

DATA DEVELOPMENT & VALIDATION METHODOLOGIES WHITE PAPER

Commonwealth of Pennsylvania
State Broadband Initiative (SBI)
Broadband Mapping Project

NTIA Data Submittal
September 28, 2012

Baker

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Introduction

The following sections of this document provide an overview of the process used for the SBI Broadband Mapping data development for the Commonwealth of Pennsylvania. The following narrative is depicted in Appendix A, Commonwealth of Pennsylvania SBI Process Workflow, and Appendix B, State Broadband Data Validation Workflow, included at the end of this document.

Broadband Provider Outreach Results

As a result of the outreach to broadband providers and investigating whether a internet service provider (ISP) fits the definition of a broadband provider as per the NOFA, the following is a summary of our findings:

- 294 Total Investigated ISPs
- 121 Total Confirmed Broadband Service Providers (unique Provider/DBAs combinations)
- 96 Broadband Service Providers who Supplied Data (unique Provider/DBAs combinations)
- 37 Total Confirmed Broadband Service Resellers
- 2 Broadband Service Resellers who Supplied Data

Attachment C, Master Outreach List, contains additional provider information.

Broadband Provider Outreach Procedure

The following outreach procedure provides the framework for communicating with Broadband Service Providers (providers). The primary goals of the outreach approach documented herein are to:

- Promote provider understanding and acceptance of the Broadband Mapping process, results, and benefits
- Clarify NTIA Broadband Mapping requirements
- Facilitate data confidentiality agreements as required
- Minimize the submittal of invalid data
- Enhance provider understanding of the semi-annual update process
- Work with providers to evaluate submittal options to facilitate data submittals

Data Submission Guidelines

Guidelines for the providers' submission of Broadband Mapping Data are documented in the "Data Submission Guidelines". These Guidelines define technical requirements, submission specifications, and coordination and documentation activities.

Pennsylvania Broadband Providers Website

A URL was deployed (http://www.bakergis.com/PABroadbandProvider/) to communicate and distribute NTIA NOFA requirements to providers along with outreach and data submittal materials including:

- NTIA NOFA and subsequent clarification
- Outreach letters to providers
- Draft Non-Disclosure/Data Sharing Agreement

- Quick Start Guides
- Data Submission Guidelines
- Data Transmittal Letter
- Broadband Data Submittal Templates
- Census TIGER Data
- Data Submittal Assistance Contact Information

Outreach Delivery Vehicles

- A State Broadband Mapping Initiative Call for Data letter from the Commonwealth of Pennsylvania Department of Community and Economic Development (DCED) was emailed to all providers in the Commonwealth. This initial provider contact letter described the program and the role of Michael Baker Jr., Inc. (Baker) acting on behalf of the DCED for Broadband Data Collection and Mapping.
- Baker distributed a follow-up letter to all providers describing the data submittal requirements and material and help available to aid with the data submittals.
- Submittal assistance was provided to providers that needed help with data submittals.
- Presentations were conducted with various broadband provider associations to present the data submittal requirements and answer questions.
- Email communication and electronic transfer of data was encouraged to facilitate a faster delivery of data and information.
- A URL was deployed and promoted to distribute outreach material and information concerning the Broadband Mapping Project.
- A secure FTP URL was provided for submittal of broadband data by providers.
- A secure Broadband Provider Data Update Webportal was deployed for providers to redline/update their service coverage, rather than supply their updated coverage for the semi-annual data updates.

Inclusion of Resellers

With the request for data current as of December 31, 2011, resellers are being included in all of the outreach, data collection, data aggregation, and verification tasks. The following reseller outreach form has been developed to secure the proper information and to minimize the resource commitment required by the reseller.

Reseller Information

R4-07/25

Reseller Name:
D/B/A Name (If applicable) :
FCC Registration Number ("FRN") (If applicable) :
Web Site Address:
Reselling Broadband Service for the following Organization(s): (List all carriers you represent)
Do you resell services for the entire area of each carrier above? ☐ Yes ☐ No
If no, indicate what area(s) you resell broadband services (List counties or Cities):
Technology of Transmission (Check all that apply):
☐ Assymmetric xDSL (ADSL) ☐ Symmetric xDSL (SDSL)
☐ Cable Modem – DOCSIS 3.0 ☐ Other Copper Wire
☐ Cable Modem - Other ☐ Optical Carrier/Fiber to End User
☐ Terrestrial Fixed Wireless – Unlicensed ☐ Satellite
☐ Terrestrial Fixed Wireless - Licensed ☐ Terrestrial Mobile Wireless
☐ Electric Power Line ☐ Other
Speed Tiers (See info on next page) : What is the fastest Broadband service plan ("Max") you offer, and what service plan ("Typical") do customers normally buy each month. To see the speed categories, turn to page 2 of this form.
Max Adv Down: ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10 ☐11
Max Adv Up: ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10 ☐11
Typical Adv Down: ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10 ☐11
Typical Adv Up: ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10 ☐11
Middle Mile Equipment (for each Carrier): ☐ Owned ☐ Leased Does your company own or lease any equipment related to the Broadband service for the Carriers you sell?
Latitude/Longitude or Location Address:
Facility Type: ☐Fiber ☐ Copper ☐ Hybrid Fiber Coax ☐ Wireless
Facility Capacity (see page 2 of this form): ☐1 ☐2 ☐3 ☐4 ☐5 ☐6
Elevation: ____ Feet above or below grade (nearest foot)

Speed Tier Codes:

Upload Speed Tier Code	Download Speed Tier Code	Description
1	--	Less than or equal to 200 kbps
2	--	Greater than 200 kbps and less than 768 kbps
3	3	Greater than 768 kbps and less than 1.5 mbps
4	4	Greater than 1.5 mbps and less than 3 mbps
5	5	Greater than 3 mbps and less than 6 mbps
6	6	Greater than 6 mbps and less than 10mbps
7	7	Greater than 10 mbps and less than 25 mbps
8	8	Greater than 25 mbps and less than 50 mbps
9	9	Greater than 50 mbps and less than 100 mbps
10	10	Greater than 100 mbps and less than 1 gbps
11	11	Greater than or equal to 1gbps

Middle Mile Serving Facility Codes:

Data Rates Code	Interconnection Point Data Rate
1	Multiple T1s and less than 40 mbps
2	Greater than 40 mbps and less than 150 mbps
3	Greater than 150 kbps and less than 600 mbps
4	Greater than 600 mbps and less than 2.4 gbps
5	Greater than 2.4 gbps and less than 10 gbps
6	Greater than or equal to 10 gbps

Figure 1 Reseller Outreach/Interview Form

Secure Broadband Provider Data Update Webportal

A secure web-based application for broadband service providers has been deployed to simplify and automate the semi-annual process for collecting and verifying data. The webportal provides an easy-to-use map redlining tool for updating a provider broadband service area and attributes. It is expected that the simplification and automation of the data collection process will increase participation and improve the timeliness of provider response, data accuracy and consistency. Providers are being encouraged to utilize this tool but data is still being accepted through other means and formats.



Figure 2 Provider Data Update Webportal Entry Page

The View/Edit Coverage Map functions via secure login/password and secured map services limit broadband providers to see and edit only their own data. Picklists of valid database attributes eliminates entry errors and create consistency. It also contains a workflow from initial provider input, saving of a provider's work-in-progress, provider formally submitting edits, aggregation into the master geodatabase, soliciting provider approval of aggregated data, and final approval of the edit.

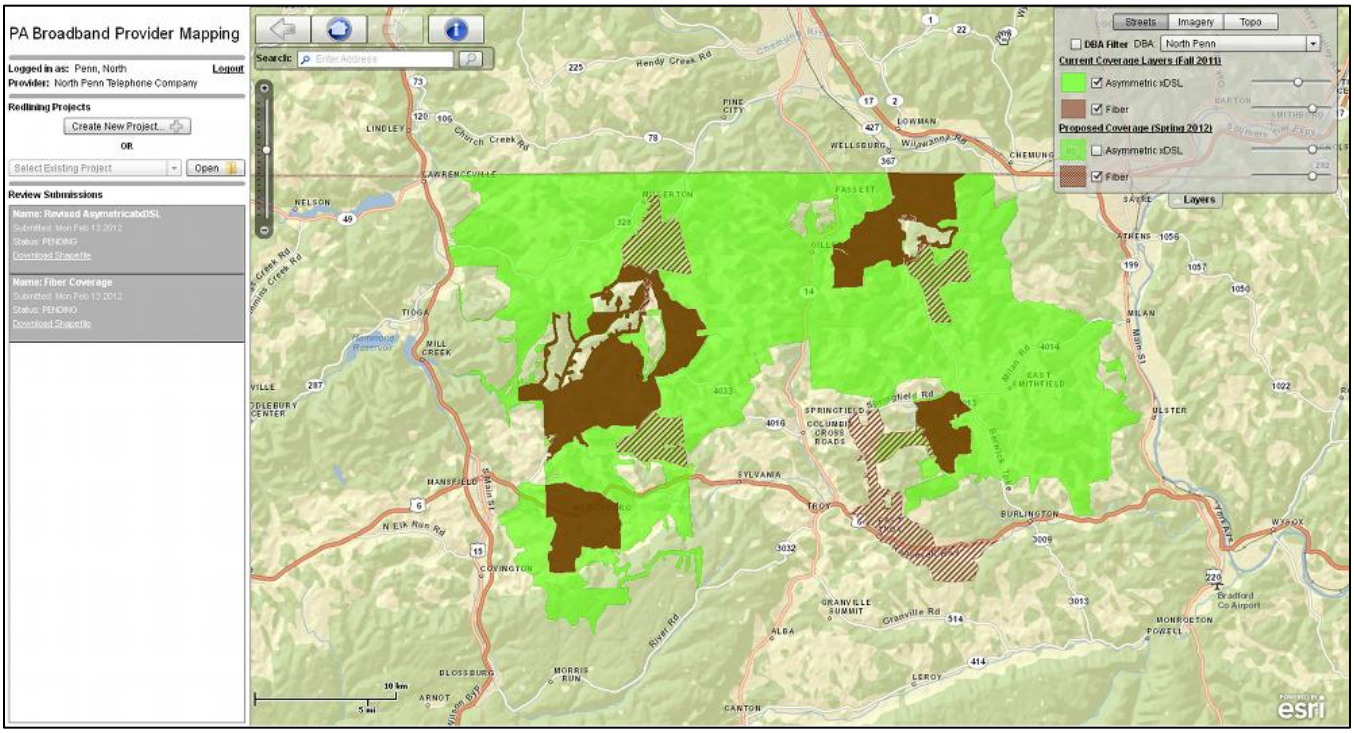


Figure 3 Provider Data Update Webportal –View/Edit Coverage Map Environment

Broadband Outreach Tracker Application

The Tracker application is utilized to collect all correspondence with providers and feedback on the effectiveness of the outreach activities by tracking items such as:

- The number and content of incoming e-mails and letters submitted from the providers
- The number and source of comments, questions, and suggestions made by providers
- The number and source of comments, questions, and suggestions made by attendees at provider meetings and conference calls
- Provider contact information and data submittal status.

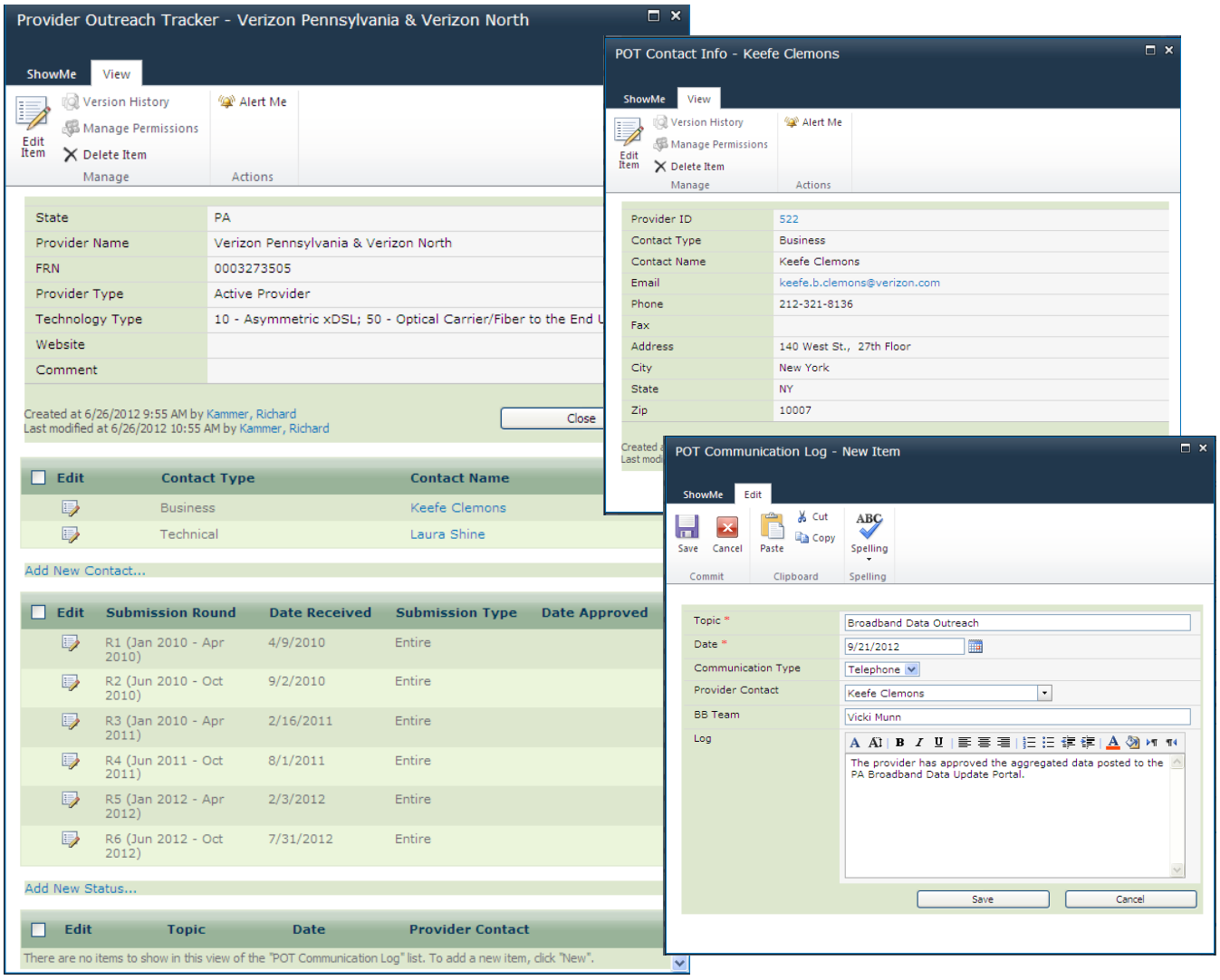


Figure 4 Broadband Outreach Tracker

Provider Submittal Validation

When a data submittal is received from a broadband service provider, it is updated in the Broadband Outreach Tracker and run through an initial validation process to assure that it meets the submittal guidelines.

Validation Checklist

The following items are part of this initial data validation process:

- Verify provider's transmittal letter requested in Data Submission Guideline with is complete and matches submitted data
- Verify the file naming conventions
- Verify each file is machine readable
- Verify data is in the correct GIS or Tabular format/file type
- Verify each field is populated and no empty or NULL values are present for mandatory fields
- Verify all ID (record number points) are unique within the submittal

- Verify all attribute data is formatted according to the submittal guidelines
- Verify topology for all geospatial submissions
- Verify Metadata for all submissions
- Verify the required contact information is included
- Verify adherence to Data Submittal Guidelines (see http://www.bakergis.com/PABroadbandProvider/ to access Data Submittal Guidelines)
  Broadband Service Availability (at least one)
  - Individual Street Addresses (Sec 3.1 & 4.1)
  - Census Blocks < 2 sq mi (Sec 3.3 & 4.3)
  - Street Segments for Census Blocks > 2 sq mi (Sec 3.2 & 4.2)
  - Service Overview (Sec 3.4 & 4.4)
  - Polygonal Boundary Area(s) (Sec 3.8 & 4.8)

  Middle-mile Points (Sec 3.5 & 4.5)
  Community Anchor Institutions (Sec 3.7 & 4.7)
  Last Mile Connection Points (Sec 3.6 & 4.6)
  WISP Antennas (Sec 4.9)

Data Usability Determination

The validation results are evaluated by the outreach and aggregation persons to determine the usability of the data. If the data meets the submission specifications, it is forwarded on for data aggregation. If it is determined to be unusable, it is returned to the provider for resolution. If the data can be manipulated to get it into a usable format, it is manipulated as required, and then forwarded on for data aggregation.

SBI Data Development

Data from the providers may be submitted in various formats as defined in the Data Submittal Guidelines, or in some cases unspecified formats may be accepted to help facilitate provider participation. Depending on the format of the submitted data, it is processed through one of the following processes to upgrade it to the NTIA SBI data standards.

Spatial Data

After validation and any required manipulation of any spatial data submitted by the providers, it is georeferenced and simply loaded into the appropriate NTIA geodatabase feature class.

Address Data Geocoding

If not already in the standard address point template, the provider tabular address data is first loaded into that template. The data is then exported to a geodatabase table using the ArcGIS Conversion Tools. ArcGIS geocoding tools are then utilized geospatially locate the address points for the tabular records. Interactive address rematching is performed against two additional street centerline datasets as needed to increase geocoding matching results. The NTIA deliverable is the geocoded address point geodatabase table. The geocoded address points are also subsequently aggregated to the census block or road segment feature class for public web map display.

Census Block Aggregation

If not already in the standard census block template, the provider tabular census block data is first loaded into that template. The data is then exported to a geodatabase table using the ArcGIS Conversion Tools. The provider tabular census block records are then joined to the geodatabase 2010 U.S. Census Block. This join is performed as many times as necessary for multiple Trans Tech values for each Provider/Census Block combination. The NTIA deliverable is the census block geodatabase table.

If the list of census blocks contains blocks > 2 sq. miles then these blocks are used to select all the 2010 U.S. Census TIGER centerlines that intersect those blocks. The Census Block record data is aggregated to each Road Segment within the Census Block. This process is performed as many times as necessary for multiple Trans Tech values for each Provider/Census Block combination.

Road Segment Aggregation

If not already in the standard road segment template, the provider road segment data is first loaded into that template. The data is then exported to a geodatabase table using the ArcGIS Conversion Tools. If the provider submittal included graphic centerline segments, these are migrated into the delivery geodatabase along with the linked attribute records. If the provider submittal was tabular road segment records only, they are then joined to the geodatabase 2010 U.S. Census TIGER centerline feature class. This join is performed as many times as necessary for multiple Trans Tech values for each Provider/Road Segment combination. The NTIA deliverable is the road segment geodatabase table.

If the provider road segment data lie within census blocks <= 2 sq. miles then the road segment data is aggregated to the census block. This process is performed as many times as necessary for multiple Trans Tech values for each Provider/Road Segment combination. The NTIA deliverable is the road segment geodatabase table.

Overview Data Aggregation

Provider Service Availability Areas submitted for entire county areas are loaded into the NTIA geodatabase Overview table. If not already in the standard template, the provider data is first loaded into that template. The data is then exported to a geodatabase table using the ArcGIS Conversion Tools. The provider overview records are then joined to the geodatabase 2010 U.S. Census County feature class. This join is performed as many times as necessary for multiple Trans Tech values for each Provider/County Area combination.

Polygonal Boundary Aggregation/Integration

Providers submitting polygonal service area data are handled in two ways. Wireline Provider data is aggregated to the census block feature class for areas where census blocks <= 2 sq. mi., or road segment feature class for areas where census blocks > 2 sq. mi. Wireless Provider Service Availability Areas submitted by polygonal area are simply loaded into the NTIA geodatabase Poly_Bndry feature class.

Wireline Provider

The polygonal data is georeferenced and loaded into the Poly_Bndry feature class. The polygon is then attributed, manually if necessary. Depending on the area, census blocks < or => 2 sq. mi., a selection set of either

census blocks or road segments that intersect the polygon boundary is created. The attributed polygon boundary is then joined with census blocks or road segments table to attribute accordingly. This join is performed as many times as necessary for multiple Trans Tech values for each Provider/County Area combination. The NTIA deliverable is the census block or road segment geodatabase table.

Wireless Provider

The polygonal data is georeferenced and loaded into the Poly_Bndry feature class. The polygon is then attributed, manually if necessary. Multiple Poly_Bndry records are created for multiple Trans Tech values for each provider. The NTIA deliverable is the polygon boundary geodatabase table.

Middle/Last Mile Data Integration

If not already in the standard template, the data is first loaded into that template. The data is then exported to a geodatabase table using the ArcGIS Conversion Tools. The point features are geo-located utilizing the lat/long information provided. The NTIA deliverable is the middle or last mile geodatabase table.

Community Anchor Institution Integration

Providers supplied some Community Anchor Institution (CAI) data with the data submittals. But the majority of the data was collected from existing GIS Layers maintained by the Commonwealth of Pennsylvania, outreaching to CAIs through state agencies and their contacts, and having CAIs complete an online survey at http://www.bakerbb.com/pa_institution_survey/.

Provider CAIs

If not already in the standard template, the data is first loaded into that template. The data is then exported to a geodatabase table using the ArcGIS Conversion Tools. The point features are geo-located utilizing the lat/long information provided. Address data is used to geocode locations only when lat/long data is not provided.

Commonwealth CAIs

CAI shapefiles were provided through the Commonwealth's other geospatial efforts. The shapefiles were then exported to the NTIA geodatabase CAI feature class. Various sources for obtaining broadband information for the CAIs were utilized. Various state agencies provided some of the information, i.e. Pennsylvania Department of Education (PDE) provided tabular broadband information for schools, PDE provided tabular broadband information for libraries, and Pennsylvania State Police provided tabular broadband information for their facilities. A CAI data survey website was also deployed and the URL distributed by various state agencies to the CAI contacts. Data from all of these sources were then aggregated into the CAI geodatabase table for the NTIA deliverable.

Typical Speeds from Other Sources

Because not all providers are submitting the typical speed attribution with their data, a method to fill in the missing information has been developed using other sources. The method utilizes speed test data supplied through the FCC speed test information as well as from other speed test data that we are independently collecting. Business rules have been established so quality and realistic typical speeds are produced. In addition, the calculated typical speeds are compared against the Centris average speed verification data to be

certain that the calculated typical speeds are within reason. The end result is a more complete data submittal to NTIA.

Propagation Modeling

Fixed wireless broadband transmission is a diverse technology. Service may be transmitted over licensed and unlicensed spectrum, and delivered by larger corporate or smaller LLC business entities, many of which serve rural areas of the State. This diversity has resulted in varying levels of SBI participation including Providers that have:

- participated,
- refused to participate,
- wished to participate but lack adequate capabilities and/or tools, or
- supplied data of marginal accuracy

The NTIA's supplemental grant funding has provided the means to generate propagation models to supplement and validate the above scenarios. In addition, the NTIA has identified fixed wireless service coverages with unusual shapes for state grantee analysis.

To facilitate development of propagation mapping, additional tower/antenna information is being requested from fixed wireless broadband providers. For those providers not responding to requests for required tower/antenna information, an attempt is made to gather the information through 3rd party sources and field investigation. The Provider, 3rd party and/or field data is processed using Terrain Analysis Package (TAP) software to develop propagation models. Maps of the resultant propagation study are sent to the fixed wireless providers for their feedback on the propagation model produced for their company.

Data Verification Summary

Pennsylvania's broadband mapping project employs a multi-prong approach to ensure the provider data is accurate and complete.

In summary, the project employs the following validation methodologies and resources:

- Provider Validation
- Data Validation via Market Intelligence Sources
- Data Validation Using State Supplied Data Points
- Field Validation
- Wireless Coverage Analysis
- Topology Validation
- Automated Validation Processing
- Confidence Level/Statistical Modeling
- SBDD Check Submission
- Stakeholder Validation

The remainder of this verification section describes the various methods in greater detail.

Provider Validation

After data development, service availability maps are generated and submitted to the providers to validate their mapping results. This provides a "sign off" on the interpretation of the submitted data and extends the outreach efforts by providing a visual representation of the data to be delivered to the State and the NTIA.

Types of Provider Maps

Provider maps generally consist of the following types.

Outreach Maps

Often, providers will send data which does not contain all the information needed for a NTIA compliant dataset. In such cases, as an aid to the outreach communication, it may be necessary to produce a map to help the provider locate their service area or verify data they have provided. These maps may take many forms, but generally are of two types:

- General Location Maps – these maps are often produced when the provider does not have a list of address or other standard submittal data and needs help defining their service area. A typical map will show counties, major roads, and towns of the general area the provider has stated as their service area. The intent of the map is to give the provider a way to markup or delineate their service area. If a provider has not provided required attribute information such as Technology of Transmission, Speed Data, etc. then it may be necessary to add a visual clue to this data like an information stamp on the map that they can easily fill out. If the provider sends the map back with a service area boundary, this can then be digitized and sent back to the provider for verification.
- Verification of Provider Supplied Boundaries – these maps are produced when the provider has sent service area boundary information which is confusing or otherwise unclear. Often these are produced when providers send CAD maps, hand drawn maps that need digitization, or lists of zip codes or counties served. A typical map will place the interpreted boundary over a location map so the provider can verify the service area. As with the General Location Map, information stamps or other visual clues may be placed on the map.

Initial Verification Maps

Once the provider data has been processed and the census block and road segment feature classes created, an Initial Verification Map (Figure 5) is produced to give the provider a visual representation of their service area by census block. These maps enable the provider to verify their service area and make changes if necessary. Initial Verification Maps are produced using a set of standards and produced at the highest resolution necessary to convey the map information to the provider. Initial Verification Maps are also produced for Wireless Polygon areas.

Detailed Verification Maps

Providers who have questions about their service areas may request additional information to help clarify issues. In these cases, it may be necessary to create a Detailed Verification Map to highlight the areas in question.

Detailed Verification Maps provide the same information as Initial Verification Maps only at a higher resolution. Several maps may be needed to accurately portray an area in question.

Revised Maps

Revised maps take two forms:

Initial or Detailed Verification Maps which have been annotated or marked-up by the provider
Outreach produced Initial or Detailed Verification Maps incorporating provider changes

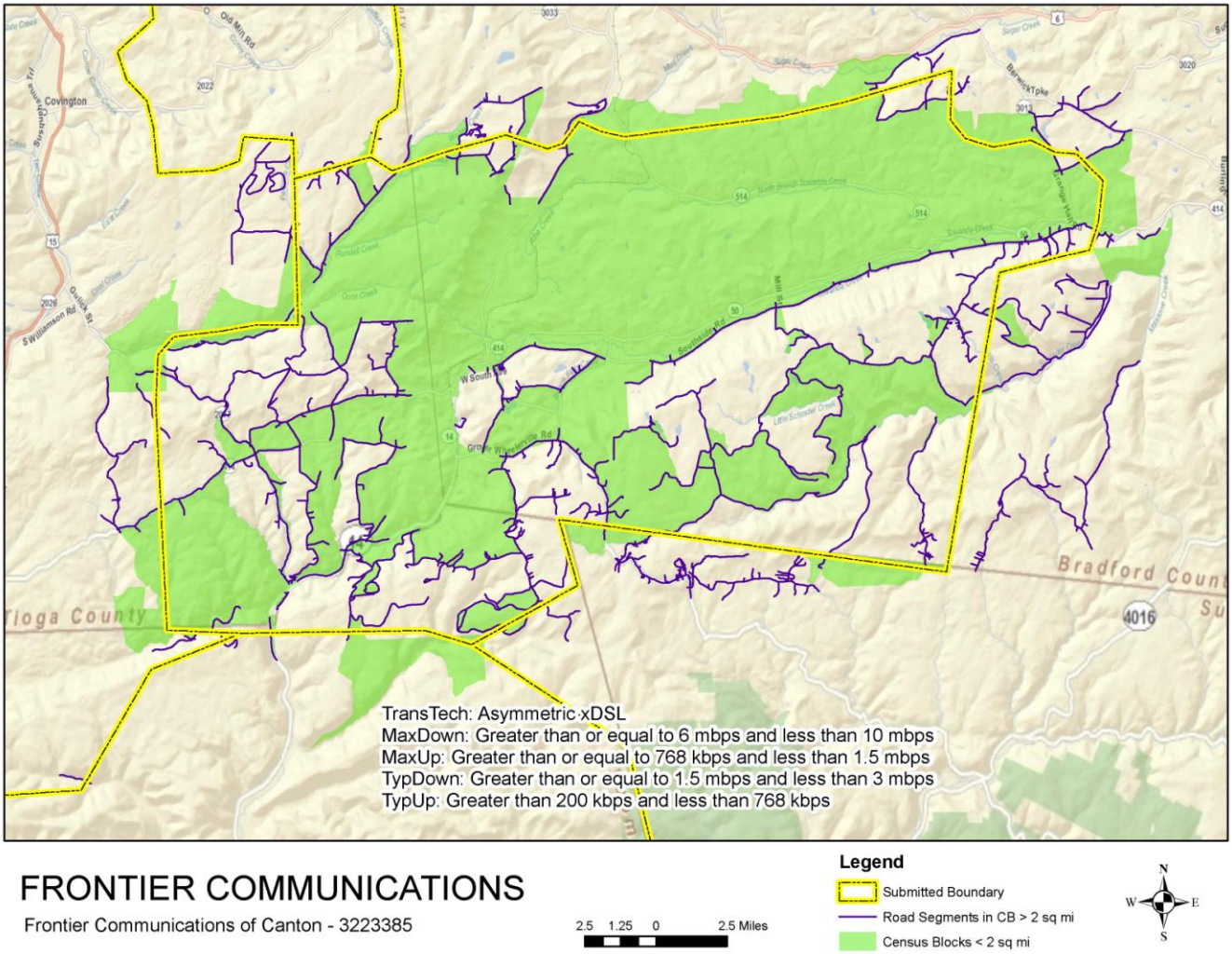


Figure 5 Provider Map

Data Validation

A critical component of the project is the validation of the data submitted by the broadband service providers. Data from various sources, as described in more detail in the following sections, is utilized to develop a level of confidence in the data received from the broadband providers.

Validation Data Set Collection and Development

This validation process employs data sets developed or acquired from different sources as described in the following sections.

Provider Feedback Loop: Maps of completed provider service areas and data are furnished back to the providers for confirmation of the processed/aggregated information. Feedback is integrated into the each provider's dataset.

Telogical Systems Wireline Market Intelligence Data: This commercially available dataset was developed using a methodology that incorporates deep web crawling and additional means, including direct mail harvesting and advertising collaterals (including door to door) to gather cable and telecommunication provider information. This dataset is used as a validation source for wireline provider service area coverage, Technology of Transmission, and Speed.

American Roamer Wireless Market Intelligence Data: This commercially available dataset is used as an independent source to verify information submitted by providers of wireless broadband service. This dataset is used as a validation source for wireless provider service area coverage.

Prior Commonwealth Broadband Mapping Dataset: Under the requirements of the Commonwealth's Act 183 of 2004 legislation, broadband coverage data was previously collected by the Commonwealth. These datasets are used as a validation source for provider service area coverage and Technology of Transmission.

FCC Speed Test: The FCC speed test data includes the IP addresses for each specific speed test conducted. This IP address is queried against a web search engine to determine the provider assigned to that address and is used as a validation source for the provider service coverage and typical speeds.

Fixed Wireless Line of Sight Analysis: Utilizing the existing PAMAP LiDAR for topography generation and determining tower/antennae heights, line of sight analysis is performed to determine areas of reported fixed wireless broadband coverage that is questionable.

Field Data Acquisition: Broadband technicians visited a sampling of census block locations to gather broadband data to be used for validation. The following criteria were taken into account when developing the census block sampling dataset:

urban vs. rural census block characteristic
censes block grouping
land vs. water census block characteristic

The overarching mission of the Federal broadband stimulus program is to expand Broadband service to areas that are currently unserved and underserved. Also, the market intelligence validation sources typically represent some rural, but more urban areas. Thus, our field data collection efforts were targeted more towards the rural areas; split 90% rural, 10% urban.

Additionally, a study by Penn State University (Glasmeier 2002) notes that a large number of census block groups typically fit within any given cable or telephone company service areas. Therefore, our field sample was also based on selection of one census block per block group and a land mass greater than 50% to avoid field

visiting areas covered mostly by water. There are a total of 10,387 block groups in PA. Using a statistical sample size calculator based upon the number of block groups in the state and +/- 4% margin of error at a 95% confidence level, the sample size is 568 census block locations statewide. The procedure for selecting the calculated field verification census blocks is provided below.

Select one census block per census block group
Convert the census block groups polygon to label points.
Select the census block polygon by doing a spatial selection using census block groups label points.
Select from the current selection where the census block land mass is 50% or greater and the block is rural.
Export the selected blocks to a new shapefile. This reset the FID for the next step.
Select every 2nd, 3rd, 4th, or so on to get the desired number of blocks. Query used to select: MOD("FID",2) = 0. This will select every other record.

The planned census block field locations are shown in Figure 6.

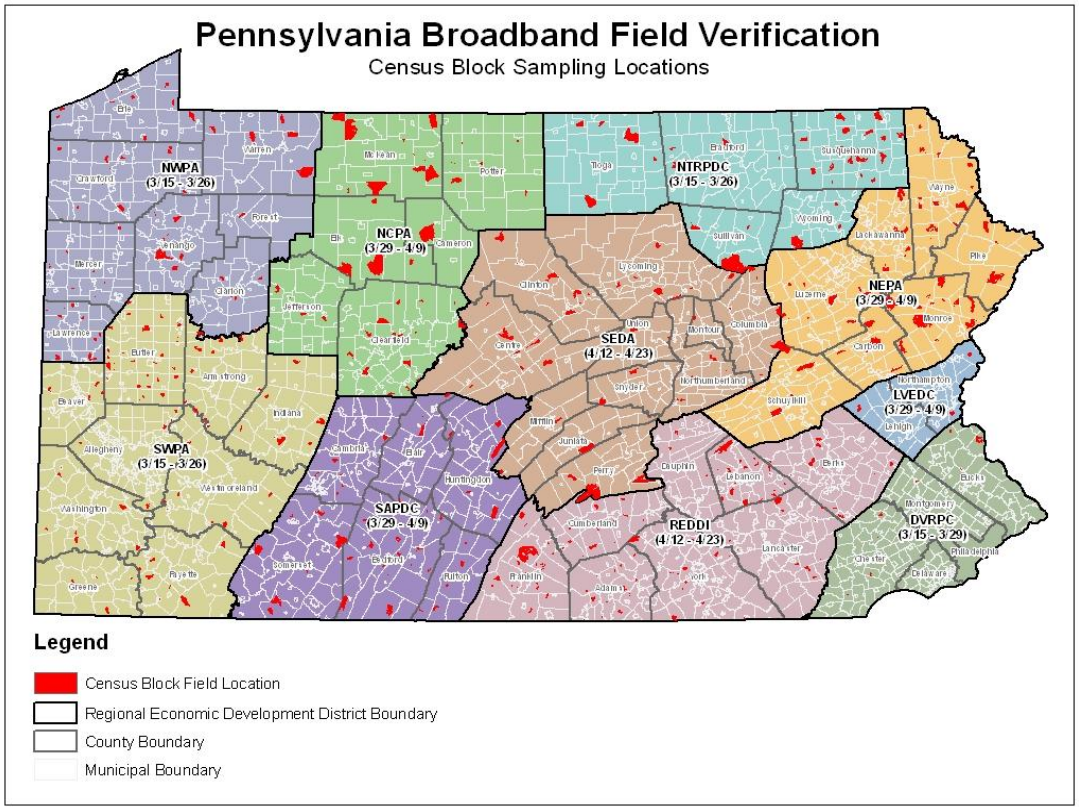


Figure 6 Planned Field Verification Census Block Locations

For each census block in the sample set, broadband technicians collected data using Panasonic Toughbook computers, loaded with MapPoint mapping software, and a customized Microsoft Access data collection form with the ability to automatically import GPS coordinates. The sample census blocks were pre-loaded and directly accessible from MapPoint. Two types of data collection were conducted (infrastructure observation and wireless speed testing) and the results were recorded and linked to the corresponding field location coordinates

within the designated sample census block. The information collected by the field broadband technicians includes:

Wireline:

GPS coordinates
circuit infrastructure feeding the area (copper, fiber, cable)
local distribution hut equipment inspection, where allowed/possible
witness access circuit speed tests, where allowed/possible
facility elevation (measurement relative to grade), where allowed/possible
distance from DSLAM measurement where applicable and determine access speed capability with an accuracy within 500ft using mapping software
collect site pictures

Wireless:

GPS coordinates
internet speed test

The map in Figure 7 shows the locations (blue points) of the census block field surveys that were performed.

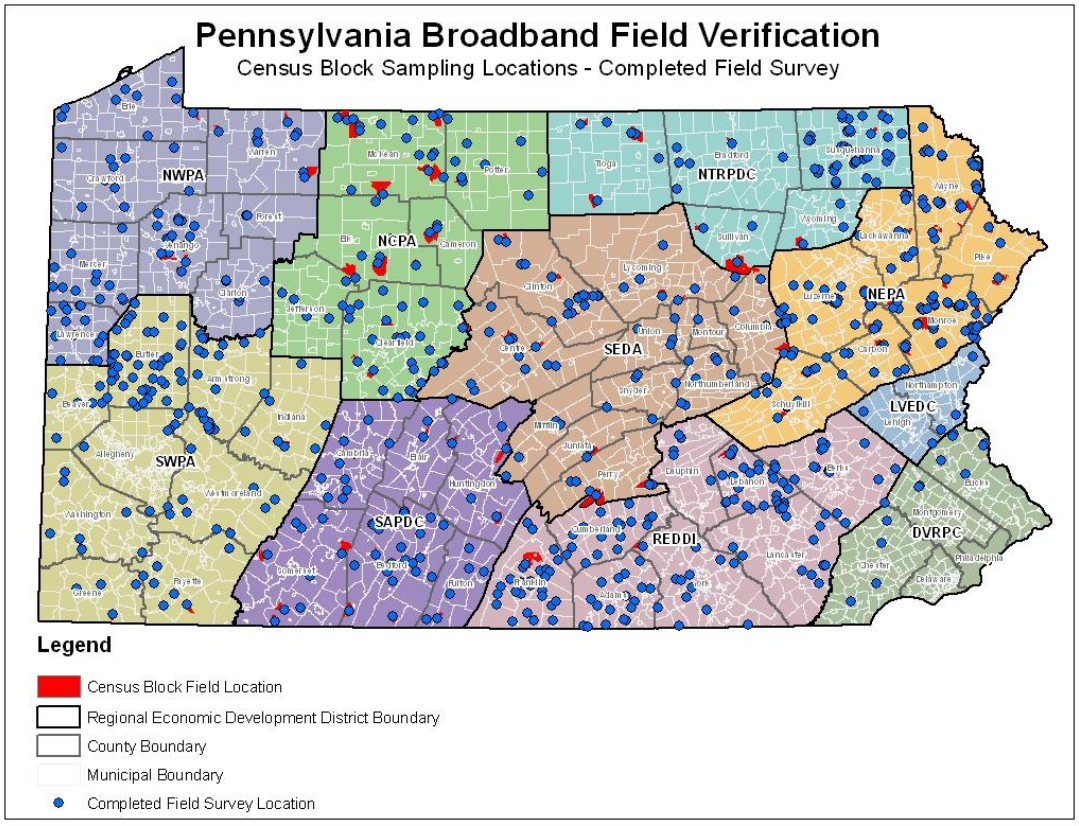


Figure 7 Completed Field Verification Locations

For the 568 census blocks that were visited, 2821 individual wired/wireless data elements were recorded and 3666 pictures were taken at those locations. This field collected dataset is used as a validation source primarily for wireline and wireless technology of transmission, middle mile, and wireless speed.

Provider Data Validation Process

Provider Feedback Loop: Feedback received from the providers is visually inspected and integrated directly in the mapping GIS database.

Service Area Validation Data: The Telogical wireline service area data is tabular and contains a separate record for each provider/technology of transmission combination with an associated census block or TIGER road segment, depending on the whether the size of the census block area (=/< or > 2 sq. mi.). This data is exported into an ArcGIS data format. The American Roamer wireless service area data is already in and ArcGIS data format. The validation data is then joined to the provider service area data by census block or TIGER road segment ID. Any database records in the provider or validation tables that cannot be joined are output to a separate layer that indicates the areas of discrepancy between the two datasets. The joined tables are then queried to detect any speed discrepancies which are also output to a separate discrepancy layer.

Field Validation Data: The field data are also collected in tabular database format, and represent a specific lat/long spatial location for each record. This data is also exported into an ArcGIS data format, joined to the provider data, queried to validate pertinent attribution. Again, records not joined and/or with detected attribution discrepancies are output to separate GIS layers.

Topology: The ArcGIS Validate Topology Tool is used to flag any topology issues in the broadband data. Flagged issues are reviewed to identify false positives and update true errors as required.

SBI Check Submission: The NTIA-provided SBI Check Submission tool is utilized to validate that the deliverable broadband data is consistent with the business logic rules set forth by the NTIA and a passing receipt is provided with the data submittal to NTIA.

Stakeholder Feedback: The state broadband mapping website includes a feedback function. Comments received from stakeholders such as the regional Economic Development Districts and the public are reviewed and used to validate the provider data submissions.

Validation and Confidence Level Reporting

To facilitate validation and confidence level reporting, Baker deployed a validation application called Statistical Evaluation and Assessment System (SEAS) which automatically compares the multiple independent validation datasets against the broadband service providers' supplied information. The SEAS application uses statistical methodologies to report the confidence level in the spatial and attribute accuracy of the information. Appendix B shows the validation workflow.

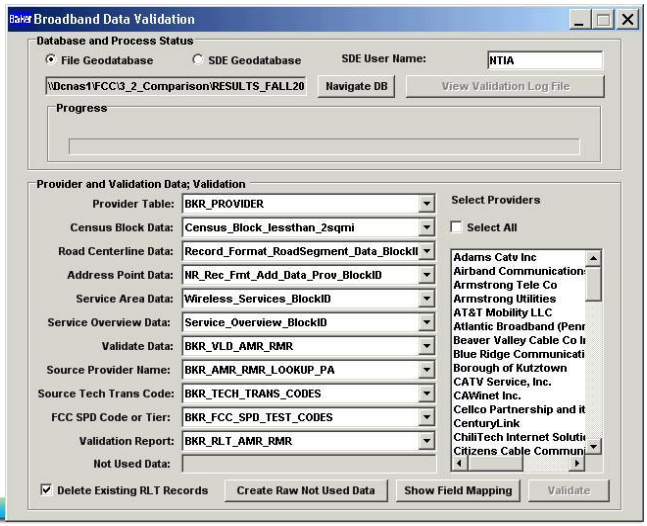


Figure 8 SEAS

The SEAS comparison is a three-part validation process:

Comparison of the collected validation source against the aggregated broadband provider data.
Match percentage calculation for each provider reported in the DataPackage.xls, "Provider Table" tab, "Comments" column.
Confidence score calculation displayed on the state broadband website.

After completing all validation data source collections, SEAS is used to automatically compare the multiple validation datasets against the aggregated broadband data which came from the providers. Through the SEAS accumulation table, it produces a match percentage per broadband service record based upon the number of matches that record has against each validation source. The matched percentage for each record is the result of the total count of the matched validations for the record divided by the total validation source being compared against the record. Validation confidence rating/score is assigned on a scale of 1 to 5 based upon the percentage of validation source matches as per the following score results:

1 Star = 0% - 19% Match
2 Stars = 20% - 39% Match
3 Stars = 40% - 59% Match
4 Stars = 60% = 79% Match
5 Stars = 80% - 100% Match
"No Analytics" = No validation source available for that provider

The Commonwealth's public broadband mapping website (www.broadbandinpa.com) is updated with the confidence level results at the record level based upon the queried geographic location and the following shows an example of this representation.

Provider Name	Transmission Technology	Max Download Speed	Max Upload Speed	Confidence Score
AT&T Mobility	Mobile Wireless	Greater than or e…	Greater than or e…	★★★☆☆
Verizon	Asymmetric xDSL	Greater than or e…	Greater than or e…	NO ANALYTICS
Comcast	Cable Modem – Other	Greater than or e…	Greater than or e…	★★★★☆

The matched percentage for the records for each provider are summarized and then divided by the total count of the records to create the final matched percentage for the specific provider. These percentages are included in DataPackage.xls on the Provider Table tab in the Comments column.

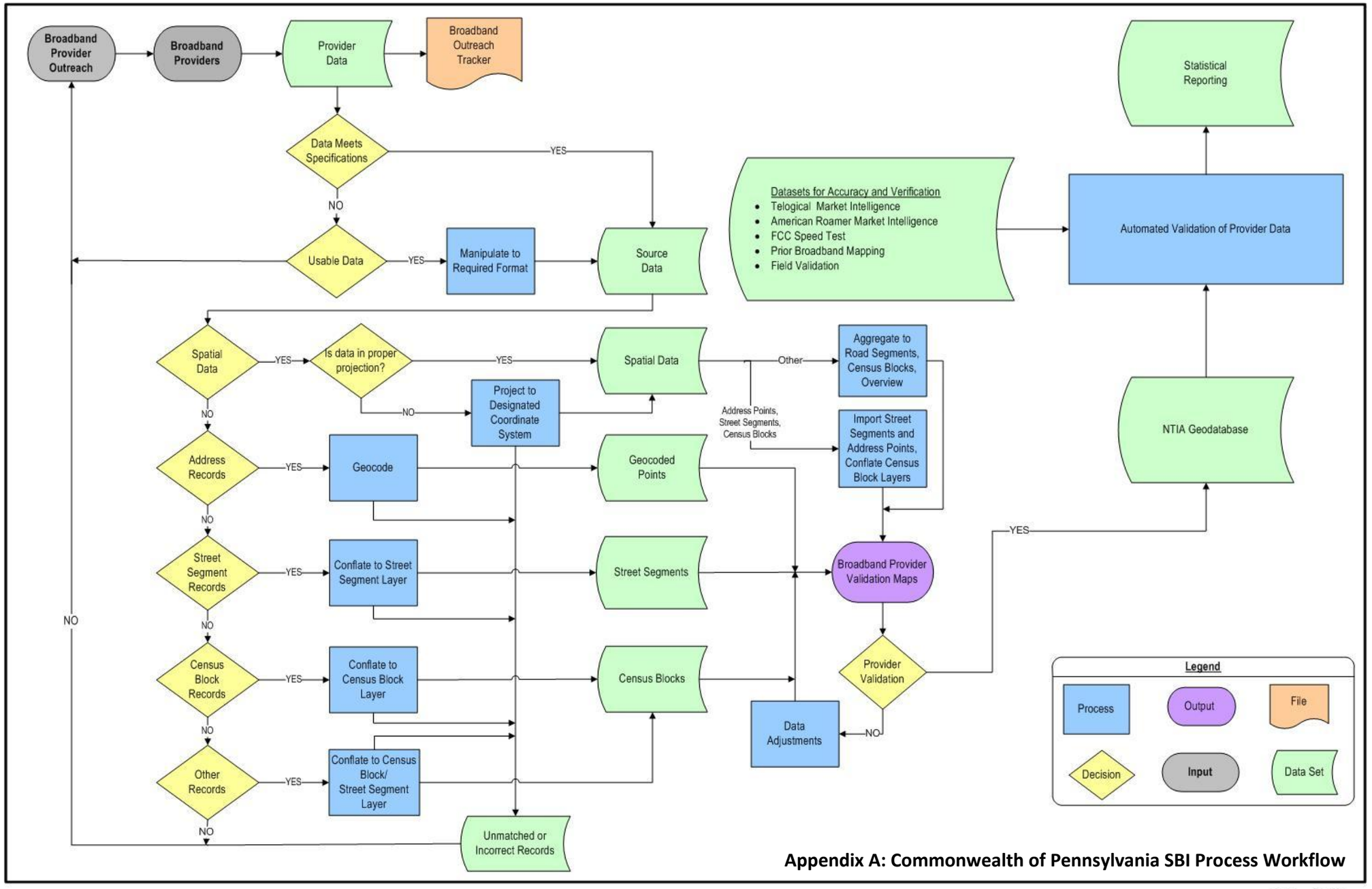
Low Confidence Provider Feedback

Provider data which is assigned a low confidence (1 or 2 stars) through the SEAS process is communicated back to the provider through a feedback loop. Generally, the low confidence feedback and reconciliation is a continuous refinement process and usually occurs between update cycles. The goal is to provide this feedback

through the Provider Data Update Webportal via a web connection that is available and rolled out to providers in January 2012.

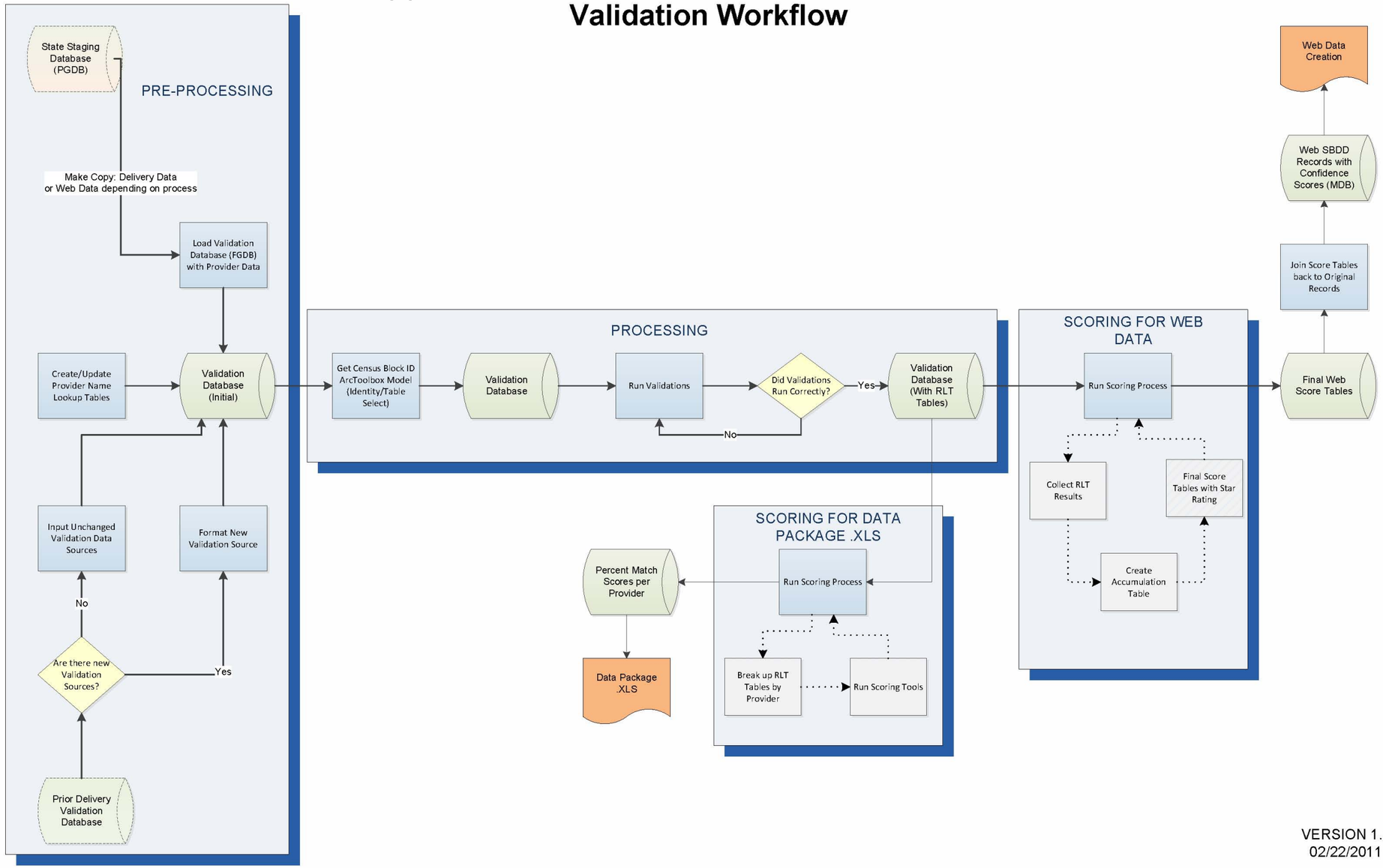
Changes and Corrections Documentation

With each semi-annual NTIA data submittal, changes and corrections documentation is provided. Significant changes in a provider's status or data, corrections to previously supplied data, providers supplying data for the first time, etc. are specified by Provider name in the Changes and Corrections document.



Appendix A: Commonwealth of Pennsylvania SBI Process Workflow

Appendix B: State Broadband Data Validation Workflow



VERSION 1.1
02/22/2011

Appendix C: Master Outreach List

Filing Company DBA	Filing Company Name	Status
21st Century Resoration & SLS		Not a Broadband Provider or Reseller
2s Graphic Design Inc.		Not a Broadband Provider or Reseller
A P Wireless		Not a Broadband Provider or Reseller
AboveNet		Not a Broadband Provider or Reseller
Access Northeast		Not a Broadband Provider or Reseller
Al's Satellite		Not a Broadband Provider or Reseller
Alteva Communications		Not a Broadband Provider or Reseller
Altius Broadband		Not a Broadband Provider or Reseller
Antietam Cable		Not a Broadband Provider or Reseller
bedford.net		Not a Broadband Provider or Reseller
BurstNET		Not a Broadband Provider or Reseller
Buytelco, Inc.		Not a Broadband Provider or Reseller
Charter Internet		Not a Broadband Provider or Reseller
CIMCO Communications, Inc.		Not a Broadband Provider or Reseller
Cincinnati Bell Inc.		Not a Broadband Provider or Reseller
Citynet Holdings, LLC		Not a Broadband Provider or Reseller
Clearview Partners		Not a Broadband Provider or Reseller
Community TV Systems Inc		Not a Broadband Provider or Reseller
Computer Central		Not a Broadband Provider or Reseller
Cpudirect Networks, LLC		Not a Broadband Provider or Reseller
Detwiler Communications Inc (Detwiler Golden Rule Communications, Inc.)		Not a Broadband Provider or Reseller
A P Wireless		Not a Broadband Provider or Reseller
Access Northeast		Not a Broadband Provider or Reseller
Airespring, Inc.		Not a Broadband Provider or Reseller
American Digital Online Services, Inc. (ADOS)		Not a Broadband Provider or Reseller
Budget Prepay, Inc. D/B/A Budget Phone, Inc.		Not a Broadband Provider or Reseller
Cablesat		Not a Broadband Provider or Reseller
Charter Internet		Not a Broadband Provider or Reseller
Cyberonic Internet Communications, Inc.		Not a Broadband Provider or Reseller
Digital Connections, Inc.		Not a Broadband Provider or Reseller
DISH		Not a Broadband Provider or Reseller
DSLBroker.com		Not a Broadband Provider or Reseller

Filing Company DBA	Filing Company Name	Status
Dubois Communications Inc		Not a Broadband Provider or Reseller
Ducom, Inc.		Not a Broadband Provider or Reseller
EA Media		Not a Broadband Provider or Reseller
East Palestine Internet		Not a Broadband Provider or Reseller
Easton Telecom Services		Not a Broadband Provider or Reseller
Eduro Networks, LLC		Not a Broadband Provider or Reseller
Entelegent Solutions, Inc.		Not a Broadband Provider or Reseller
EZLinx (NEPAdata.com Ventures, LLC)		Not a Broadband Provider or Reseller
Farber Technology		Not a Broadband Provider or Reseller
Global Crossing North America, Inc		Not a Broadband Provider or Reseller
Graybar Utility		Not a Broadband Provider or Reseller
Ground Control		Not a Broadband Provider or Reseller
Herr Cable		Not a Broadband Provider or Reseller
Hotwire Communications, Ltd.		Not a Broadband Provider or Reseller
International Broadband Electric Communications, Inc. (IBEC, Inc)		Not a Broadband Provider or Reseller
Internet Communications Inc.		Not a Broadband Provider or Reseller
ISP 1		Not a Broadband Provider or Reseller
JB Cable		Not a Broadband Provider or Reseller
Keystone Wireless, LLC d.b.a. Immix Wireless		Not a Broadband Provider or Reseller
Leading Edge Computer Services, Inc.		Not a Broadband Provider or Reseller
Leap Wireless International, Inc.		Not a Broadband Provider or Reseller
Lebanon MobileFone		Not a Broadband Provider or Reseller
LightEdge Solutions, Inc.		Not a Broadband Provider or Reseller
Line Systems, Inc.		Not a Broadband Provider or Reseller
Losch Internet Services		Not a Broadband Provider or Reseller
Meriplex Communciations, Ltd		Not a Broadband Provider or Reseller
Metropolitan Telecommunications Holding Co / Netlogic, Inc.		Not a Broadband Provider or Reseller
Milestone Communications Inc		Not a Broadband Provider or Reseller
Millheim TV Transmission Company		Not a Broadband Provider or Reseller
MTT First (A/K/A MountainTop Technologies, Inc.)		Not a Broadband Provider or Reseller
Nauticom		Not a Broadband Provider or Reseller
Netrepid		Not a Broadband Provider or Reseller

Filing Company DBA	Filing Company Name	Status
OpenRange Communications		Not a Broadband Provider or Reseller
Optical Telecommunications Inc.		Not a Broadband Provider or Reseller
Optical Telecommunications Inc.		Not a Broadband Provider or Reseller
PAOnline Netrepid		Not a Broadband Provider or Reseller
PenTeleData Limited Partnership I		Not a Broadband Provider or Reseller
Philadelphia Cable TV Internet Phone		Not a Broadband Provider or Reseller
Phoenix Cable Incorporated		Not a Broadband Provider or Reseller
Pitcairn Community Cable		Not a Broadband Provider or Reseller
Presque Isle Technology Solutions		Not a Broadband Provider or Reseller
Presque Isle Technology Solutions		Not a Broadband Provider or Reseller
PulseAIR		Not a Broadband Provider or Reseller
Qualcomm (DBA MediaFLO)		Not a Broadband Provider or Reseller
Qwest Communications International dba Qwest Communications Company, LLC		Not a Broadband Provider or Reseller
Reliance Globalcom Services, Inc. (Yipes Communications Group, Inc.)		Not a Broadband Provider or Reseller
Retel TV Cable		Not a Broadband Provider or Reseller
Satellite Internet Broadband		Not a Broadband Provider or Reseller
SCR Online		Not a Broadband Provider or Reseller
Self Service America, discount ISP		Not a Broadband Provider or Reseller
Snip Link LLC		Not a Broadband Provider or Reseller
Southside TV (Southside Television Association)		Not a Broadband Provider or Reseller
Stage 2 Networks, LLC		Not a Broadband Provider or Reseller
Sunset Net		Not a Broadband Provider or Reseller
Telovations, Inc.		Not a Broadband Provider or Reseller
tw telecom inc.		Not a Broadband Provider or Reseller
UHP Wireless Networks		Not a Broadband Provider or Reseller
USA Digital Communications		Not a Broadband Provider or Reseller
Valley Cable Systems		Not a Broadband Provider or Reseller
Ward Communications		Not a Broadband Provider or Reseller
Wavecrazy		Not a Broadband Provider or Reseller
Westfield Community Antenna Assoc.		Not a Broadband Provider or Reseller
Whitefence		Not a Broadband Provider or Reseller
WinBeam (Northwest Infonet)		Not a Broadband Provider or Reseller

Filing Company DBA	Filing Company Name	Status
Your Internet Services		Not a Broadband Provider or Reseller
Zampelli Electronics		Not a Broadband Provider or Reseller
ACC Business	AT&T	Other
CLEAR	Affiliate of Clearwire	Other
Fisk Internet Services, LLC	Getwireless.net, Inc.	Other
Jefferson County Cable	Blue Devil Cable TV, Inc.	Other
Pencor Services, Inc. (PenTeleData)	Blue Ridge Communications	Other
Susquehanna Communications	Comcast Cable Communications, LLC	Other
American Telecharge, Inc.		Potential
BackWoods Wireless		Potential
BCN Telecom, Inc.		Potential
BetterWorld Telecom, LLC		Potential
Broadband Dynamics, LLC D/B/A Diversified		Potential
Broadstar, LLC		Potential
Broadvox		Potential
Business Automation Technologies, Inc. d/b/a Data Network Solutions		Potential
Cellular One of NEPA (Northeast Pennsylvania)		Potential
Cooperative Communications, Inc.		Potential
Country Cable TV		Potential
Covista Communications, Inc.		Potential
CS Technologies Plus		Potential
cyberMIND		Potential
DSCI Corporation		Potential
DSLOPTIONS		Potential
DynaLink Communications, Inc.		Potential
Easton Telecom Services		Potential
EasyStreet Online Services		Potential
Ernest Communications, Inc.		Potential
FSN Broadband LP		Potential
ICDC Wireless Inc.		Potential
Interglobe Communications, Inc.		Potential
Interlync Internet Services, Inc.		Potential
LaunchNet		Potential
Layer Four Solutions, LLC		Potential

Filing Company DBA	Filing Company Name	Status
LocalNet Corp		Potential
Master Vision Cable		Potential
Pennsylvania Cable Network		Potential
Prescient Worldwide		Potential
Purecom		Potential
SureWire Internet		Potential
Surf Erie Internet Services		Potential
Adams Cable Service	Adams Catv Inc	Provider
Airband Communications, Inc.	Airband Communications, Inc.	Provider
Armstrong Telephone - North (Duke Center)	Armstrong Tele Co	Provider
Armstrong Telephone- PA (Clinton Area)	Armstrong Tele Co	Provider
Armstrong Utilities	Armstrong Utilities	Provider
AT&T Corp, Inc.	AT&T Corp, Inc.	Provider
AT&T Mobility LLC	AT&T Mobility LLC	Provider
Atlantic Broadband	Atlantic Broadband (Penn), LLC	Provider
Beaver Valley Cable	Beaver Valley Cable Co Inc.	Provider
Bentleyville Communications Corporation	FairPoint Communications	Provider
Blue Devil Cable	Blue Devil Cable TV, Inc.	Provider
Blue Ridge Communications	Blue Ridge Communications	Provider
Broadview Networks Holdings, Inc.		Provider
Brockway Tv Inc		Provider
CABLEVISION	CSC HOLDINGS, INC	Provider
CATV Service	CATV Service, Inc.	Provider
CAWinet	CAWinet, Inc.	Provider
CenturyLink	CenturyTel, Inc.	Provider
ChiliTech Internet Solutions, Inc.	ChiliTech Internet Solutions, Inc.	Provider
Citizens Cable Communications	Citizens Cable Communications	Provider
Citizens of Kecksburg	Citizens of Kecksburg	Provider
Clarity Connect, Inc.	Clarity Connect, Inc.	Provider
Clear.com	Clearwire Corporation	Provider
Coaxial Cable Tv Corp	Coaxial Cable Tv Corp	Provider

Filing Company DBA	Filing Company Name	Status
Cogent Communications, Inc.	Cogent Communications, Inc.	Provider
Comcast	Comcast Cable Communications, LLC.	Provider
Consolidated Communications	Consolidated Communications	Provider
Conterra Ultra Broadband, LLC	Conterra Ultra Broadband Holdings, Inc.	Provider
CONXX	CONXX	Provider
Covad Communications Company	DIECA Communications, Inc.	Provider
Cricket Communications, Inc.	Leap Wireless International, Inc.	Provider
DBSi		Provider
Deposit Telephone Company, Inc.	TDS TELECOM	Provider
DirecTV		Provider
EagleZip.com	EagleZipCom LLC	Provider
Evenlink		Provider
Fibertech	Fiber Technologies Networks, L.L.C.	Provider
Frontier Communications	Frontier Communications	Provider
Frontier Communications of Breezewood	Frontier Communications	Provider
Frontier Communications of Canton	Frontier Communications	Provider
Frontier Communications of Oswayo	Frontier Communications	Provider
Full Service Computing Corp		Provider
Gap CableTV	Gap CableTV	Provider
Getwireless.net, Inc.	Getwireless.net, Inc.	Provider
Hancock Telephone Co	Hancock Telephone Co	Provider
Hickory Telephone Company	Hickory Telephone Company	Provider
Hometown Utili-com	Borough of Kutztown	Provider
HughesNet	Hughes Communications, Inc.	Provider
Hydrosoft Internet		Provider
ICON Technologies Inc.		Provider
Innernet, Inc.		Provider
Ironton Telephone Co	Ironton Telephone Co	Provider
KCnet	Keystone Community Network, Inc.	Provider

Filing Company DBA	Filing Company Name	Status
Kuhn Communications	Kuhn Communications	Provider
Lackawaxen Telephone Co	Lackawaxen Telephone Co	Provider
Lantek	Lantek	Provider
Laurel Highland Telephone Company	Laurel Highland Telephone Company	Provider
Level 3 Communications, LLC	Level 3 Communications, LLC	Provider
Lumos Networks (Formerly Ntelos Media)		Provider
Mahanoy & Mahantango Telephone Company	TDS TELECOM	Provider
Marianna and Scenery Hill Telephone Company	FairPoint Communications	Provider
MetroCast Communications	Gans Communications, LP	Provider
Navpoint Internet		Provider
Netcarrier Telecom, Inc.	Netcarrier Telecom, Inc.	Provider
Netconex		Provider
Nitel, Inc.		Provider
Nittany Media, Inc.		Provider
Noroc Broadband	Noroc Broadband LLC	Provider
North Penn	North Penn	Provider
Northeastern Telephone	Northeastern Telephone	Provider
One Communications	One Communications	Provider
PaCLEC Corporation		Provider
PAETEC Communications, Inc.	PAETEC Communications, Inc.	Provider
Palmerton Telephone Co	Palmerton Telephone Co	Provider
Pennsylvania Telephone Co	Pennsylvania Telephone Co	Provider
PulseNet		Provider
Pymatuning Indep. Tel. Company	Pymatuning Indep. Tel. Company	Provider
QCOL, Inc	QCOL, Inc	Provider
Raystown Wireless		Provider
RCN Telecom Services of Philadelphia, Inc.	RCN and RCN Business Services	Provider
RCN Telecom Services, Inc.	RCN and RCN Business Services	Provider

Filing Company DBA	Filing Company Name	Status
Service Electric Cable TV, Inc.	Service Electric Cable TV, Inc.	Provider
Service Electric Cablevision, Inc.	Service Electric Cablevision, Inc.	Provider
Shen-Heights TV Associates, Inc.	Shen-Heights TV Associates, Inc.	Provider
Sidera Networks	Sidera Networks, LLC	Provider
Skycasters	Skycasters, LLC	Provider
SkywayUSA	Skyway	Not a Broadband Provider or Reseller
Smoothstone IP Communications		Provider
South Canaan Telephone Company	South Canaan Telephone Company	Provider
Sprint	Sprint Nextel Corporation	Provider
StarBand Communications Inc.	StarBand Communications Inc.	Provider
StarLinX	StarLinX	Provider
StarTec Global Communications		Provider
Sti Wireless		Provider
Sting Communications	Sting Communications	Provider
Sugar Valley Telephone Company	TDS TELECOM	Provider
Tele-Media	Tele-Media Company of Zion, LLC	Provider
Telnes Broadband		Provider
TIME WARNER CABLE	TIME WARNER CABLE LLC	Provider
T-Mobile	T-Mobile USA, Inc.	Provider
Towerstream Corporation		Provider
Transbeam Inc.		Provider
U.S. Cellular		Provider
Usa Choice Internet Services Company, Llc	Usa Choice Internet Services Company, Llc	Provider
Venus Telephone Corporation	Venus Telephone Corp.	Provider
Verizon Pennsylvania Inc.	Verizon Pennsylvania Inc.	Provider
Verizon Wireless	Cellco Partnership and its Affiliated Entities	Provider
ViaSat, Inc. (formerly WildBlue Communications, Inc.)	ViaSat, Inc.	Provider
Wave2Wave Communications	Wave2Wave Communications, Inc.	Provider

Filing Company DBA	Filing Company Name	Status
West Side Telecommunications	West Side Telephone Company	Provider
Western PA Internet Access		Provider
WestPAnet	WestPAnet	Provider
Windstream	Windstream Pennsylvania, Inc	Provider
Wire Tele-View Corp.	Wire Tele-View Corp.	Provider
Wireless PA Internet Access		Provider
WorldConnX, Inc.		Provider
XO Communications Services, Inc. (Affiliated Entity)	XO Communications, LLC	Provider
Yukon Waltz Telephone Company	Yukon Waltz Telephone Company	Provider
Zito Media	Zito Media, L.P.	Provider
1USA.COM		Reseller
Advanced Mobile Group		Reseller
AL's Satellite		Reseller
American Telephone Company LLC		Reseller
Bandwidth.com		Reseller
Beacon Technologies		Reseller
Broad Sky Networks		Reseller
Broadband Dynamics, LLC D/B/A Diversified		Reseller
Broadband National		Reseller
Broadband.com		Reseller
BullsEye Telecom, Inc.		Reseller
Computer Solutions, Inc.		Reseller
Csolutions, Inc.		Reseller
DCT Telecom Group, Inc.		Reseller
Delmarva T1		Reseller
Diehl Michael J Cable Television D/B/A Somerfield Cable TV		Reseller
Double Dog	Double Dog	Reseller
Drizzle		Reseller
DSL Extreme		Reseller
Earthlink (D/B/A New Edge Network, Inc.)		Reseller
Hans Cedardale Satellite Inc.		Reseller

Filing Company DBA	Filing Company Name	Status
In the Stix Broadband, LCC		Reseller
IPNS		Reseller
Juno Online Services, Inc.		Reseller
Matrix Business Tech		Reseller
NetZero, Inc.		Reseller
New Edge Holding Company dba New Edge Network, Inc.		Reseller
North Central Internet		Reseller
One-Stop Communications	One-Stop Communications	Reseller
Philadelphia High Speed Wireless Internet		Reseller
RealLinx		Reseller
Steel City Broadband		Reseller
Telefonica Data Corp SA dba Telefonica USA, Inc.		Reseller
TOAST.net Internet Service		Reseller
Tracon Telecom		Reseller
USA Digital Communications		Reseller
Virtuallycheap Internet Services		Reseller
Zayo Bandwidth Northeast, LLC		Reseller