

West Virginia Geological and Economic Survey

State Broadband Mapping Methodology

For the State of West Virginia, September 2011

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Overview

This document gives a summary of the data collection, normalization and verification processes used by the State of West Virginia (State) for the September 2011 data submission to the National Telecommunication and Information Agency (NTIA) in accordance with the State Broadband Data Development (SBDD) program. While the processes used in this data submission remained the same as ones for the previous submissions, there were additional challenges overcoming the changes from 2000 to 2010 census blocks. Additionally, the State of West Virginia interactive broadband map is now available to the public and is able to receive comments and feedback from consumers and citizens of the state.

Purpose

This documentation was developed to illustrate the processes used during the data collection, normalization and verification processes. The information within this document will provide a background to the development of the provider list and data request, and specific issues encountered by West Virginia regarding data collection, normalization and validation.

Data Sources

Provider List

The provider list for the fourth round of data collection started during the first round of data collection. For this round, the list was regenerated to include any new providers within the state. The list was created by contacting the West Virginia Cable Telecommunications Association, the West Virginia Public Services Commission (PSC) and the West Virginia Broadband Deployment Council. The state receives an updated provider list from the PSC every six months. This information was compiled and compared against the list from the Federal Communications Commission (FCC). Providers were then contacted using information provided by the FCC's public information search Web tool. Providers who were contacted during the first round of data were contacted again through the same name and address. If a provider contacted during the first round had given more detailed contact information for a specific individual, those individuals were contacted instead of the contact provided by the FCC.

The provider list is updated every six months to reflect any mergers or acquisitions that have occurred. There are some legal issues when a merger occurs, but the data integration does not occur until up to a year later. In those circumstances, the data is kept separate until a full merger occurs.

Data Gathering

Provider Data Request

This component of the project was heavily reliant on working with service providers to obtain data. Each identified provider was mailed a standard data request outlining the elements identified in the Notice of Funds Availability (NOFA) Technical Appendix that were requested from providers. This request included information regarding the availability of broadband services, technology used to provide them, the location of certain broadband infrastructure and the speed of the service. Data was requested to be submitted in the form of census block lists and service area boundaries, including address level and street segment data. If a provider was unable to fulfill such requirements, the West Virginia Geological and Economic Survey (WVGES) worked with those providers to gather the necessary data in an alternative approach.

After the initial data request was mailed, follow up phone calls and emails were made to remind providers of due dates and to collect any missing or unclear data. As of this submission, the response rate from providers is over 90 percent. After data was received, the data was normalized per NTIA standards and placed into the provided geodatabase. WVGES continued to

operate under the same assumption as used in the first round of data gathering. As the focus was on normalizing, not changing the data, WVGES made no core changes without first consulting the provider.

Providers typically submitted only advertised speed data. A very small percentage of providers are willing to submit typical speed data as doing so would be an admission that advertised and typical speeds are not the same. Advertised speed data was given by all providers and then pushed to typical speeds as per NTIA's advice in the Round 3 data review conference call.

In addition to the data request, each provider was required to sign a Nondisclosure Agreement (NDA) between themselves and WVGES. The NDA outlined how provider data would be handled and what portions of that data would be considered confidential, which would be shared with the NTIA and which were to be made publically available.

Coverage Information

Data was derived and normalized into four formats in accordance with the data model:

- Census blocks (2000) of two or less square miles
- Street segments (2000) of census blocks greater than two square miles
- Address level (geocoded point data)
- Wireless area (shapefile)

The normalization procedures were as follows:

- Determine service being provided – what technologies are being used to provide the service
- Understand data/determine how to process – determine which feature class in the geodatabase data belongs
- Georeferencing/geocoding necessary data – georeferencing data for wireless area coverage and other service area maps, as well as geocoding address level data
- Segregating data into NOFA compliant formats – completely filling in geodatabase fields, as well as making sure topology is correct
- Quality assurance/quality control (QA/QC) – verification and validation of data

Typically there were two main types of data supplied for normalization – service area maps and flat Excel tables.

Service areas were georeferenced, digitized and then intersected with the master blocks and roads files. These blocks and road segments were then loaded into the geodatabase and the additional company specific data was appended to those records.

Flat Excel tables were exported to a database and then joined with the FIPS ID for the block files and the TLID for the roads files. The joined fields were exported and then imported into the database. NTIA has not required this information and in cases where a TLID was not given by the provider there was much greater difficulty and inaccuracy as roads had to be geocoded and hand selected.

Geocoding Issues

The West Virginia Statewide Addressing and Mapping Board (SAMB) information is not yet completed across all of the counties in West Virginia, leaving areas within the State without complete or verified address information. This led to low geocoding match rates of provider supplied information, especially in rural areas, throughout the data normalization workflows. For some of these areas, additional broadband coverage processes were used to derive coverage estimates described in the next section.

One part of this issue was due to the acquisition of Verizon by Frontier. When Frontier submitted digital subscriber line access multiplexer (DSLAM) locations for the April 1, 2011 deadline it did not include the entire Verizon infrastructure. Frontier has since re-submitted its DSLAM locations, which now should include those missing Verizon DSLAMs and the coverage map has been extended into certain area that were not previously included

Additional Data Processing Techniques

Because of geocoding inconsistencies in certain areas of the State, some provider address information could not be mapped and other data processing techniques had to be implemented to create broadband coverage estimates. In cases where DSLAM points were able to be provided, broadband coverage was mapped by loading the DSLAM points into Environmental System Research Institute's (ESRI's) Network Analyst. For this processing, the West Virginia State SAMP street centerlines were used as the source roads. DSLAM points were loaded into the facilities point feature class of the service area template using a 1000 foot snapping tolerance to help locate points to nearest roadway. Any points still not connecting to the road network were viewed and manually linked to the road network. Processing was run to create segment lines for each point and to create a detailed polygon area around each street segment area for each point. A 15,000 foot distance parameter was used and no impedances were placed on the streets.

Once the process was run, the created segment lines and polygon areas were linked to the original DSLAM point attribute table and exported from the analyst dataset into standalone polygon and line feature classes. These two feature classes were clipped to the provided wire center boundaries. These coverage areas were used to select covered census blocks and street segments for the data submission. Final broadband coverage estimates were reviewed with the provider prior to final submission.

Another unique processing issue occurred when providers submitted address-level fixed wireless data which would produce error through the new data model. As per discussion with NTIA, the unlicensed fixed wireless points were plotted and then buffered out to 800 feet. A shapefile was created and moved to the wireless feature class within the geodatabase.

One of the foremost issues of this round of data collection has been converting to 2010 Census Blocks. NTIA's decision to switch to 2010 Census Blocks did not leave much time to notify providers of the change. Many providers submitted 2000 Census Blocks, not 2010 Census Blocks. The conversion led to multiple inaccuracies between Round 3 and Round 4 submissions because of the problems intersecting 2000 Census Blocks with 2010 Census Blocks. Many block boundaries had been redrawn and the crosswalk file provided by the Census was in a very unwieldy format and not much help.

FRN Number Discrepancies

Discrepancies between Round 2 and Round 3 data submissions were noticed concerning FCC Registraton Numbers (FRNs). Affected providers were contacted directly to clear up these issues. FRNs that were loaded into the database come from direct contact with providers.

Community Anchor Institutions

The process used to identify the Community Anchor Institutions was based on the information provided by NTIA. This included the categories of schools K-12, libraries, medical/healthcare, Public Safety, higher education and other community support consisting of either government or nongovernmental facilities.

All public schools in West Virginia were used for the K-12 category. Libraries consisted of all public libraries throughout West Virginia. Medical/healthcare included hospitals, nursing homes and primary care centers. The primary care centers are made up of main locations of the primary care centers along with satellite clinics and school-based health centers. Public Safety consisted of West Virginia police departments along with the correctional facilities and juvenile centers, fire departments and

9-1-1 centers. Higher education consisted of public and private universities located across West Virginia. The community support consisted of courthouses, regional development centers and workforce locations.

There was a cutoff created to focus on identifying main facilities as Community Anchor Institutions (CAIs). However, if there is a need to go and include more facilities, the State is open to adding those facilities for future updates.

The following agencies were contacted for information: West Virginia (WV) Department of Education, WV Library Commission, Hospitals located throughout the state, Nursing Homes located throughout the State, WV Division of Primary Care, WV Primary Care Association, WV 9-1-1 Center Directors, WV Emergency Management Directors, WV Regional Jail Authority, WV Higher Education Policy Commission, WV Courthouse Facility Improvement Authority, WV Workforce, WV Regional Development Centers and county addressing coordinators.

Data was collected and verified by the West Virginia Division of Homeland Security. Surveys were sent out to various facilities and included a section where their primary city-style address could be filled in. For those facilities that returned the survey, the statewide addressing and mapping data that the counties provided was used as a way to verify the address. Once the location was verified the latitude and longitude coordinates were added. In cases where surveys were not returned, the statewide addressing and mapping data was used to determine if the information could be matched. If this wasn't possible, then the Internet was used to find a Webpage with additional information. If this method was not successful, attempts were made to contact the facility directly. At this point in time, there is approximately a 90-95 percent match rate for the location of the CAIs.

Validation and Verification

Throughout the data gathering and data preparation processes for each data submission, the data verification has been continuous and has evolved based on the evolution of the data model. The focus has been on getting complete data from all providers and assuring that all data can be processed into the required data model for submission. Where providers did not submit data in acceptable formats for data normalization into NOFA formats or where they did not submit complete data or any data, there has been continued focus on working with the providers by WVGES to continue to improve the source information being provided. Data verification and validation is an on-going, long term process that will continue to evolve throughout the broadband data development program. With this fourth data submission in September 2011 being a much more complete broadband coverage across the State because of additional data supplied by providers, additional data verification methods, beyond what has been implemented to date, will continue to be evaluated to refine the map, where applicable.

Validation Processes

Data validation begins within the data collection process to determine if the data submission by providers is formatted in a way that can be normalized into the required NOFA formats. Where data is deemed incomplete or in non-conforming standards, WVGES staff reached out to providers as necessary to improve the data submissions. After each round of data preparation the format for the updates being collected has improved.

Quality assurance and quality control has been a big focus of the data validation of the submittals assuring that the required data fields are populated properly and that data fields are populated with values that follow the data model rules. As the data model has evolved over each round of data submission these QA/QC checks have been modified to include the changes in fields, values, domains, etc. that are being required for submission.

Validation methods employed include the following:

- Assuring all applicable providers' datasets are propagated forward to each round of data collection
- Verifying that all required fields are populated with valid values and default values are used when appropriate. This includes:
 - Speeds valid for the technologies reported

- Latitude/longitude coordinates fall within an acceptable range, given the state boundaries
- The relationships between maximum and typical, and downstream and upstream speeds are valid
- Service reported at the block level is done using blocks of the appropriate size (less than two square miles)
- Speeds and technologies reported per provider are consistent between blocks and segments
- Administrative information (provider name, doing business as [DBA] Name, FRN) is consistently reported per provider in each populated feature class.

Outreach to Providers

To further assure the providers' broadband footprints would be accurately represented in data submissions, "check maps" depicting each respective provider's served small census blocks and segments located in large blocks were distributed back to providers. Providers were requested to either approve their check maps as-is, or submit additional changes if their coverage was not accurately represented. Any modifications received as a result of this effort were incorporated into the broadband coverage maps. WVGES plans to incorporate future data reviews with providers using web collaboration tools.

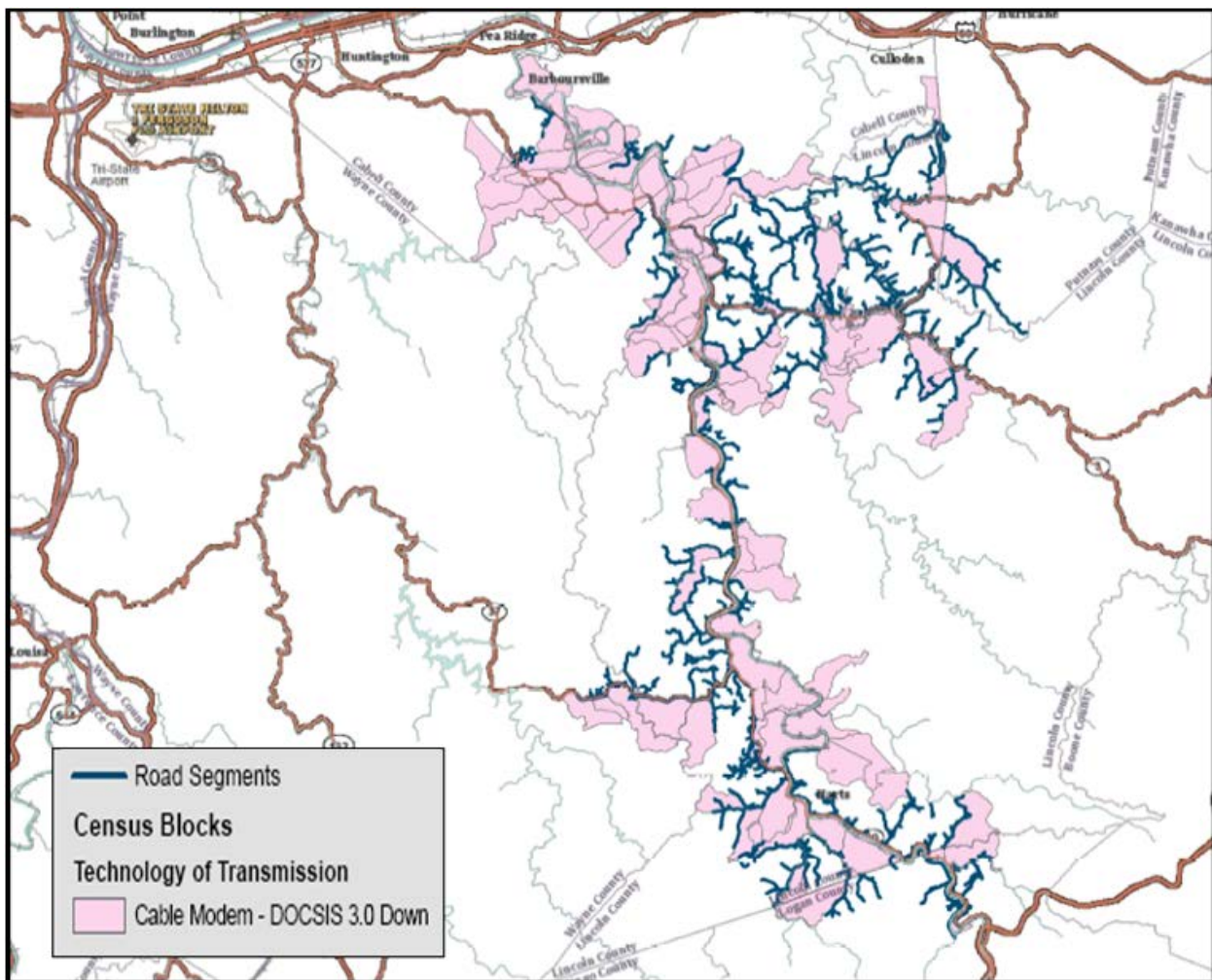


Figure 1—Example of a portion of a provider check map

The validation process for the September 2011 submission includes the use of the Python scripts for validation provided by NTIA.

Third Party Datasets

As data collections and data normalization processes progressed, additional validation was conducted using commercially available datasets. The following commercially available datasets were used as a reference for the specific technologies that their data represented.

- American Roamer datasets
- TeleAtlas Exchange boundaries
- Media Prints Cable boundaries

These datasets were used primarily as a validation source for provider service coverage.

State Broadband Interactive Map

The State of West Virginia released its interactive broadband mapping Website to the public in May 2011. The Website address is www.wvbroadbandmap.org. The Website provides consumers the opportunity to review broadband availability across the State.

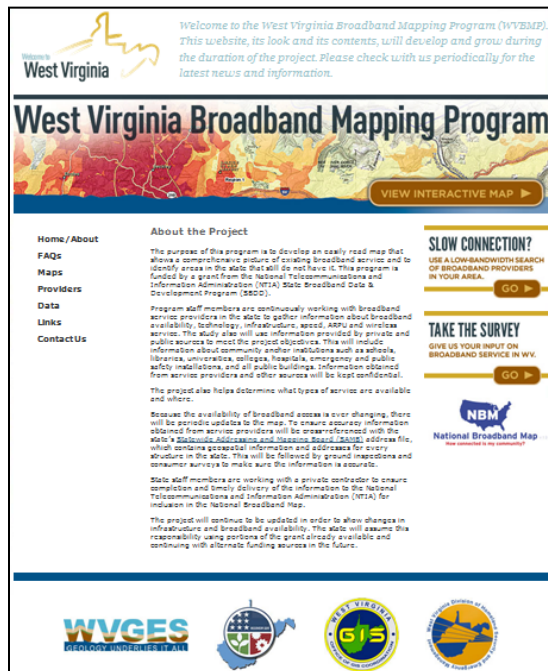
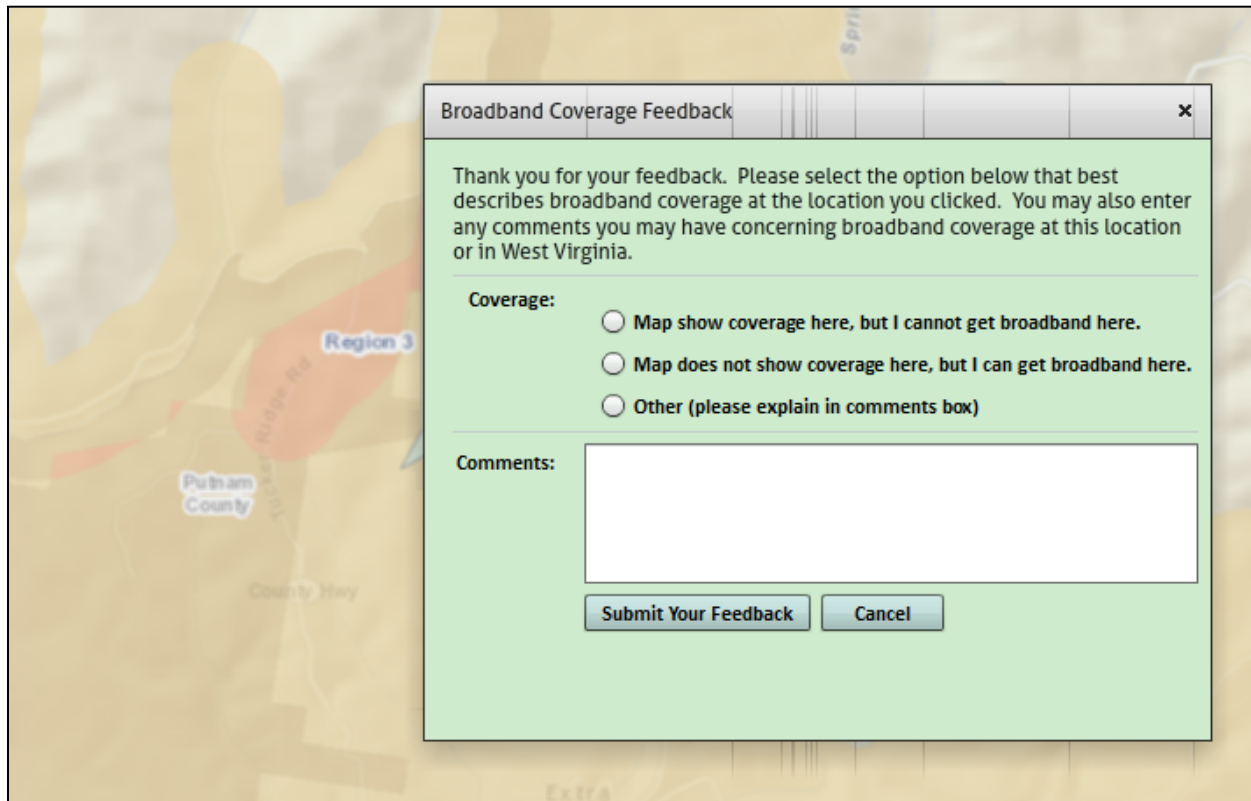


Figure 2—WVBMP main landing page

The main landing page for the West Virginia Broadband Mapping Program (WVBMP) provides background information on the program, contact information and a frequently asked questions section. The landing page has the main link to the broadband coverage map and a link to an address lookup tool for users with slow internet connections. This will allow them to view what coverage is available around their address or zip code without needing to view the entire map, which might not be feasible for users who might still be on dial-up connection speeds. By having this slow internet connection coverage tool, it allows feedback from those consumers even if they do not have the capabilities to bring up the interactive map application.

The Web application has the functionality for consumers and citizens using the State broadband map Web application to submit comments and feedback. The information gathered from that feedback is being reviewed as more potential source information for validating and determining confidence levels of the broadband coverage across the regions of the State. By

comparing comments supplied by consumers about broadband availability to the broadband coverage, trends could be recognized where potential inconsistencies in the existing broadband map could exist. This could delineate the need for further focused validation or verification in specific areas that could refine the broadband coverage information for future data submissions.



The image shows a screenshot of a web-based feedback tool titled "Broadband Coverage Feedback". The tool is overlaid on a map of West Virginia, which shows various regions and counties, including "Region 3" and "Putnam County". The feedback form has a light green background and contains the following elements:

- Title Bar:** "Broadband Coverage Feedback" with a close button (X).
- Message:** "Thank you for your feedback. Please select the option below that best describes broadband coverage at the location you clicked. You may also enter any comments you may have concerning broadband coverage at this location or in West Virginia."
- Coverage Section:** Labeled "Coverage:", it contains three radio button options:
 - ☐ Map show coverage here, but I cannot get broadband here.
 - ☐ Map does not show coverage here, but I can get broadband here.
 - ☐ Other (please explain in comments box)
- Comments Section:** Labeled "Comments:", it features a large white text input area.
- Buttons:** At the bottom, there are two buttons: "Submit Your Feedback" and "Cancel".

Figure 3—Example of feedback tool interface

Users browsing the interactive map can click on any location and select to provide specific feedback for that location. This will store the coordinate information of the selected location allowing them to select from a couple of coverage categories for their comment or select "other". Within the feedback tool, they can type in more specific details about their broadband coverage.

After the initial release of the broadband map, there was some initial feedback and comments mainly pertaining to a few areas that were not showing coverage. The feedback indicated that there should be coverage or scenarios where we were showing coverage. One resident made a comment that there was not cable service on a particular road or area. Some of the missing coverage was due to the acquisition of Verizon by Frontier as discussed above.

During the next six month data collection period leading up to the April 2012 data submission, the State plans to incorporate more advertising to the interactive broadband map and feedback tools. Continuing to work more closely with the regional planning councils to review coverage in their communities, a plan to include an advertisement of the interactive broadband map into local phone bills is being developed.

A speed test has been developed within the WVBMP interactive Website. The design of the Website includes links to the speed test developed using the Ookla broadband speed test tools. The speed test is embedded within a broadband survey wizard that allows consumers to provide specific information that will help the State analyze information about use and demand for broadband within the State. To get more users to take the speed test to obtain more results for analysis over the next six months, the speed test will be advertised along with the interactive Website. Speed test results and statistics will be

leveraged to compare against the existing broadband coverage and help validate speed information. As stated previously, this could assist in determining if there are any trends or patterns in the information that could be an additional tool for prioritizing areas where more refined verification and validation might need to occur.

Future Steps for Validation

Future plans for data validation continue to include establishing confidence levels to assign to broadband coverage based on comparisons with other source information collected, such as feedback from crowd sourcing results from the State broadband map and the national broadband map. Confidence rankings will be used to prioritize any areas where additional verification techniques might be used (consumer and business surveys).

As part of continued broadband planning activities and future validation of data, a third party dataset from Infogroup is being purchased. For broadband map validation, the Infogroup datasets provide consumer broadband use information including coordinate based location information along with provider name and technology that is being used by that particular consumer. The Infogroup data will allow the consumer information to be plotted on the map and compared against existing coverage maps to determine if there are any trends within the Infogroup data that help to determine where additional validation needs to occur. For example, there may be clusters of consumer points for a particular provider that exists in an area of the State where there is no coverage for that provider. The goal would be to identify the major patterns or trends that might need to be re-visited with a provider if data appears to be missing.

Another dataset that is being considered for purchase for broadband planning activities and broadband demand analysis is Telogical's broadband statistical datasets that provide pricing information. Included in the datasets is information on broadband maximum advertised speed by providers which could help validate some of the speed data within the broadband mapping datasets.

Throughout the broadband data development program, as addressing information from the State Addressing and Mapping Board's addressing datasets are continually updated, address point information from providers will continually be re-verified prior to each submission to NTIA to improve geocoding results and refine the broadband coverage areas.

Providers

Non-Responsive Providers

Names of providers who were non responsive will be passed along to the WV Geographic Information Systems (GIS) Coordinator's Office to be contacted again.

Atlantic Broadband LLC

DBA: Atlantic Broadband, LLC

FRN: 0009596883

This provider was contacted eight times. Data was not provided by the October submittal date. Further attempts at data gathering will be made in the next round of data collection.

Hughes Communications, Inc.

DBA: HNS Licensuse Sub, LLC

FRN: 0018483073

Detailed data was not provided by the October submittal data. Further attempts at data gathering will be made in the next round of data collection.

StarBand Communications Inc.

DBA: StarBand Communications Inc.

FRN: 0005087457

Detailed data was not provided by the October submittal data. Further attempts at data gathering will be made in the next round of data collection.

[WildBlue Communications, Inc.](#)

DBA: WildBlue Communications, Inc.

FRN: 0007843766

Detailed data was not provided by the October submittal data. Further attempts at data gathering will be made in the next round of data collection.

[Skyweb, Inc](#)

DBA: SKYWEB Inc.

FRN: 0018516799

This provider was contacted eight times. Tower locations were provided along with additional information for each tower site. Two computerized propagation studies were performed to approximate coverage for a local provider supplying broadband data. The two studies were predicted in the 900 MHz and 2.4 GHz bands that are utilized at these locations. The data was received from the provider that defined the tower sites currently utilized to provide coverage. Parameters provided include site locations, ground elevation, transmit power, antenna height above ground, and antenna gain. All of these components were compiled into EDX Signal software program which calculates the associated link budget and in which the program takes into account terrain and land use land clutter (LULC). Propagation studies show potential coverage throughout the area. Additional assumptions made include a predicted reliability of 90 percent for any signal received by a device and no additional signal loss was taken into account for signals received inside buildings which may further impact the coverage predictions. The coverage area was being reviewed by the provider on the final week prior to submission for October deadline. Data was not finalized in time for the October submission and will be included within the April 2012 submission.

Satellite Providers

Data requests sent to Satellite providers were met with the response of "We provide to the entire state." Attempts made at gathering more detailed data sets were unsuccessful for this round of data collection. Further attempts will be made for the next round of data collection.

Provider that Submitted Data

Provider Name	DBA Name	FRN
Armstrong Holdings, Inc.	Armstrong Telephone Company - Northern Division	0004311528
Armstrong Holdings, Inc.	Armstrong Telephone Company-WV	0004379731
Armstrong Holdings, Inc.	Armstrong Utilities, Inc.	0003765617
AT&T Inc	New Cingular Wireless Services, Inc.	0003766532
Broadview Networks Holdings, Inc.	Broadview Networks Holdings, Inc.	0010296853
Cequel Communications, LLC	Suddenlink Communications	0015784663
Citizens Communications Company	Frontier Communications Corporation	0003576352
City of Philippi	City of Philippi	0001984244
Comcast Corporation	Comcast Cable Communications Inc.	0003768165
Community Antenna Service, Inc.	Community Antenna Service Inc.	0004966131
Deutsche Telekom AG	T-Mobile USA, Inc.	0006945950
DSL.net, Inc.	DSLnet Communications, LLC	0004324851

Provider Name	DBA Name	FRN
Gateway Telecom, LLC	Gateway Telecom LLC	0018536623
Hardy Telecommunications, Inc.	Hardy Telecommunications Inc	0002008043
Hardy Telecommunications, Inc.	Hardy Telecommunications, Inc CLEC	0013169313
Hickory Tech Corporation	Enventis Telecom Inc.	0008394322
Inter Mountain Cable, Inc.	Inter-Mountain Cable Inc	0001789080
Inter Mountain Cable, Inc.	Mikrotec CATV, LLC	0014471288
JB-Nets	JB-Nets	0016474868
Leap Wireless International, Inc.	Cricket Communications, Inc.	0002963528
Level 3 Communications, LLC	Level 3 Communications, LLC	0003723822
Level 3 Communications, LLC	Broadwing Communications, LLC	0008599706
LightEdge Solutions, Inc	LightEdge Solutions, Inc.	0015546443
Metropolitan Telecommunications Holding Company	Metropolitan Telecommunications Holding Company	0009806019
Micrologic, Inc.	Micrologic, Inc.	0018675256
New Edge Holding Company	New Edge Network, Inc.	0003720471
NTELOS, Inc.	NTELOS Communications Inc.	0004342762
NTELOS, Inc.	West Virginia PCS Alliance, L.C.	0002049328
Otelco Inc.	War Acquisition Corp	0018657858
Qwest Communications International, Inc.	Qwest Communications Company, LLC	0003605953
Shenandoah Telecommunications Company	Shentel Cable Company	0018024075
Sprint Nextel Corporation	Sprint Nextel Corporation	0003774593
Spruce Knob Seneca Rocks Telephone, Inc.	Spruce Knob Seneca Rocks Telephone, Inc.	0004337002
TelAtlantic, Inc.	West Side Telecommunications	0002009405
TelAtlantic, Inc.	Communications Plus, Inc.	0009281262
Time Warner Cable LLC	Time Warner Cable LLC	0013430244
TW Telecom inc.	tw telecom holdings inc.	0014942668
Verizon Communications Inc.	Cellco Partnership	0018506568
Verizon Communications Inc.	Verizon Business Global LLC	0010856284
Verizon Communications Inc.	Verizon West Virginia Inc.	0002011278
Visual Link Internet LLC	Visual Link Internet LLC	0017645813

Table 1—Providers That Have Submitted Data for SBDD Program