hub to which this data record applies. *- Value length must be less than 256 characters.*
In-Service Date	In_service_date	Date	2023-02	The month and year in which the hub was activated and put in service. *- Value must match valid ISO-8601 date format including the year and month in this format: YYYY-MM.* *- If the hub was put in service prior to June 30, 2022, the filer is not required to enter the exact month and may instead enter 2022-01.*

Field Name	Header	Data Type	Example	Description / Notes
Technology	technology	Enumerated Integer	50	Code, taken from the list below, indicating the type of technology used. *- Value must be one of the following codes:* *10 – Copper / DSL* *40 – Coaxial Cable / HFC* *50 – Optical Carrier / Fiber to the Premises*
Latitude	latitude	Decimal (10,7)	38.903693line	Geographic coordinate latitude of the distribution hub in decimal degrees using WGS-84 coordinate reference system. *- Must be a minimum of 6 and a maximum of 7 decimal digits.*
Longitude	longitude	Decimal (10,7)	-77.009682	Geographic coordinate longitude of the distribution hub in decimal degrees using WGS-84 coordinate reference system. *- Must be a minimum of 6 and a maximum of 7 decimal digits.*

2.1.2 Fixed Wireline Access Node Locations

Field Name	Header	Data Type	Example	Description / Notes
Access Node ID	node_id	String	02208-B	Unique identifier, assigned by the filer, for the access node to which this data record applies. *- Value length must be less than 256 characters.*
Hub ID	hub_id	String	CHG13074A	Unique identifier for the parent distribution hub for the access node to which this data record applies. *- Value must match a valid hub_id value in the Fixed Wireline Distribution Hub Locations file.*

Field Name	Header	Data Type	Example	Description / Notes
In-Service Date	In_service_date	Date	2023-02	The month and year in which the node was activated and put in service. *- Value must match valid ISO-8601 date format including the year and month in this format: YYYY-MM.* *- If the node was put in service prior to June 30, 2022, the filer is not required to enter the exact month and may instead enter 2022-01.*
Technology	technology	Enumerated Integer	50	Code, taken from the list below, indicating the type of technology used. *- Value must be one of the following codes:* *10 – Copper / DSL* *40 – Coaxial Cable / HFC* *50 – Optical Carrier / Fiber to the Premises*
DSL Buffer	dsl_buffer	Integer	600	Distance in feet that defines the service provisioning limit from the DSLAM to the customer premises. *- Value required if technology is 10 and should be null if technology is 40 or 50.*
Latitude	latitude	Decimal (10,7)	38.903693	Geographic coordinate latitude of the access node in decimal degrees using WGS-84 coordinate reference system. *- Must be a minimum of 6 and a maximum of 7 decimal digits.*
Longitude	longitude	Decimal (10,7)	-77.009682	Geographic coordinate longitude of the access node in decimal degrees using WGS-84 coordinate reference system. *- Must be a minimum of 6 and a maximum of 7 decimal digits.*

2.2 Fixed Wireless Provider Infrastructure Data

These data may be required from fixed broadband service providers that report service using a terrestrial fixed wireless technology, i.e., Unlicensed Terrestrial Fixed Wireless, Licensed Terrestrial Fixed Wireless, or Licensed-by-Rule Terrestrial Fixed Wireless. The data files are similar to the supporting data required by fixed wireless providers that submit their biannual BDC availability data in a polygon format rather than as a list of locations (for more information see https://help.bdc.fcc.gov/hc/en-us/articles/5291309996699-Fixed-Wireless-Broadband-Supporting-Data).

Section	Data Name	Description / Notes
2.2.1	Fixed Wireless Propagation Modeling Details	Information about the propagation modeling and planning used to generate the coverage data for a fixed broadband service provider in the relevant area, in tabular format.
2.2.2	Fixed Wireless Link Budget Parameters	Parameters and values included in all link budgets used in the propagation modeling that generated the coverage data for a fixed broadband service provider in the relevant area, in tabular format.
2.2.3	Fixed Wireless Base Station Location and Height	Infrastructure information on the base stations included in the propagation modeling used to generate the coverage data for a fixed broadband service provider in the relevant area, in tabular format.
2.2.4	Fixed Wireless Base Station Carriers	Infrastructure information on the carriers (i.e., antennas) deployed on each base station included in the propagation modeling used to generate the coverage data for a fixed broadband service provider in the relevant area, in tabular format.
2.2.5	Fixed Wireless Base Station Loading	Infrastructure information on the cell loading measured for the carriers for each base station included in the propagation modeling used to generate the coverage data for a fixed broadband service provider in the relevant area, in tabular format.

2.2.1 Fixed Wireless Propagation Model Details

This file contains records of each propagation model used to model terrestrial fixed wireless broadband coverage. The file must be in Comma Separated Value (CSV) format. All values are required unless otherwise indicated.

Field	Data Type	Example	Description / Notes
model_id	Text	ITM-1A	Unique identifier for the propagation model used to generate the coverage data. *- Value length must be ≤ 256 characters.*
tool_name	Text	Atoll	Name of the planning tool used to generate the coverage data.
tool_version	Text	3.4.0	Version number of the planning tool used to generate the coverage data.
tool_developer	Text	Forsk	Name of the developer of the planning tool used to generate the coverage data.

Field	Data Type	Example	Description / Notes
model_resolution	Integer	10	Granularity of the model used to generate the coverage data in meters. *- Value may be approximate for models measured in arcseconds (e.g., 1 arcsecond ≈ 30 meters).* *- Value must be > 0 and ≤ 100.*
receiver_height	Decimal	5.5	Height above ground (AGL) of the receiver / CPE antenna used in modeling in meters. *- Value must be ≥ 4 and ≤ 7.*
terrain_source	String	USGS	Provider or source of terrain data.
terrain_vintage	Date	2021-10-18	Vintage date of terrain data requiring at least the year of the data. *- Value must match valid ISO-8601 date format including, at a minimum, the year, e.g.: YYYY[-MM-DD]*
terrain_resolution	Integer	30	Resolution or granularity of terrain data in meters. *- Value may be approximate for datasets measured in arcseconds (e.g., 1 arcsecond ≈ 30 meters).* *- Value must be > 0 and ≤ 100.*
clutter_source	String	ESA Worldcover	Provider or source of clutter data.
clutter_vintage	Date	2020	Vintage date of clutter data requiring at least the year of the data. *- Value must match valid ISO-8601 date format including, at a minimum, the year, e.g.: YYYY[-MM-DD]*
clutter_resolution	Integer	10	Resolution or granularity of clutter data in meters. *- Value may be approximate for datasets measured in arcseconds (e.g., 1 arcsecond ≈ 30 meters).* *- Value must be > 0 and ≤ 100.*
calibration_flag	Boolean Integer	1	Boolean integer flag of whether the model has been validated and calibrated at least one time using on-the-ground and/or other real-world measurements taken by the provider or its vendor. *- Value must be the following code:* *1 – True*
calibration_date	Date	2021-09-05	Most recent date that the model was calibrated. *- Value may be null.* *- Value must match valid ISO-8601 date format including, at a minimum, the year and month, e.g.: YYYY-MM[-DD] if not null.*

Field	Data Type	Example	Description / Notes
calibration_process	Text		Brief narrative summary of the process used to calibrate the model. *- Value may be null.*

2.2.2 Fixed Wireless Link Budget Parameters

This file contains records of each fixed wireless link budget in Comma Separated Value (CSV) format matching the specification provided in the table below. All values are required unless otherwise indicated.

Field	Data Type	UL Example	DL Example	Description / Notes
link_budget_id	String	VA1238UL	VA1238DL	Unique identifier to identify the link budget. *- Value length must be < 256 characters.*
link_direction	Enumerated String {1}	U	D	Direction of the link budget described in this record. *- Value must be one of the following codes:* *U – Uplink* *D – Downlink*
technology	Enumerated Integer	106	106	Technology standard used by the link budget described in this record from one of multiple values. *- Value must be one of the following codes:* *101 – 802.11b* *102 – 802.11a* *103 – 802.11g* *104 – 802.11n / WiFi 4* *105 – 802.11ac / WiFi 5* *106 – 802.11ax / WiFi 6* *107 – 802.11be / WiFi 7* *120 – 802.11ad* *121 – 802.11ay* *130 – 802.11ac-derived OFDM* *140 – 802.16* *201 – OFDM Proprietary* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)*

Field	Data Type	UL Example	DL Example	Description / Notes
				406 – 4G LTE (3GPP release 13) *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*
duplex_scheme	Enumerated String {1}	D	D	Duplex scheme used in the link budget from one of two possible values representing either Frequency Division Duplexing or Time Division Duplexing. *- Value must be one of the following codes:* *F – FDD* *D – TDD*
allocation_ratio	String	2:1	2:1	Downlink to uplink time allocation ratio, e.g., "2:1", if duplex scheme is TDD. This parameter is not applicable for FDD. *- Value must be null if duplex_scheme value is "F".* *- Value must match valid ratio format: "<numeric>:<numeric>", if not null, and each numeric value must be an integer > 0.*
morphology	Enumerated Integer	2	2	Indicates the morphology of the area used in the link budget using one of multiple possible values. *- Value must be one of the following codes:* *1 – Urban* *2 – Suburban* *3 – Rural*
target_speed	Decimal (7,2)	250.0	500.0	Target user speeds of the link budget in Mbps. *- Value must be > 0 and ≤ 10000.*
modulation_scheme	String	256-QAM 3/4	256-QAM 5/6	Modulation and coding scheme to deliver the target user speed of the link budget.

Field	Data Type	UL Example	DL Example	Description / Notes
				- Value must match a valid modulation scheme format: "<string> <numeric>/<numeric>", and each numeric value must be an integer > 0.
antenna_configuration	String	1x8	4x2	Typical deployed antenna configuration. NxM format: Number of Tx ports at transmitter x Number of Rx ports at receiver in a particular direction (UL or DL). For example, if AP has 4 Tx / 8 Rx ports and if CPE has 1 Tx / 2 Rx ports, antenna_configuration should be: Uplink: 1x8. Downlink: 4x2. *- Value must match a valid matrix format: "<numeric>x<numeric>", and each numeric value must be an integer > 0.*
operational_frequency	Decimal (9,3)	6750.0	6750.0	Center frequency of the operational carrier in MHz. *- Value must be > 0.*
channel_bandwidth	Decimal (6,2)	160.0	160.0	Total bandwidth of the operating channel in MHz. For example, in the case where channel bandwidth is 160, it may be 80+80 or 160 MHz for 802.11ac and 802.11ax. Make a note if it is 80+80. *- Value must be > 0 and ≤ 1000.*
total_subcarriers	Integer	1992	1992	Total number of subcarriers for the channel (i.e., resource element). *- Value may be null if provider does not use OFDM/OFDMA technology.* *- Value must be > 0 if not null.*
subcarrier_spacing	Decimal (8,3)	78.125	78.125	Subcarrier (or resource element) spacing / bandwidth in KHz. *- Value may be null if provider does not use OFDM/OFDMA technology.* *- Value must be ≥ 15 and ≤ 10000 if not null.*
cell_load	Decimal (3,2)	0.5	0.5	Cell loading factor (both own cell and neighboring cells) percentage. *- Value must be ≥ 0.5 and ≤ 1.*

Field	Data Type	UL Example	DL Example	Description / Notes
required_subcarriers	Integer	996	996	Number of required subcarriers to deliver the target user speeds. *- Value must be > 0 if not null.* *- Value must be null for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).*
required_sinr	Decimal (4,2)	21.5	27.5	Required signal to interference and noise ratio to deliver the target speeds in dB. *- Value must be ≥ -20 and ≤ 50.*
spectral_efficiency	Decimal (7,2)	3.2	6.5	Required spectral efficiency to deliver the user speeds at the cell edge in bps / Hz. *- Value must be > 0.*
total_tx_power	Decimal (5,2)	11.00	18.00	Total transmitter power for the cell including multiple transmitters in dBm. *- Value must be > 0.*
total_tx_losses	Decimal (4,2)	0.00	2.00	Total losses in the transmitting path from the amplifier to the antenna in dB. *- Value must be ≥ 0 and ≤ 10.*
tx_antenna_gain	Decimal (4,2)	25.00	18.00	Transmitting antenna gain in dBi. *- Value must be ≥ -20 and ≤ 40.*
total_eirp	Decimal (4,2)	36.00	36.00	Total maximum effective isotropic radiated power in dBm including multiple transmitting antennas ports. *- Value must be ≥ 0 and ≤ 80.*
eirp_per_subcarrier	Decimal (5,2)	6.02	3.0	*Maximum effective isotropic radiated power (including multiple transmitting antennas) per subcarrier, in dBm (with up to two decimal digits).* *- Value must be less than or equal to the lesser of <total_eirp> and (<total_eirp> - (10*log(<total_subcarriers>)) + 3) for downlink link budgets.* *- Value must be less than or equal to the lesser of <total_eirp> and*

Field	Data Type	UL Example	DL Example	Description / Notes
				*(<total_eirp> - (10*log(<required_subcarriers>)) + 3) for uplink link budgets.*
rx_antenna_gain	Decimal (4,2)	18.00	25.00	Receiving antenna gain in dBi. *- Value must be ≥ -20 and ≤ 40.*
total_rx_losses	Decimal (4,2)	0.00	0.00	Total losses in the receiving path from the antenna to the receiver in dB. *- Value must be ≥ 0 and ≤ 10.*
rx_noise_figure	Decimal (4,2)	3.00	3.00	Noise figure of the receiver system in dB. *- Value must be ≥ 0.*
rx_sensitivity	Decimal (5,2)	-100.5	-94.5	Receiver sensitivity in dBm per subcarrier. Should be calculated after the receiver's antenna *- Value must be < 0.*
thermal_noise_power	Decimal (5,2)	-173.98	-173.98	Thermal noise power density in dBm per Hz, typically –173.98 dBm/Hz. *- Value must be < 0.*
thermal_noise_power_per_subcarrier	Decimal (5,2)	-125.05	-125.05	Thermal noise power in dBm per subcarrier. *- Value must be equal to (<thermal_noise_power> + 10*log(<channel_bandwidth>)) for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).* *- Value must be < 0.*
total_noise_power_per_subcarrier	Decimal (5,2)	-122.05	-122.05	Total (thermal & noise figure of receiver) noise power in dBm per subcarrier. *- Value must be equal to (<thermal_noise_power> + 10*log(<channel_bandwidth>) + <rx_noise_figure>) for downlink or uplink link budgets where the total_subcarriers value is null (i.e., the provider does not use OFDM/OFDMA technology).*

Field	Data Type	UL Example	DL Example	Description / Notes
				- *Value must be < 0.*
fading_std_deviation	Decimal (4,2)	6.5	6.5	Standard deviation of the log-normal signal slow fading in dB. - *Value must be > 0.*
cell_edge_probability	Decimal (3,2)	0.99	0.99	Desired percentage probability of receiving the signal at or above the receiver sensitivity at the cell coverage boundary. - *Value must be ≥ 0.75 and ≤ 1.*
fade_margin	Decimal (4,2)	15.00	15.00	Signal slow fading margin in dB required to deliver the desired cell edge reliability. - *Value must be > 0.*
penetration_margin	Decimal (4,2)	0.00	0.00	Additional signal loss in dB due to surrounding obstructions when the receiver is inside a vehicle or building. - *Value may be null.* - *Value must be ≥ 0 if not null.*
other_losses	Decimal (4,2)	0.00	0.00	Any other unaccounted signal losses in dB. - *Value may be null.* - *Value must be ≥ 0 if not null.*
other_gains	Decimal (4,2)	0.00	0.00	Other unaccounted gains in dB. - *Value may be null.* - *Value must be ≥ 0 if not null.*
total_margins	Decimal (4,2)	15.00	15.00	Total net margins in dB. - *Value must be ≥ 0.*
mapl	Decimal (5,2)	107.0	107.5	Maximum allowable path loss of the link in dB. The value of mapl should be calculated after the receiver's antenna - *Value must be > 0.*
minimum_signal_strength	Decimal (5,2)	-103.5	-104.5	Minimum required signal strength in dBm per subcarrier at the receiver to deliver the specified performance targets (e.g., RSRP for 4G LTE). The LTE/5G-NR RSRP value should be based on the provider's design of the transmitting Reference Signal(s) EIRP

Field	Data Type	UL Example	DL Example	Description / Notes
				via a physical antenna port or multiple antenna ports. *- Value must be < 0.*

2.2.3 Fixed Wireless Base Station Location and Height

This file contains records of each cell site used to offer fixed wireless services in Comma Separated Value (CSV) format matching the specification provided in the table below. All values are required unless otherwise indicated.

Field	Data Type	Example	Description / Notes
site_id	String	VA0128	Unique site ID, assigned by the filer, for the base station to which this data record applies. *- Value length must be ≤ 256 characters.*
latitude	Decimal (10,7)	38.903692	Geographic coordinate latitude of the infrastructure in decimal degrees using WGS-84 coordinate reference system. *- Value must have minimum precision of 6 decimal digits.*
longitude	Decimal (10,7)	-77.009676	Geographic coordinate longitude of the infrastructure in decimal degrees using WGS-84 coordinate reference system. *- Value must have minimum precision of 6 decimal digits.*
site_height	Decimal (5,1)	30.0	*Height of the base station site above-mean-sea-level (AMSL), in meters.* *- Value must be greater than or equal to -100 and less than or equal to 6500.*
model_id	String	ITM-1A	Unique identifier for the propagation model used to generate the coverage data for the base station. *- Value must correspond to a model_id value in the Fixed Wireless Propagation Modeling Information file.*
morphology	Enumerated Integer	2	Indicates the morphology of the area for which coverage is modeled from the base station using one of multiple possible values. *- Value must be one of the following codes:* *1 – Urban* *2 – Suburban* *3 – Rural*
number_of_ sectors	Integer	3	Number of base station sectors. *- Value must be > 0 and ≤ 12.*

Field	Data Type	Example	Description / Notes
backhaul_medium	Enumerated	50	Type of technology used for backhaul at this base station using one of multiple possible values. *- Value must be one of the following codes:* *10 – Copper Wire* *40 – Coaxial Cable / HFC* *50 – Optical Carrier / Fiber to the Premises* *60 – Geostationary Satellite* *61 – Non-geostationary Satellite* *70 – Unlicensed Terrestrial Fixed Wireless* *71 – Licensed Terrestrial Fixed Wireless* *72 – Licensed-by-Rule Terrestrial Fixed Wireless* *0 – Other*
backhaul_capacity_incoming	Decimal (8,3)	10.0	One-way provisioned capacity of backhaul link in Gbps given capabilities of existing hardware – incoming to the base station. *- Value must be > 0.*
backhaul_capacity_outgoing	Decimal (8,3)	10.0	One-way provisioned capacity of backhaul link in Gbps given capabilities of existing hardware – outgoing from the base station. *- Value must be > 0.*
backhaul_latency	Integer	10	Backhaul Service Level Agreement latency in milliseconds (round-trip). *- Value must be > 0.*

2.2.4 Fixed Wireless Base Station Carriers

This file contains records of each carrier (i.e., antenna) for each sector of the fixed wireless provider's cell sites (identified in the corresponding Fixed Wireless Base Station Location and Height data file) in Comma Separated Value (CSV) format matching the specification provided in the table below. All values are required unless otherwise indicated.

Field	Data Type	Example	Description / Notes
site_id	String	VA0128	Unique site ID for the base station with which the carrier/antenna is associated. *- Value must correspond to a site_id value in the Fixed Wireless Base Station Location and Height file.* *- Value length must be < 256 characters.*
sector_id	String	A	Unique sector ID for the sector of the site / base station to which this data record applies. This is sometimes recorded as a suffix to a Site ID, such as VA0128-A, but filers should enter only the suffix here.

Field	Data Type	Example	Description / Notes
cell_id	String	32193025	Fixed Wireless broadcast cell identifier matching the cell_id value that devices on the network record.
pci	String	503	Physical cell ID for downlink synchronization, which is created from PSS (Primary Synchronization Signal) and SSS (Secondary Synchronization Signal). *- Value may be null if the technology is other than 4G LTE or 5G-NR.* *- Value must be ≥ 0 and ≤ 503 if the technology is 4G LTE (i.e., technology value is 401, 402, 403, 404, 405, 406, 407, 408, 409, or 410).* *- Value must be ≥ 0 and ≤ 1007 if the technology is 5G-NR (i.e., technology value is 501, 502, or 503).*
sector_height	Decimal (5,1)	60.0	Height of the antenna sector above-ground-level (AGL) in meters. *- Value must be ≥ 0 and ≤ 1000.*
sector_azimuth	Decimal (4,1)	120.0	Azimuth of the antenna sector orientation in decimal degrees. *- Value must be ≥ 0 and < 360.*
sector_down_tilt_electrical	Decimal (3,1)	2.0	Electrical down-tilt angle of the sector antenna in decimal degrees. *- Value may be null if not applicable.* *- Value must be ≥ -90 and ≤ 90 if not null.*
sector_down_tilt_mechanical	Decimal (3,1)	6.0	Mechanical down-tilt angle of the sector antenna in decimal degrees. *- Value must be ≥ -90 and ≤ 90.*
effective_isotropic_radiated_power	Decimal (4,1)	27.5	Total maximum effective isotropic radiated power level of transmitter in decibel-milliwatts (dBm) including multiple transmitting antennas ports. *- Value must be ≥ 0.*
mimo_configuration	String	4x4	The deployed antenna technology (e.g., 2x2, 4x4, 8x4, etc.). *- Value may be null if not applicable.* *- Value must be in valid matrix format: "<numeric>x<numeric>", if not null, and each numeric value must be an integer > 0.*
antenna_model	String	PCS-06515-0DH	The deployed antenna make and model.

Field	Data Type	Example	Description / Notes
technology	Enumerated Integer	501	Technology standard used by the channel/carrier described in this record from one of multiple values. *- Value must be one of the following codes:* *101 – 802.11b* *102 – 802.11a* *103 – 802.11g* *104 – 802.11n / WiFi 4* *105 – 802.11ac / WiFi 5* *106 – 802.11ax / WiFi 6* *107 – 802.11be / WiFi 7* *120 – 802.11ad* *121 – 802.11ay* *130 – 802.11ac-derived OFDM* *140 – 802.16* *201 – OFDM Proprietary* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)* *406 – 4G LTE (3GPP release 13)* *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*
downlink_ link_budget_id	String	VA1238DL	Unique identifier for the downlink link budget assumed in generating the coverage data for the base station carrier. *- Value must correspond to a valid downlink link_budget_id value in the Fixed Wireless Link Budget Parameters file*.
uplink_ link_budget_id	String	VA1238UL	Unique identifier for the uplink link budget assumed in generating the coverage data for the base station carrier. *- Value must correspond to a valid uplink link_budget_id value in the Fixed Wireless Link Budget Parameters file*.

Field	Data Type	Example	Description / Notes
downlink_carrier_aggregation_link_budget_ids	String	VA1238DL, VA353DL	List all downlink link budgets, separated by a comma, that are deployed in carrier aggregation with this RF carrier. *- Value may be null if downlink carrier aggregation is not used for this RF carrier.* *- Each value must correspond to a valid downlink link_budget_id value in the Fixed Wireless Link Budget Parameters file and to a valid downlink_link_budget_id value associated with a separate record in the Fixed Wireless Base Station Carriers file.*
uplink_carrier_aggregation_link_budget_ids	String		List all uplink link budgets, separated by a comma, that are deployed in carrier aggregation with this RF carrier. *- Value may be null if uplink carrier aggregation is not used for this RF carrier.* *- Each value must correspond to a valid uplink link_budget_id value in the Fixed Wireless Link Budget Parameters file and to a valid uplink_link_budget_id value associated with a separate record in the Fixed Wireless Base Station Carriers file.*

2.2.5 Fixed Wireless Base Station Loading

This file contains records of actual cell loading measurements for cell sites used to offer fixed wireless services in Comma Separated Value (CSV) format matching the specification provided in the table below. All values are required unless otherwise indicated.

Field	Data Type	Example	Description / Notes
site_id	String	VA0128	Unique site ID for the base station to which this data record applies. *- Value length must be ≤ 256 characters.* *- Value must correspond to a site_id value in the Fixed Wireless Base Station Carriers file.*
sector_id	String	A	Unique sector ID for the sector to which this data record applies, created by adding a suffix to the site ID. *- Value must correspond to a sector_id value in the Fixed Wireless Base Station Carriers file.*
cell_id	String	32193025	Fixed Wireless broadcast cell identifier matching the cell_id value that devices on the network record. *- Value must correspond to a cell_id value in the Fixed Wireless Base Station Carriers file.*

Field	Data Type	Example	Description / Notes
timestamp	Datetime	2021-12-15T09:15:00-05:00	Timestamp of the time at which the cell loading data measurement began. *- Value must match valid ISO-8601 format including seconds and timezone offset, e.g.: YYYY-MM-DD[T]hh:mm:ss±hh:mm*
duration	Integer	900	Duration of the measurement interval in seconds. *- Value must be ≥ 60 and ≤ 900.*
technology	Enumerated Integer	501	Technology standard used by the channel/carrier described in this record from one of multiple values. *- Value must be one of the following codes:* *101 – 802.11b* *102 – 802.11a* *103 – 802.11g* *104 – 802.11n / WiFi 4* *105 – 802.11ac / WiFi 5* *106 – 802.11ax / WiFi 6* *107 – 802.11be / WiFi 7* *120 – 802.11ad* *121 – 802.11ay* *130 – 802.11ac-derived OFDM* *140 – 802.16* *201 – OFDM Proprietary* *401 – 4G LTE (3GPP release 8)* *402 – 4G LTE (3GPP release 9)* *403 – 4G LTE (3GPP release 10)* *404 – 4G LTE (3GPP release 11)* *405 – 4G LTE (3GPP release 12)* *406 – 4G LTE (3GPP release 13)* *407 – 4G LTE (3GPP release 14)* *408 – 4G LTE (3GPP release 15)* *409 – 4G LTE (3GPP release 16)* *410 – 4G LTE (3GPP release 17)* *501 – 5G-NR (3GPP release 15)* *502 – 5G-NR (3GPP release 16)* *503 – 5G-NR (3GPP release 17)* *0 – Other*

Field	Data Type	Example	Description / Notes
downlink_ bandwidth	Decimal (6,2)	10.0	Total bandwidth of the downlink RF carrier used for the deployed service in MHz. If using TDD, enter the entire bandwidth of the TDD carrier. *- Value must match the channel_bandwidth value for the corresponding downlink link budget in the Fixed Wireless Link Budget Parameters file of the link budget identified in the Fixed Wireless Base Station Carriers file for this site and sector.*
downlink_ bandwidth_use	Decimal (6,2)	5.2	Average amount of bandwidth of the downlink carrier that is carrying user traffic during the measurement interval in MHz. *- Value must be ≤ value for downlink_bandwidth.*
downlink_cell_load	Decimal (3,2)	0.52	Total calculated downlink cell loading percentage during the measurement interval. *- Value must be equal to (<downlink_bandwidth_use> / <downlink_bandwidth>).*
downlink_ throughput	Decimal (8,2)	30.90	Average downlink throughput of network traffic for the cell during the measurement interval in megabits per second (Mbps). *- Value must be ≥ 0.*
uplink_ bandwidth	Decimal (6,2)	10.0	Total bandwidth of the uplink RF carrier used for the deployed service in MHz. If using TDD, enter the entire bandwidth of the TDD carrier. *- Value must match the channel_bandwidth value for the corresponding uplink link budget in the Fixed Wireless Link Budget Parameters file of the link budget identified in the Fixed Wireless Base Station Carriers file for this site and sector.*
uplink_ bandwidth_use	Decimal (6,2)	10.0	Average amount of bandwidth of the uplink carrier that is carrying user traffic during the measurement interval in MHz. *- Value must be ≤ value for uplink_bandwidth.*
uplink_cell_load	Decimal (3,2)	1.0	Total calculated downlink cell loading percentage during the measurement interval. *- Value must be equal to (<uplink_bandwidth_use> / <uplink_bandwidth>).*
uplink_ throughput	Decimal (8,2)	6.70	Average uplink throughput of network traffic for the cell during the measurement interval in megabits per second (Mbps). *- Value must be ≥ 0.*

Field	Data Type	Example	Description / Notes
cell_users	Decimal (8,3)	43.2	Average number of active radio resource control channel users connected (e.g.,., RRC-connected users in LTE) to the cell during the measurement interval. - *Value must be ≥ 0.*

2.3 Satellite Provider Infrastructure Data

Satellite broadband service providers may be required to generate and submit to the Commission infrastructure information as part of certain processes within the Broadband Data Collection. For example, satellite providers that avail themselves of the waiver to the Professional Engineer certification requirement are required to maintain such information and submit it to the Commission upon request. In addition, providers may be required to submit such data to verify their availability data.

The specifications for the infrastructure data files are provided in Sections 2.3.1 through 2.3.4 and vary based upon the type of satellite system that the provider uses to offer service. Satellite providers have previously submitted most of this information using FCC Form 312 (Application for Satellite Space and Earth Station Authorizations) and accompanying Schedule S (Technical and Operational Description); however, unless otherwise indicated the provider must submit into the BDC system information on actual, live operations as of the applicable BDC reporting period (as opposed to authorized, but not yet operating, parameters). These data must be submitted in the specified file format in the BDC system via file upload.

2.3.1 System Information

This file contains records of the general operating parameters for the satellite system. The file must be in Comma Separated Value (CSV) format. All values are required unless otherwise indicated.

Field Name	Header	Data Type	Example	Description / Notes
Space Station or Satellite Network Name	network_id	String	SpaceBus 12	Unique identifier to identify the space station or satellite network. *- Value length must be less than 256 characters.*
Satellite Network Type	network_type	String	N	Enter the type of satellite constellation. *- Value must be one of the following codes:* *G – Geostationary Orbit (GSO)* *N – Non-geostationary Orbit (NGSO)* *O – Other*
Total Number of Satellites	total_sats	Integer	54	Number of satellites in the active constellation. *- Value must be greater than 0.*
Total Deployed Shell Count	total_shells	Integer	1	The number of orbital shells in the active constellation. *- Value must be greater than 0.*

Field Name	Header	Data Type	Example	Description / Notes
System Downlink Capacity	conus_dl_capacity	Decimal (6,1)	45000.0	Maximum offered downlink capacity to the entire continental United States, in Gbps. *- Value must be greater than 0.*
System Uplink Capacity	conus_ul_capacity	Decimal (6,1)	25000.0	Maximum offered uplink capacity to the entire continental United States, in Gbps. *- Value must be greater than 0.*

2.3.2 Space Station Orbital Shell Information

This file must contain the records for each constellation or orbital shell of space stations deployed by the satellite broadband service provider as-of the applicable reporting period. The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Field Name	Header	Data Type	Example	Description / Notes
Shell ID	shell_id	String	Shell1	Unique ID, assigned by the filer, for the shell to which this data record applies. *- Value length must be less than 256 characters.*
Shell Altitude	shell_alt	Integer	600	The altitude above the surface of the Earth at which the space station orbits, in kilometers
GSO Orbital Location	gso_long	Decimal (3,2)	164.14	For GSO only, enter orbit longitude location in degrees. *- Value may be null for non-GSO systems; for GSO systems, value must be between -180.00 and 180.00 degrees.* *- Note that negative value denotes Westbound and positive value denotes Eastbound direction.*
Shell Inclination Angle	shell_incl	Integer	45	The angle between the Earth's equatorial plane and the space station's orbital plane, in degrees. *- Value must be between 0 and 180 degrees*

Field Name	Header	Data Type	Example	Description / Notes
Shell Orbital Planes	shell_plane_count	Integer	3	The number of orbital planes in the constellation. *- Value must be greater than 0.*
Satellites Per Shell Orbital Plane	sats_per_plane	Integer	18	Enter the number of satellites per orbital plane. *- Value must be greater than 0.*
Shell Orbital Period	shell_orbital_period	Integer	5801	The time for the space station to complete a revolution in its orbit. *- Value must be between 0 and 1000000 seconds.*
Shell Apogee	shell_apogee	Integer	600	The point in a space station's orbit that is the greatest distance from the center of the Earth, stated in altitude and measured in kilometers. *- Value must be greater than 0 and less than 60000.*
Shell Perigee	shell_perigee	Integer	600	The point in a space station's orbit that is closest from the center of the Earth, stated in altitude and measured in kilometers. *- Value must be greater than 0 and less than 60000.*
Shell Argument(s) of Perigee	shell_arg_of_perigee	Integer	0	The angle, in degrees, between the ascending node and the point of perigee. *- Value must be between 0 and 360 degrees.*
Right Ascension of Ascending Node(s)	raan	Integer	0; 120; 240	The angle between the origin of longitude to the ascending node, measured in degrees. *- Value must be between 0 and 360 degrees.*

Field Name	Header	Data Type	Example	Description / Notes
Uplink Link Budget ID	uplink_lb_id	String	ABC123UL; DEF123UL	List of all uplink link budgets, separated by a semicolon, that are used to generate the coverage data from the identified orbital shell. *- Value may include either a single uplink_lb_id or multiple uplink_lb_id values separated by semicolons. Each semicolon-delimited value must match to a valid uplink link_budget_id value in the Satellite System Link Budget Parameters file.*
Downlink Link Budget ID	downlink_lb_id	String	ABC123DL; DEF123DL	List of all downlink link budgets, separated by a semicolon, that are used to generate the coverage data from the identified orbital shell. *- Value may include either a single downlink_lb_id or multiple downlink_lb_id values separated by semicolons. Each semicolon-delimited value must match to a valid downlink link_budget_id value in the Satellite System Link Budget Parameters file.*

2.3.3 Satellite System Link Budgets Parameters

This file contains records of each satellite link budget in Comma Separated Value (CSV) format matching the specification provided in the table below. All values are required unless otherwise indicated. Providers must submit a unique link budget for each unique combination of type of service, EIRP, beam, frequency, bandwidth, target speed, steering/elevation angles, and maximum power flux density.

Header	Data Type	UL Example	DL Example	Description/Notes
link_budget_id	String	ABC123UL	ABC123DL	Unique identifiers (uplink and downlink) to identify the link budget for each unique combination of type of service, EIRP, beam, frequency, bandwidth, target speed, steering/elevation angles, and maximum power flux density. *- Value length must be less than 256 characters.*

Header	Data Type	UL Example	DL Example	Description/Notes
link_direction	Enumerated String {1}	U	D	Direction of the link budget described in this record. *- Value must be one of the following codes:* *U – Uplink (earth to satellite)* *D – Downlink (satellite to earth)*
technology	Enumerated Integer	603	603	Technology standard used by the link budget described in this record from one of multiple values. *- Value must be one of the following codes:* *601 – Geo Satellite (CDMA-based)* *602 – Geo Satellite (TDMA-based)* *603 – Geo Satellite (OFDMA-based)* *611 – Non-Geo Satellite (CDMA-based)* *612 – Non-Geo Satellite (TDMA-based)* *613 – Non-Geo Satellite (OFDMA-based)* *620 – Other*
duplex_scheme	Enumerated String {1}	F	F	Duplex scheme used in the link budget from one of two possible values representing either Frequency Division Duplexing or Time Division Duplexing (including CSMA/CA). *- Value must be one of the following codes:* *F – FDD* *D – TDD*
allocation_ratio	String			Downlink to uplink time allocation ratio. This parameter is not applicable for FDD. *- Value must be null if duplex_scheme value is "F"; if not null, then value must match valid ratio format "<numeric>:<numeric>" where each numeric value is an integer greater than 0.*
beam_id	String	Earth-Tx01	Sat-Tx03	Unique descriptive transmitting beam identifier. *- Value length must be less than 256 characters.*

Header	Data Type	UL Example	DL Example	Description/Notes
beam_type	Enumerated String {1}	C	C	Type of service beam. *- Value must be one of the following integer codes:* *F – Fixed* *T – Steerable* *H – Shapeable* *C – Both Steerable and shapeable* *P – Spot* *O – Other*
beam_polarization	Enumerated String {1}	R	R	Enter the transmit polarization for the beam. *- Value must be one of the following codes:* *H – Horizontal* *V – Vertical* *R – Right Hand Circular* *L – Left Hand Circular* *M – Mixed* *O – Other*
target_speed	Decimal (7,2)	3.0	30.0	Target user speeds of the link budget, in Mbps. *- Value must be greater than 0.*
modulation_scheme	String	8PSK	16QAM	Modulation and coding scheme to deliver the target user speed of the link budget. *- Value must match a valid modulation scheme format: "<string> <numeric>/<numeric>", and each numeric value must be an integer > 0.*
operating_frequency	Decimal (6,3)	12000;12750	14000;14500	Enter the lower and upper frequency band limits of the particular beam in MHz, delimited by semicolons (";"). *- Value limited to 6 decimal places to the left of the decimal and 3 decimal places to the right e.g. 12345.123.*
channel_bandwidth	Decimal (6,2)	600.0	600.0	Total bandwidth of the operating channel, in megahertz. *- Value must be greater than 0.*
elevation_angle	Decimal (6,2)	45.0	45.0	Elevation angle with regard to horizon from earth terminal to satellite, in degrees. *- Value must be greater than 0 and less than or equal to 90.*

Header	Data Type	UL Example	DL Example	Description/Notes
channel_load	Decimal (3,2)	0.5	0.5	Average channel traffic loading factor (both own beam and neighboring beams), in decimal percentage. *- Value must be ≥ 0 and ≤ 1.*
required_sinr	Decimal (4,2)	8.7	12.2	Required signal to interference and noise ratio to deliver the target speeds, in dB. *- Value must be ≥ -20 and ≤ 50.*
spectral_efficiency	Decimal (7,2)	1.0	2.0	Required spectral efficiency to deliver the user speeds at the cell edge, in bps / Hz. *- Value must be > 0.*
total_tx_power	Decimal (5,2)	18.3	19.4	Total transmitter power for the channel (including multiple transmitters), in dBW. *- Value must be > 0.*
total_tx_losses	Decimal (4,2)	1.5	0.5	Total losses in the transmitting path from the amplifier to the antenna, in dB. *- Value must be ≥ 0 and ≤ 10.*
antenna_tx_peak_gain	Decimal (4,2)	45.0	50.0	Transmitter maximum antenna gains at satellite and earth terminal with regard to elevation/steering angles, in dBi.
total_eirp	Decimal (4,2)	61.8	68.9	Total maximum effective isotropic radiated power (including multiple transmitting antennas) per channel, in dBW.
eirp_density	Decimal (3,1)	-26.0	-18.9	The EIRP density for the beam, in dBW/Hz. *- Value must be between -100.0 and 100.0.*
antenna_rx_peak_gain	Decimal (4,2)	50.0	45.0	Receiver antenna maximum gains at satellite and earth terminal with regard to elevation/steering angles, in dBi.
total_rx_losses	Decimal (4,2)	0.5	1.5	Total losses in the receiving path from the antenna to the receiver, in dB.
g_t_system	Decimal (5,2)	26.0	18.5	Receiver G/T_system, in dB/K, G at peak gain and T_system at input to the first LNA.
t_system	Decimal (4,2)	223.9	316.2	T_system in Kelvin(K) at input to the first LNA.
thermal_noise_power	Decimal (5,2)	-117.3	-115.8	Thermal system noise power per channel, in dBW.
rx_sensitivity	Decimal (5,2)	-108.6	-103.6	Receiver sensitivity to deliver the targeted performance, in dBW. *- Value should be calculated after the receiver's antenna.*

Header	Data Type	UL Example	DL Example	Description/Notes
atmospheric_ absorption_margin	Decimal (5,2)	0.2	0.2	Margin due to atmospheric absorption (O2, water vapor, etc.), in dB.
rain_fade_margin	Decimal (5,2)	3.0	3.0	Margin to account for rain fading, in dB.
antenna_misalignment_ loss	Decimal (5,2)	1.0	1.0	Loss due to Tx-Rx antenna pointing error, in dB.
polarization_mismatch_ loss	Decimal (5,2)	0.0	0.0	Loss due to Tx-Rx polarization alignment error, in dB.
interference_margin	Decimal (5,2)	2.0	1.0	Interference margin from adjacent beams due to traffic loading, in dB.
total_margins	Decimal (5,2)	6.2	5.2	Total net losses and margins, in dB.
distance_to_satellite	Decimal (6,2)	35786.0	35786.0	Average distance to satellite for earth terminal elevation angles of 0-5°;5-10°;10-30°;30-50°;50-70°;70-90° above the horizon, in Km. *- For GSO satellites, enter one value.* *- For Non-GSO satellites, enter values delimited by* semicolons (";")
mapl	Decimal (5,2)	213.7	210.8	Maximum allowable path loss of the link, in dB. *- Value must be > 0 and should be calculated after the receiver's antenna.*
power_flux_density_ max	Decimal (5,2)	-100.3	-93.2	Maximum power flux density values in dBW/m2/channel_BW, after accounting for total margins, for earth terminal elevation angles of 0-5°;5-10°;10-30°;30-50°;50-70°;70-90° above the horizon. *- For GSO satellites, enter one value.* *- For Non-GSO satellites, enter values delimited by* semicolons (";")

2.3.4 Satellite System Capacity Information

This file must contain the records for the system capacity for specific geographic regions on earth of each constellation or orbital shell of space stations deployed by the satellite broadband service provider. The records must reflect data as of the applicable BDC reporting period and for the specific state(s) and county or counties within the geographic area(s) identified by Commission staff, and they must be based on each unique shell ID and associated link budget.

The file must be in Comma Separated Value (CSV) format and match the specifications in the table below. All values are required unless otherwise indicated.

Header	Data Type	UL Example	DL Example	Description / Notes
shell_id	String	Shell1	Shell1	The offered capacity generated by the unique shell, identified by shell_id, assigned by the filer, for the shell to which this data record applies. *- Value length must be less than 256 characters.*
link_direction	Enumerated String {1}	U	D	Direction of the link described in this record. *- Value must be one of the following codes:* *U – Uplink (earth to satellite)* *D – Downlink (satellite to earth)*
state_fips	String {2}	48	48	2-digit U.S. Census Bureau FIPS code for the state (a list can be found on the U.S. Census webpage at https://www.census.gov/library/reference/code-lists/ansi.html#states). *- Value must be a valid state or territory from the latest U.S. Census Bureau decennial data.*
state_capacity	Decimal (6,1)	1800.0	5000.0	Maximum offered capacity to the entire requested state, in Gbps. *- Value must be greater than 0.*
county_fips	String {5}	48009	48009	5-digit U.S. Census Bureau FIPS code for the county (a list can be found on the U.S. Census webpage at https://www.census.gov/library/reference/code-lists/ansi.html#cou). *- Value must be a valid county from the latest U.S. Census Bureau decennial data.*
county_capacity	Decimal (5,1)	150.0	450.0	Maximum offered capacity to the entire requested county, in Gbps. *- Value must be greater than 0.*