



# UNIVERSITY of NEW HAMPSHIRE

## New Hampshire Broadband Mapping and Planning Program University of New Hampshire Methodology Paper October 2014 Data Submission

### I. Data Description

In accordance with the effective NTIA guidance for Round 10 data submissions, the New Hampshire Broadband Mapping and Planning Program (NHBMP) submitted the data set described below and associated documents to NTIA in October of 2014.

NH\_SBDD\_2014\_10\_01.gdb – file geodatabase containing feature classes for:

Feature Class	Number of Records
BB_ConnectionPoint_LastMile	0
BB_ConnectionPoint_MiddleMile	142
BB_Service_Address	0
BB_Service_CAInstitutions	3,969
BB_Service_CensusBlock	109,004
BB_Service_Overview	0
BB_Service_RoadSegment	58,033
BB_Service_Wireless	56
State_Boundary	1

In total, over 167,000 individual data records on broadband availability were submitted by New Hampshire. Collectively, these records describe availability as reported by 40 broadband providers in the state. In addition, the NHBMP submitted data on 3,969 community anchor institutions.

To achieve this level of reporting, the NHBMP relied on a number of sources to identify potential providers in the state. The following table details the disposition of the initial set of providers:

Description	Number of Records
Potential providers identified in NH	98
Providers confirmed as delivering service in NH	62
Providers represented in the NHBMP submission	40

## **II. Provider Participation**

The NHBMP has identified 62 broadband providers in the state. As noted above, 40 of these providers participated in the program for the Fall 2014 cycle. This represents a net increase of one provider from the Spring, 2014 reporting cycle, resulting from two previously reporting providers no longer offering service and three new providers offering service (one mobile wireless and two fiber). The 40 current participating providers include:

<b>Provider Name</b>	<b>Technology</b>
1. 186 Communications, LLC	Fiber
2. Argent Communications, LLC**	Cable, Fixed Wireless
3. AT&T Mobility LLC	Mobile Wireless
4. BayRing Communications (dba Freedom Ring Communications, LLC)**	DSL, Fiber, Middle Mile
5. Bretton Woods Telephone**	Fiber
6. Charter Communications Inc.	Cable
7. Comcast Cable Communications, LLC	Cable
8. Cyberpine Cooperative, Inc.*	Fixed Wireless
9. DSCI Corporation*	Middle Mile
10. Dunbarton Telephone Company, Inc.*	DSL
11. FairPoint Communications, Inc.	DSL
12. FastRoads, LLC.	Fiber
13. G4 Communications**	DSL, Middle Mile
14. Granite State Communications (aka Granite State Telephone)	DSL, Fiber
15. Great Auk Wireless (dba GAW High-Speed Internet Inc.)*	Fixed Wireless
16. GWI (aka Biddeford Internet Corporation)	DSL, Fiber, Other Copper Wireline
17. HughesNet**	Satellite
18. Lakes Region Wireless**	Fixed Wireless
19. Level 3 Communications	Fiber, Middle Mile
20. Lighttower Fiber Networks	Middle Mile
21. MegaPath (fka Covad Communications Company)	DSL, Other Copper Wireline, Middle Mile
22. MetroCast**	Cable
23. Oxford Networks*	Middle Mile
24. Skycasters*	Satellite
25. Sovernet Communications*	DSL, Fiber
26. Spectra Access*	Fixed Wireless
27. Sprint	Mobile Wireless
28. StarBand Communications, Inc.**	Satellite
29. Tamworth Wireless Cooperative**	Fixed Wireless

30. TDS Telecom	DSL, Fiber, Middle Mile
31. Time Warner Cable	Cable
32. T-Mobile	Mobile Wireless
33. Topsham Communications**	Fiber
34. U.S. Cellular*	Mobile Wireless
35. USAT Corp.	Mobile Wireless
36. Verizon Wireless	Mobile Wireless
37. ViaSat (fka WildBlue Communications, Inc.)	Satellite
38. Wave Comm, LLC**	Fixed Wireless
39. Wireless LINC of NH and VT (fka NCIC)*	Fixed Wireless
40. WiValley**	Fiber, Fixed Wireless

\* Provider confirmed that coverage has not changed since June, 2014 and therefore did not submit revised data for this round.

\*\* Provider did not confirm or submit revised data for Fall, 2014 submission. Data from previous round is being resubmitted.

The following 21 providers have remained unresponsive to multiple and ongoing requests to participate in the NHBMP, have indicated that they will not participate or have dropped out of the program after initially providing data.

Provider Name	
1. Boston Telephone	2. Broadview Networks***
3. CityVoice	4. DESTEK
5. EarthLink Business (aka One Communications)	6. Fibercast Cable Communications
7. FirstLight	8. The Granite Connection
9. Grolen Communications	10. ITLLC (f/k/a Russet Communications)
11. Met Tel	12. MV Communications
13. NCIA	14. NHvt
15. Qwest Communications	16. RadiusNorth
17. SkyWire Wifi (f/k/a Akers Pond)	18. TelJet***
19. Turnpike Technologies	20. USAi.net
21. WindStream	

\*\*\* Provider formally indicated that they will not be participating in the program.

The following provider has been identified as providing internet service, but the maximum download and upload speeds they currently offer do not meet the broadband definition.

Provider Name	
1. Dixville Telephone	

The 6 providers listed below were identified from analysis of FCC Form 477 data. The NHBMP has contacted these providers, but to this date they have either been unresponsive or data has not been received so we cannot confirm their status in NH.

Provider Name	
1. Airespring, Inc.	2. Global Crossing North America, Inc.
3. Hickory Tech	4. NewEdge Network, Inc.
5. NextWave Wireless, Inc.	6. Telovations, Inc.

Finally, the NHBMP identified a number of providers during previous rounds that we no longer maintain on the active list because they have either ceased providing service, have merged with other providers, or were never an active provider in NH.

Provider Name	
1. Access Communications	2. All Media, Inc.
3. Alterracom Networks	4. BIT-NET
5. BurgNet	6. CheshireNet
7. ClearWire	8. Cogent
9. Cooperative Resources	10. Equal Access Networks
11. FCG Networks	12. Finowen
13. First Bridge	14. GreenNet
15. Green Wave Wireless	16. IAMNOW.net
17. JLC	18. LevelOne Communications
19. Mainstream EIS	20. Mason Coop
21. OTT Communications	22. RNK Communications
23. segTel, Inc.	24. Sidera Networks, LLC
25. TTLC.net	26. Upper Valley Wireless
27. Vermont Telephone	28. WaveGuide
29. Wireless Horizon	30. WorldPath

The initial master list of providers was extracted from the “New Hampshire Broadband Action Plan”, 2008, NH Telecommunications Advisory Board (TAB) and NH Department of Resources and Economic Development (DRED). This listing was cross-referenced against a statewide cell tower inventory maintained by the NH Office of Energy and Planning. NHBMP staff maintains an ongoing effort to identify additional active service providers in the state based on continuing interactions with TAB and DRED, review of speed test results, updated FCC data when published, and other sources as available.

### **III. Data Collection and Integration**

#### **A. Primary Data Collection**

##### **Data Acquisition**

Primary data was collected directly from the service providers. The NHBMP first developed a set of guidance documents based on NTIA specifications, and distributed those to the individual providers. Once the guidance was disseminated, NHBMP staff followed up with providers via

phone/email to encourage participation and address questions, as required. Typically, multiple communications were required to ensure a complete data submission was received.

#### Data Pre-Processing

To support the data mapping and integration efforts, the following base data sets were acquired and/or retrieved from the NH GRANIT state GIS clearinghouse archives:

- State and town boundaries (based on 1:24,000 USGS DLG files);
- 2001 Land Cover data set (derived from Landsat TM imagery);
- 2010 TIGER Census Blocks;
- 2010 Census MAF/TIGER Road Segments; and
- 2009 USGS National Elevation Data set (NED).

All required NTIA fields were added to the census block and road segment data sets. In addition, the road segments were processed against the census blocks to populate two fields used internally – the left block ID and the right block ID associated with each road segment.

#### Data Processing and Integration

The broadband availability data was processed and integrated using a suite of GIS tools and procedures, depending upon the format and content of the data submitted by the individual providers. Generally, the processing involved executing one or more of the following steps:

- Scanning and georeferencing paper maps and using the results as a visual reference to select out corresponding features from the project base data sets.
- Geocoding addresses using both an internal locator based on the TIGER road segments, and where required, the ESRI TA\_BatchAddress\_US subscription service; where NDAs were in place, geocoded points were then used to identify the host census block (if  $\leq 2$  sq. mi.), or the TIGER road segment in closest proximity but within 500' (if the host census block was  $> 2$  sq. mi.). Related note(s):
  - In some cases, the selection of the TIGER road segment in closest proximity to the geocoded point yielded a pattern of disconnected road segments with broadband service.
- Using ArcGIS Network Analyst to select road segments within a cumulative distance of 3,000 and/or 18,000 linear feet from central office locations, depending upon data submitted by the provider. The selected segments were subsequently used to identify adjacent census blocks  $\leq 2$  sq. mi. or used as features to quantify coverage along census blocks  $> 2$  sq. mi. Note that in early submission rounds, adjacent census blocks were flagged based on road segments intersecting those blocks. More recently, we refined our approach to define adjacency as blocks sharing a boundary with the road segment. This more conservative approach resulted in some blocks dropping out of provider coverage footprints.
- Processing KMZ image files, using the bounding rectangle to establish interior georeferencing, and then converting the georeferenced image to polygons.
- Utilizing Cellular Expert ArcGIS extension to generate a signal prediction surface for wireless providers submitting antenna locations (and associated data). Related note(s):

- The statewide cell tower inventory provided the starting point for the signal propagation modeling efforts.
- Subsequently, working with UNC-Raleigh and a NH-based fixed-wireless provider, the data processing models were refined to take into consideration visibility parameters (in addition to vegetation and topography).
- A -90 DB threshold was used to define service areas of fixed-wireless providers.
- In processing the fixed-wireless polygon data, exterior polygons, e.g. those outside of the main coverage footprint, that were < .125 sq. mi. were eliminated. Interior non-coverage polygons were not eliminated.
- Processing satellite coverage footprints to incorporate the Utah shadow analysis (as posted on the project wiki).

The NHBMP maintains a record of all specific processing steps applied to each provider's data submission in each round. We review that methodology with each provider as part of the verification process to ensure appropriate processing steps are followed.

#### Data Processing Issues

The NHBMP encountered a number of issues in processing the broadband data for the state. These include:

- Most providers submitted data only on areas that are currently served, and not on areas that could be served following the NTIA guidance. This contributed to the pattern of occasional disconnected rural road segments with broadband service.
- Reliance on the TIGER road segments likely yielded overstated broadband coverage in rural areas. A single rural customer address, when geocoded, could result in a long street segment being selected as part of a provider's coverage area.
- Most providers submitted advertised speed data rather than typical speed data.
- Fixed wireless providers frequently did not deliver the full set of antenna parameters required for the signal propagation software, and required multiple requests for data followed by requests for clarification of those data submitted. While submissions continued to improve in terms of comprehensiveness over the course of the project, this remained an issue throughout.
- For providers who submitted address records, the first process was to geocode those addresses to the 2010 TIGER road segments. For any ungeocoded addresses, the program next utilized ESRI's online geocoding services. Any remaining, ungeocoded records were geocoded manually using Bing. In some instances, records continued to remain uncoded after this three-phase approach. We have identified a number of issues with some of the resulting geocoded data:
  - In reviewing addresses geocoded against ESRI services, we discovered a small number of records that did not appear to be correctly positioned. The incorrect positioning was confirmed by viewing the geocoded points relative to both TIGER road data and by referencing Bing. In some instances, the geocoded points were positioned a significant distance away from any mapped road segment. A proximity analysis with a 500' distance constraint was used to identify the closest road in these instances.

- Finally, some geocoded results were mapped in a town other than the town identified by the provider in their address records. In most instances the geocoded result was to a neighboring town and was within .1 miles of the recorded town. The NHBMP retained the geocoded locations and notified the provider of these discrepancies.
- For speeds reported by providers in ranges, e.g. 4G LTE, the speed tier reported was selected to include the upper end of the range.
- Some fixed wireless providers continue to report minimum download speeds < 768 kbps, e.g. outside of the NTIA domain, but maximum download speeds within NTIA speed tier domain values. In these instances, the NHBMP reported the data based on the maximum speed reported.

## B. Community Anchor Institutions

Data was submitted for 3,969 Community Anchor Institutions (CAIs) in the state covering the full range of categories established by NTIA, as follows:

Category	Number of CAIs	Percent of Total
1. School – K through 12	730	18.4%
2. Library	731	18.4%
3. Medical/health care	947	23.9%
4. Public safety	566	14.3%
5. University, college, other post-secondary	63	1.6%
6. Other community support – government	735	18.5%
7. Other community support – non governmental	197	5.0%
TOTAL	3,969	100.0%

This submission represents a decrease of 93 CAIs over the prior data set due to one of several factors, including institutions that consolidated listings (e.g. schools no longer reporting libraries separately), institutions identified as being no longer in operation, or elimination of duplicate records.

In this data collection and maintenance round, the collection was largely accomplished by the individual community anchor institutions via the project's CAI web portal. The nine regional planning commissions in New Hampshire provided regional technical support, with the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) and NHBMP staff at the University responsible for developing guidance, for overseeing collection, and for compiling the resulting regional data sets into a standardized statewide layer. The primary steps in the process included:

- Issue initial and reminder emails to existing CAI contacts, requesting that they review/update their record(s);
- Review updated statewide lists of healthcare facilities, schools and libraries to identify newly opened facilities and those which have closed;

- Map the location of each unmapped CAI, using existing GIS data sets, reference to aerial imagery, property boundaries, web research, and field data collection where necessary;
- Develop a list of previously identified CAIs who have remained unresponsive to previous requests and therefore have incomplete broadband information;
- Contact new and unresponsive CAIs to collect their broadband details using an email outreach methodology as well as phone surveys;
- Working with the NH Department of Education (DOE), initiate specialized email to those schools that have not updated their broadband data;
- Verify data (see verification section below).

One issue related to the CAI data collection and submission remains outstanding. The 791 libraries reported in the dataset include the standard set of public libraries, but also include a number of libraries that are associated with K-12 schools. At present, these entries do not include a CAIID and therefore were assigned a value of 'ZZZZ' per NTIA guidance.

#### **IV. Validation**

##### **A. Primary Data Collection**

The NHBMP utilized multiple processes to verify the broadband provider data collected during the current round. These processes, each of which is described further below, included:

- Internal verification
- Provider verification
- Ground infrastructure checks
- Use of orthophotography
- Use of parcel data
- Use of FCC filing data
- Crowdsourced data – including speed tests and surveys
- Satellite dish inventory

The NHBMP continued to use local knowledge to conduct an internal analysis of the reasonableness and consistency of our mapping results. Significant overstatements or understatements of service areas resulting from internal processing issues were readily identified and addressed. The NHBMP also verified the “reasonableness” of data by comparing current coverage footprints to those reported during the prior round. This allowed us to identify areas where service areas changed substantively, and to communicate these findings to the provider for verification.

The Fall, 2014 feedback loop with providers continued to benefit from the strong relationship now established between the providers and program staff. This round’s efforts engaged all providers in data validation, including those who did not submit new data. The NHBMP returned maps (.pdf files) to each provider for review and correction. Where providers delivered addresses or road segments, the product returned was a geographically referenced version of the data that was submitted. In addition to the service data maps, the NHBMP also provided a listing of roads to those wireline providers where it was identified that service may

be partially or not available along a given roadway (see Town Verified Wireline Service Maps below). For wireless providers who delivered antenna locations and specifications, the program provided maps that displayed the modeled coverage area generated from the Cellular Expert signal propagation modeling software. Some providers requested the data verification information be provided in shapefile and/or Google Earth (.kmz) format. Additionally, the NHBMP created a secure interactive mapping verification website for the five providers whose service areas cover a majority of the state. As in the past, our experience was that the web-based solution was not fully utilized, likely due to limited provider staff resources. Overall, the provider verifications yielded a number of requests for modifications, all of which are represented in the data submission.

Orthophotography was utilized to support a number of mapping activities. Among other applications, it assisted in verifying tower locations and mapping results for the wireless signal propagation modeling, was used as an important reference layer in the verification maps delivered to providers, served as a reference layer in the Town Verified Wireline Service Maps, and contributed extensively to the mapping and verification of Community Anchor Institutions.

Community Anchor Institution mapping was supported by two other substantive data sets – parcel data and “community destination” data. The parcel data was used to map and/or verify locations. (Note that it also was used to assist in verifying the positional accuracy of address data submitted by providers.) The statewide community destinations inventory served as a starting point for compiling and mapping municipal facilities.

The NHBMP utilized FCC Form 477 filings to support the verification of provider coverage areas. Analysis of tracts reported as being served by each provider against those developed from the provider’s submission allowed for verification and validation of service areas. There were some instances where a provider’s FCC report indicated a greater footprint than indicated by their data submission, and this information was relayed back to the provider during the data review period.

Other verification measures included:

- Speed test – The NHBMP program has posted a customized speed test on the project web site ([iwantbroadbandnh.org](http://iwantbroadbandnh.org)). To date, nearly 12,000 have been submitted. We have processed those data to map the locations from which the tests were conducted and to summarize the test results. Through further analysis of the speed tests focusing on reported providers, the program compared the service identified to the provider’s reported coverage area to ensure there were not areas unreported, and/or areas where speed test results represented a significant deviation from the reported speed tier.
- Broadband survey – The NHBMP website also hosts an online broadband survey, encouraging users to report their broadband access (or lack thereof) at the address level. The address submitted is then geocoded, which delivers a means of verifying provider coverage data at specific locations. (The survey is also linked to the speed test, so that users completing the form are asked to take the speed test as well.) To date, 775 surveys have been completed.

- Satellite dish survey – The NHBMP has completed a drive-by inventory of satellite dishes in selected rural areas of the state, under the premise that a cluster of buildings with satellite broadband dishes signifies an area with no other broadband options available. This information has been utilized as part of the internal data review cycle.
- Cellular Drive Testing – The NHBMP has completed a mobile wireless drive test to identify the areas of New Hampshire that are lacking mobile wireless data coverage. The 5 mobile wireless providers (AT&T, Sprint, T-Mobile, US Cellular, and Verizon Wireless) provided the NHBMP with polygon shapefiles of their coverage in an aggregate for the state. It is recognized through personal experience, community emails, and online surveys that these data overstate the actual service coverage. The drive test results were used to review, verify and enhance the coverage information submitted by the providers.
- Town Verified Wireline Service Maps – In the summer/fall of 2013, town verification maps were provided to each of the 234 cities/towns in the state. The maps displayed coverage service areas for wireline technologies (DSL and cable). Based on these maps, the NHBMP requested that community members with knowledge of the broadband landscape review and submit corrections, as appropriate. From the returned data, a listing of roadways that may be unserved or partially served was provided to the respective wireline providers for review and comment.

## **B. Community Anchor Institutions**

The CAI data has been subjected to several rounds of verification during this and previous data submission cycles. An initial round of verification was completed in May, 2010 by re-interviewing a randomly selected subset of CAI contacts (20% of the entities within each of the 7 data categories). Later verification rounds were accomplished by generating a broadband profile sheet for each CAI, emailing that to each CAI contact for review, and modifying the CAI record based on any updates returned.

As of March, 2012, we created an interface for CAI contacts to review and modify their individual records via the NHBMP website. We continued to leverage the use of these web technologies during the current reporting period, and received over 757 updates via the website for the round 10 submission.

In response to NTIA's stated interest in improving the records associated with schools and libraries, the NHBMP collaborated with the NH DOE and the NH State Library to update the reporting for these specific CAI categories. In the former case, the DOE Commissioner issued a personal request to school superintendents to encourage their participation in the project. Similarly, the NH State Librarian contacted his associates via email. In addition, NHBMP staff issued multiple follow-up requests to schools and libraries. As a result, the data set improved over the program period in two specific areas:

- Of the 757 updates, over 73% of them were from schools (26%) and libraries (47%)

- There was a 34% increase in the amount of schools and libraries that reported a change to a fiber connection in their technology of transmission