

North Carolina Data Submission Fall 2014

Data Collection Methodology

NC Broadband, a Division of the North Carolina Department of Commerce

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Executive Summary

North Carolina's SBDD Grant

The North Carolina Department of Commerce is the designated Eligible Entity in North Carolina to receive funding under the State Broadband Data and Development (SBDD) grant program of the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce. North Carolina was awarded \$6,610,996 in federal funding under this program through Award #37-50-M09002. This grant runs from October 1, 2009 – October 1, 2014.

North Carolina Department of Commerce

NC Broadband, a division of the North Carolina Department of Commerce, is responsible for implementation of the work under the SBDD grant. In this capacity, NC Broadband serves as the State Broadband Initiative for North Carolina. Work under the SBDD grant is being conducted by staff members of NC Broadband as well as the relevant contractors under the grant.

NC Broadband is responsible for implementation of the following programs as part of this grant:

- State Capacity Building
- Data Collection and Mapping of broadband availability
- Technical Assistance to communities
- Implementation of the LITE-UP Pilot Program
- Update of the NC Master Address File

The Department of Commerce is the state's leading economic-development agency, working with local, regional, national and international companies. The Department's mission is to improve the economic well-being and quality of life for all North Carolinians. The mission is carried out by serving existing business and industry, including providing international trade assistance; recruiting new jobs and domestic and foreign investment; encouraging entrepreneurship and innovation; marketing North Carolina and its brand; supporting workforce development; strengthening communities; and promoting tourism, film and sports development. The Department also provides data, statistics, information and reports for state government and agencies, which regulate commerce in the state. As such, the Department of Commerce is a natural fit to house the State Broadband Initiative for North Carolina, with broadband infrastructure being key to reaching North Carolina's business and workforce goals, and with broadband infrastructure being a critical component to allow all NC businesses and communities to participate in the global economy.

The Center for Geographic Information Science at UNC-Greensboro

The Center for Geographic Information Science (CGISc) at the University of North Carolina Greensboro (UNCG) is an educational research entity that relies on theories, concepts, and applications to solve, analyze, and model the geographic aspects of human and natural phenomena. CGISc collaborates and partners with government agencies, non-profit organizations and private corporations. Research activities are supported by faculty, staff, students, and partners from various specialized fields such as geographic information systems, remote sensing and image processing, cartography, engineering, and mathematics.

As a contractor under this grant, CGISc assists the data administrator and GIS specialist of DOC's NC Broadband division in the processing of incoming datasets, cartography using the collected and mapped information, and analysis of spatial data for strategic planning. The center also conducts predictive modeling for fixed wireless providers of broadband service based on equipment configurations and field-calibrated ground conditions such as terrain, tree canopy, and the built environment.

Fall 2014 Broadband Data Collection and Mapping Process

Data Collection

The official data request letter from the NC Department of Commerce was sent hardcopy in the mail to all identified providers of broadband service on July 14th. An email version was distributed as well, on July 15th. Providers were given a link to the relevant Webpage which houses: Data Instructions, the Excel Data Template, the NC Department of Commerce Designation Letter, the Guidance Letter from NTIA from June 2011, and a file to download the 2010 Census Block GIS layer from NC OneMap. Providers were also reminded that they may choose to submit availability data by census block and street segment, considered public data under the grant program, or address-level data, and were asked to contact DOC with questions about confidentiality of data. Providers were asked to reply to the data request on or before Friday, August 1, 2014.

As mentioned above, Excel and geodatabase templates were shared with providers, along with PDF format instructions summarizing all NTIA requirements and information relevant to each type of provider (fixed wireless, mobile wireless, and wireline). Technical assistance was provided to any organization who requested it, and some outreach to providers was conducted for increased participation and data improvement purposes.

A secure server hosted by MCNC is configured with an open source, browser-based direct file upload system called eGroupware. Providers were sent a log-in name and password for this upload system once they contacted either Angie Bailey or Stephanie Jane Edwards to communicate that their data was ready for submission. A confirmation e-mail went to Stephanie Jane once data had been uploaded.

Reminder e-mails were sent, or phone calls made, to providers who had not responded by the end of August. NC Broadband did use some previously-submitted datasets for providers that were unresponsive, or who asked that previous data be used for this round. The number of known broadband

service providers operating in North Carolina is currently at 111, with several providers being removed, and others being identified and added.

Out of these 111 known providers, 77 now have broadband data in this statewide geodatabase. Since the last data collection, several providers have been added to the list of identified broadband providers operating in North Carolina, and three (Cogent Communications, Crystal Broadband Networks, and Red's Cable) reported coverage data for the first time. The list of providers was also reduced by three because Broadlink Wireless has ceased operations, ATMC Wireless was acquired by AT&T, and Clearwire was acquired by Sprint. Vistanet Telecommunications is still in operations and has participated in data collection for several rounds, but their small coverage area was not included this round due to equipment issues that are temporary according to the provider. Several additional providers were still in communications with NC Broadband at the time of statewide data submission, in an effort to produce usable data for future broadband planning/promotion efforts.

Integration of Provider Data into NTIA Statewide Geodatabase

For ease of data integration, a front-end Excel format template was offered to all providers, containing notes defining required fields, explanations of which data is required in which formats by which types of providers, and hyperlinks connecting fields to additional tables listing the corresponding NTIA-specified values and codes (for speed tiers, technology types, connection point facility types and capacities, county codes, end user types). A brief description of how census block FIPS codes work was also taken from an internet source and distributed as needed to providers who had questions about how to report this information.

BB Service by Census Block

As requested by the NTIA mapping and planning team, all census block data is included with 2010 census block geometry. Technical assistance was often needed by providers to correctly report served areas by either the 15-digit FIPS codes or in some way by which NC Broadband staff could derive the appropriate FIPS codes.

BB Service Road Segment

The reporting and mapping of data by street segment presented significant challenges to accurate interpretation of where broadband availability is and is not. This is mainly attributed to the difficulty of standardization among the many data structures by which providers report street segments. Quality of data has improved since some providers have switched to submitting data in shapefile format, and others have been able to start including a Tigerline ID (TLID) field for reference in mapping tabular information. Use of this unique identifier has reduced ambiguity in some tabular datasets and improved data quality upon mapping.

BB Service Address

A few address-level datasets were submitted to NC Broadband with the latitude/longitude coordinates already determined in a spatial format, but most needed to be geocoded. This was done using the NC Master Address file as the primary reference file, significantly increasing the accuracy of matching records. Secondary sources for address records that did not find a match this way included street segment interpolation, ESRI data utilizing the 4-digit ZIP extension, and manual placement/digitizing based on a combination of reference data and online browser maps. Upon completion of geocoding for each provider submitting address data, the address point features were overlain with a 2010 census block layer to add the census block FIPS code attribute, then all address feature points were loaded into

the geodatabase feature class. The geocoded shapefiles for each provider are kept with geocode match score and match reference type for every matched address, so the thoroughness of this data type could be tracked and/or improved with more time.

BB Service Wireless

Approximately ten small, fixed wireless providers have been able to share technical information about their transmitting towers, antennae, and frequencies, so that NC Broadband can produce for them a service coverage shapefile using the contracted services of the University of NC at Greensboro Center for Geographical Information Science (<http://cgis.uncg.edu>) . An Excel template was developed with all the relevant information that can be filled in by providers with technical assistance in some cases, and the propagation model is field-calibrated to reflect actual ground conditions. NC Broadband has recently begun to work with TowerCoverage.com, in order to obtain wireless footprints from some fixed wireless providers in the state that subscribe to the towercoverage.com service and who do not participate in the broadband mapping efforts by any other means.

BB Service Overview

Records for overview containing subscriber-weighted nominal speeds of a given provider were generally joined to a template layer of county features, using the option to keep matching records only. Then these matching features and their new attributes were exported as a new shapefile before being loaded into the collective overview feature class. For providers with multiple technology types serving a given county in at least one instance, this information was single-field geocoded using the 5-digit county FIPS code, and then geocoded point features were spatially joined to the county polygon using “within” criteria.

Some detail formatting performed as needed:

- Add state FIPS code and any needed leading zeros onto county code for the new State+County FIPS code. Most providers list just the county code because this was the original NOFA request.
- Change state abbreviation values from “37” to “NC”.
- Change weighted speeds to appropriate units (kbps) and remove unit text.
- Translate to county from weighted speeds reported by RSA/MSA/CBSA.
- Verify that reported county averages line up with reported service areas, and work with providers to fill in any gaps if possible.

BB Service - Community Anchor Institutions

Only anchor institutions that could be geolocated were included. Only 17 CAIs were identified that could not be geocoded to a point feature. CAIs were collected by contacting administrative offices of some CAI category types and receiving databases of information, as well as collecting from individual CAI locations for other types using survey emails and follow up phone calls as necessary. There are 7,047 CAI’s identified, located, and included in the geodatabase to date. In this current data collection round, most CAI’s are included as previously reported, but many attributes of the senior centers were updated, and library speeds were updated using data from an EDGE Initiative survey through the state public library system. The following steps were used to update library speed information:

- Translated speed ranges into most closely corresponding NTIA speed code, avoiding overstatement when possible:
 - 0-1.4 Mbps (megabits per second) → 3

- 1.5 Mbps → 4
 - 1.6-4.9 Mbps → 5
 - 5.0-9.9 Mbps → 6
 - 10.0-14.9 Mbps → 7
 - 15.0-19.9 Mbps → 7
 - 20.0-39.9 Mbps → 8
 - 40.0-69.9 Mbps → 8
 - 70.0-99.9 Mbps → 9
 - 100 Mbps-999 Mbps → 10
- Excluded 25 Bookmobile records
 - For 19 records that had download speed values lower than upload, the values were swapped with the hypothesis that survey respondents may have confused the two.
 - If there was no response in connectivity speed fields of new survey data, the previous speed code values were retained for that library (rather than changing to placeholder value ZZ).
 - Matched improved library attributes with previously collected library location data, via a combination of auto and manual processes. 15 library records did not find a counterpart in the new speed data and were left as-is until verification can be obtained about these locations.
 - TransTech codes have not been updated because the information was not included in the most recent survey, and we want to retain the last known technology type until confirmed otherwise.

Census Block data (tabular)

- Fields standardized and transferred into Excel template
- Geocoded to centroids of census blocks using 2010 Census Block layer in WGS1984 projection as reference file for “Address Locator”.
- Spatial join of geocoded census block data points to polygon features

Street Data

Some datasets were submitted to NC Broadband by providers already in shapefile format, and others were reported in various tabular formats (text, Excel, CSV, etc.). Of the tabular datasets, some included a Tigerline ID (“TLID”) field along with some or all other fields such as city, state, zip, and census block FIPS.

- For datasets submitted tabular with TLID:
 - Max and Min address ranges were calculated from the FromRight, ToRight, FromLeft, ToLeft format used by most standard street segment reference files and incoming datasets
 - All data formatted into back-end Excel format, including converted speeds if reported at some other granularity.

- Table geocoded to Tigerline 2010 street segment file using single-field and “TLID” values, with zero offset.
- Geocoded point features converted to street segment geometry via spatial join using “contains” criteria, keeping matched records only.
- For datasets submitted tabular without TLID:
 - Max and Min address ranges were calculated from the FromRight, ToRight, FromLeft, ToLeft format used by most standard street segment reference files and incoming datasets
 - All data formatted into back-end Excel format, including converted speeds if reported at some other granularity.
 - Table geocoded to Tigerline 2010 street segment file using hypothetical addresses created at intervals by a Python script and either ZIP5 or census block FIPS (whichever available) as address locator zone.
 - Geocoded point features converted to street segment geometry via spatial join using “contains” criteria, keeping matched records only.
- For datasets submitted as shapefiles: Checked for duplicates using frequency tool, duplicates removed in one of various ways as deemed appropriate, and geometry checked and repaired if needed. VB If/Then statements used to calculate “Max” and “Min” address range attributes required by the NTIA/FCC, converted from the FromRight, ToRight, FromLeft, ToLeft format used by most standard street segment reference files and incoming datasets:
 - **To calculate “Min”:**

```

Dim fromRight
Dim toRight
Dim fromLeft
Dim toLeft

fromRight = [FROMRIGHT]
toRight = [TORIGHT]
fromLeft = [FROMLEFT]
toLeft = [TOLEFT]

Dim minright
If fromRight = 0 And toRight = 0 Then
    minright = 0
ElseIf fromRight = 0 Then
    minright = toRight
ElseIf toRight = 0 Then
    minright = fromRight
Else
    If fromRight < toRight Then
        minright = fromRight
    Else
        minright = toRight
    End If
End If
          
```

```

Dim minleft
If fromLeft = 0 And toLeft = 0 Then
    minleft = 0
ElseIf fromLeft = 0 Then
    minleft = toLeft
ElseIf toLeft = 0 Then
    minleft = fromLeft
Else
    If fromLeft < toLeft Then
        minleft = fromLeft
    Else
        minleft = toLeft
    End If
End If

```

○ **To calculate “Max”:**

```

Dim fromRight
Dim toRight
Dim fromLeft
Dim toLeft

```

```

fromRight = [FROMRIGHT]
toRight = [TORIGHT]
fromLeft = [FROMLEFT]
toLeft = [TOLEFT]

```

```

Dim maxright
If fromRight > toRight Then
    maxright = fromRight
Else
    maxright = toRight
End If

```

```

Dim maxleft
If fromLeft > toLeft Then
    maxleft = fromLeft
Else
    maxleft = toLeft
End If

```

```

Dim max
If maxleft > maxright Then
    max = CStr(maxleft)
Else
    max = CStr(maxright)
End If

```

Creating last mile and middle mile features

- Formatted numeric fields in Excel as text since the short integer format in the data model for these fields will not accept values from the Excel import's default general format.
- ArcToolbox > Data Management Tools > Layers and Table Views > Create XY Event Layer
- Zoom to Layer, verifying that all points are located inside NC boundaries

Provider-specific notes, functions and corrections performed by NC Broadband as needed

AT&T F14

- Converted subscriber weighted nom speed data from CBSA to county. Selected counties from mapped subscriber weighted nominal speed data that actually contain broadband availability data by census block or street segment. Exported selection as Overview file.
- There were some instances where some CBs reported as served in a county were in a non-reported CBSA. In each instance, the CBs lay just outside the edge of a reported CBSA, so the reported CBSA numbers were attributed.
- Calculated conversion of Left and Right To/From addresses for street segment data to NTIA's required Max/Min values (using "min" and "max" formulas in Excel)
- Checked data by CB for duplicates, none found.
- Removed 30 duplicates from street data in Excel
- Mapped street segment data to 2010 census tigerline street centerlines using 2010 TLID field.
- Verified FRN's 0004979233 for AT&T Mobility, 0004496774 for AT&T Corp middle mile, and 0001857952 for BellSouth Telecommunications DBA AT&T North Carolina.

AT&T Mobility

- Dissolved shapefile footprints into single features based on common wireless characteristics.
- Used the shapefiles given, and the Mobility spreadsheet to fill in the attribution
- Shapefiles are UMTS, HSPA+, and LTE. Attribution states HSPA, HSPA+, and LTE, so we used HSPA values for UMTS shape.
- cleaned up donut holes and islands, verified vertice limit was acceptable
- Use the same speed codes for both advertised and typical speeds

ATMC

- Merged shapefiles of address level data from two counties served, renaming and consolidating attribute fields.
- Added Address field populated with a concatenation formula of component address information. Note: concatenated differently based on source data, since attributes structured differently for each. Postal field used for City.
- Checked for duplicates in address data (address and transtech fields), 19,090 duplicates removed.
- Added EndUserCat field and populated with code 5

- Overlay of address points w/CB layer to get FIPS code field
- Manually nudged 8 address points (in Calabash, NC) on the SC border into the tigerline state boundary.
- Applied spectrum value from previous submission to wireless footprint
- Created new fields and used Calculate Geometry function in ArcMap to generate Lat and Long attributes
- Confirmed FRN's 0004383485 for wireless and 0004061586 for wireline in FCC FRN Search System.

BRMEMC (Blue Ridge Mountain Electric Membership Corporation)

Data from Fall 2013 was transferred after confirming no changes. It was previously mapped as follows:

- Worked with provider who sent FTTL service area polygon, clipped out 2012 Tigerline street segments inside this polygon and applied broadband characteristics described by the provider.
- Added FRN from search engine results and verification using the FCC FRN system.

CenturyLink F14

- Used If/Then scripts to calculate min and max address fields from left and right max/min ranges in ArcMap field calculator
- No duplicate census blocks found. Determined with frequency tool that the only duplicates in streets feature class are those from the reference data that differ in the name field (likely all segments with a highway name and a road name), and these were not removed.
- Removed census blocks 370370206001032 and 370370206001017, plus 3 additional street segments based on citizen input and earlier follow up with Gerry at CenturyLink.
- 2602 street features removed due to null geometry
- Weighted speeds and middle mile records not supplied, and were carried forward from previous rounds.
- Verified FRN 0018626853 in FCC's online search system.

Charter F14

- Added Provider Type of 1 and EndUserCat field with value 5 for "Other/Unknown"
- Streets submitted and mapped in 2010 Tigerline, with no address range information. No unique identifier in common with reference Tigerline file, and no resulting address range info. Map overlay operation revealed that the geometry perfectly overlays with the 2010 Tigerline data with address ranges. Therefore the address range and zip code information was transferred to the provided streets. This resulted in a resolution of duplicates to a single street name, and an overall net gain of feature counts as streets were broken down into shorter segments with corresponding address range attributes.
- Checked for duplicates in CB and street shapefiles using Delete Identical, none found.
- Corrected records per followup with provider, changing techtype 41 records with max speed codes of 10 to docsis 3.0 tech type code 40.
- Exclusion of a small area of 24 street segments and census blocks along the southern border of Cleveland County which was determined by the provider contact to be bleedover from availability data in SC.
- Ran repair geometry on census blocks and street segments. No errors found.

Chatham Wireless

Data from Fall 2013 was transferred, which was previously mapped as follows:

- Recreated tower locations by zooming in on PDF map in Chatham County proposal/report showing Chatham wireless existing service area with street network for reference.
- Based on report information, buffered tower location point features by 4 miles and merged all boundaries.
- Duplicated footprint to create a separate record for each spectrum range used according to the proposed report.
- Populated attributes based on information in proposal/report and provider website.
- Ran repair geometry tool to ensure no errors in footprint shape.

Comcast F14

- Mapped CB's submitted this round
- Added Transtech field of 40 census blocks and street segment data.
- Manually selected street segments from TIGER 2010 street segments as reported by the provider in spreadsheet format.
- Spatially joined the tabular data to the resulting subset of TIGER 2010 street segment features (using Intersect criteria with search range of 5 feet). Ran Delete Identical tool on the resulting street segments based on unique shape, TLID, and TransTech.
- Excluded street segments that were reported entirely inside reported census blocks (all census blocks reported were less than two square miles)
- Verified FRN 0013431911 in FCC's online search system.

Comporium Communications (Citizen's Telephone and Springboard Telecom) F14

- Carried forward Springboard census block data from previous rounds after verifying no changes in the data.
- Added streets from within a 15000 foot radius of one new DSLAM reported by Citizen's Telephone (using intersect criteria, minus segments with identical geometry to spring 2014 street data).
- Formatted attribute structure/values of new streets, appended to previously reported streets. Deleted duplicate records.
- Checked geometry for errors, none found.
- Verified FRN 0003731882 for Springboard Telecom, LLC and 0001961416 for Citizen's Telephone.

Cricket F14

- put the shp in the appropriate format and dissolved correctly.
- Confirmed FRN 0002963528 in FCC FRN Search System
- Missing typical speeds, copied from advertised.
- reduced the number of vertices to a reasonable number (was under limit, but still excessive at 100k +)
- removed polygon islands and donuts smaller than 0.125 square mile
- Added EndUserCat field and populated with a value of 5

Country Cablevision and Carolina Mountain Cablevision F14

- Formatted fields of new address data
- Removed 173 duplicates from Carolina Mountain Cable, 318 from Country Cable, existing due to exclusion of unit/apt numbers
- Geocoded addresses and ensured that those in Haywood County are designated served by Carolina Mountain Cablevision
- Verified FRN 0008635526 for Carolina Mountain Cablevision and 0005039144 for Country Cablevision in the FCC's online FRN search system.
- Mapped deployment data for fiber connections sent via email through technical assistance program. Combined address information from multiple text files into single, fixed width text file and imported into Excel. Text to columns for address components.
- Removed 229 duplicates after removing extra numbering of multiple records at a single address.
- Removed 85 records that had no actual house number. Geocoded remaining records.
- Manually cleaned up another larger batch of previously geocoded fiber deployment address records from late spring. Re-parsed street addresses to remove apartment numbers and populate component fields, and then removed 790 duplicate records.
- Merged all geocoding results, cleaned up previous FTTL update and matched address script output, then removed 516 duplicates overall (one duplicate created and removed after manual typo edit). Note: 229 unmatched records would not load into working GDB due lat/long placeholder value being out of bounds.

DNet F14

- Downloaded and georeferenced KML files from towercoverage.com
- Applied attributes manually from towercoverage.com spreadsheets. No way to determine which site is associated with which part of the multi-site coverage footprint, except for generally licensed spectrum is only incorporated in Macon County. Isolated that county's S.O.A.R. coverage adjacent to site features attributed as using wireless for transtech 71 footprint, and duplicated that footprint feature for each spectrum category used. Used only spectrum code 6 for unlicensed wireless across the rest of the footprint.
- Dissolved coverage features by unique technology, speed, and spectrum combinations.
- Removed polygon parts less than 0.125 square mile in area.
- Clipped coverage to state boundaries.
- Carried forward last mile data from fall 2013, except added one new point that was represented in the towercoverage.com site list.
- Verified FRN 0006287379 in the FCC's online search system.

Electronics Service Co of Hamlet F14

- Customized propagation model for unique antenna setup high up in trees
- Clipped output to state boundary
- Populated last mile Ownership field with '0' for owned, but still need confirmation from provider
- Used an Intersect spatial query method to separate wireless coverage footprint inside Montgomery County and re-attribute it to Ellerby Telephone Company, per the provider.

Electronic Solutions F14

- wireless propagation modeling used for updated footprint
- Last mile end user totals updated. Coordinates of one last mile connection point corrected.

- Middle mile point unchanged and carried over from previous submission
- FRN 0018446666 confirmed in FCC registration system

Ellerbe Telephone Company F14

Data was submitted and confirmed to contain no changes from Spring 2014 data, which was processed in the following way:

- Worked with provider to edit unidentifiable CB FIPs codes and to report census blocks >2 square miles at the street level. (2 census blocks >2 square miles still at the census block level because revised data contained no streets in those blocks. Will follow up with provider.)
- streets- Used the field given by the provider to match to a "Roads" file available via US Census. This Roads file was then joined to the TIGER roads by an ID field, therefore giving the parsed addressed fields required by the NTIA
- Mapped census block data and then removed census blocks for which street segment data was also provided.
- Checked cb data for duplicates, none found.
- Missing values in ownership field, so ownership was assumed in last mile data.
- Overview – Montgomery & Moore County missing; does not cover all the census blocks that were provided (also had this problem in last submission)
- Verified FRN 0004373411 in the FCC's online search system

Frontier F14

- Mapped (created XY event layer then export to shapefile) DSLAMS as last mile connection points.
- Populated ownership field for Last mile as zero for owned
- Applied a 15,000 foot service circle to last mile points for availability (dissolve by list using the corresponding speed fields), then a 8700 foot and 6000 radius to a subset of points as per the provider
- Created subset of 2010 road segments that intersect each set of radius buffers, via select by location using intersect criteria. Done in order of decreasing radius/increasing speed in order to capture the appropriate max speed tier that applies to any given street segment.
- Added fields for EndUserCat and ProviderType, populated all records with 5 and 1, respectively.
- Removed duplicates (of both spatial and attribute characteristics) inherent in Tigerline reference data.
- Verified FRN 0018802660 using the FCC's online search system

Greenlight F14

- Reprojected shapefiles as submitted. Carried broadband characteristic attributes from previous round over to new address feature class.
- Removed extra spaces and concatenated full contents for Address field.
- Recalculated lat/long attributes to capture 6 decimal places, revealing the variation in geometry of point features
- Removed 14 duplicates from address layer
-
- Confirmed FRN 0015950934 in FCC registration system.

HughesNet F14

Mapped previously submitted data, which was processed in the following way:

- Joined list of ZIP codes for North Carolina to 2010 ZIP code boundaries.
- Merged ZIP code boundaries into single feature
- Repaired geometry on merged polygon
- Joined attributes from Fall 2013 HughesNet data, and checked each field to ensure all values represent the broadband characteristics reported by the provider this fall
- Found FRN 0017434911 using the FCC's online system search. Applied FRN to HughesNet data.

Interstar F14

Mapped fall 2013 data, which was processed in the following way:

- Saw that previous service area polygons still represent the best approximation of coverage over this new set of addresses plus previously submitted addresses, so transferred previous polygon created in the following way:
 - Identified clusters of these address points, then used subsets of the point locations to derive Minimum Bounding Polygons (Convex Hulls) representing available wireless coverage.
- One-to-one spatial join associating provider attributes and speeds with minimum bounding polygons.
- Added spectrum field and populated with code 6.
- This data was then re-attributed with ProvName, DBAName, and FRN of Starvision, Inc., per confirmation from the provider that Interstar has been consolidated into this sister company.

Inteliport

Mapped previous data which was mapped in the following way:

- Provider is working on but has not yet been able to compile equipment specs that would allow us to run a propagation model, so in the meantime, polygons were created from census block locations.
- Follow up from provider in March 2012 clarified the max advertised speed values, based on service tiers and throttling used to keep streaming media from overloading the bandwidth when many users are subscribing to a given microcell. These were reduced from the maximum bandwidth capacity values included previously.
- Census block shapes used in the wireless feature class were merged into a single, multipart polygon based on their identical attributes.

Level 3 Communications

Data from fall 2013 was transferred, which was previously mapped as follows:

- Used script to sort newly submitted addresses from those previously submitted, using newly submitted attributes in both cases
- Applied value of 0 for Owned in ownership field of middle mile data, since this is a middle mile provider and it is very likely that they own all the middle mile facilities
- Verified FRN 0003723822 in the FCC's online search system.

MAIN F14

Data carried forward from Spring 2014, which was processed in the following way:

- Added EndUserCat field with code 5

- Verified FRN 0008338493 in FCC FRN search system and populated FRN field with this value from previous rounds. Ownership had entity name, which was replaced with 1/0 codes

MCNC F14

- Used new output data sets from MCNC for Address and MidMile data
- Added the negative sign in the longitude field for 3 records in the address feature class, carried forward corrected coordinates from two address points that were edited in spring 2014 (using rooftop coordinates from Google Geocoding API).
- Added ZIP codes for 4 address records
- Shortened value in Street field for one record that exceeded character maximum due to inclusion of a building number.
- Verified FRN 0001844554 in the FCC's online search system.

Mediacom F14

- Removed 3,168 duplicates.
- Sorted address data using script, geocoding new addresses and updating the fields from previously reported addresses. 4326 address records currently unmatched after geocoding process.
- Spatial join to obtain census block FIPS codes (which often disagreed with provider supplied FIPS codes, some of which were incomplete).
- Missing Provider Name, DBA Name, and FRN fields. Populated with last year's submission values.
- No EndUserCat information given. Used the value of 5
- Carried over middle mile information from previous rounds, as it was not reported this round.
- Verified FRN 0004036778 in FCC's online search system.

Megapath F14

- Populated with EndUserCat code 2 for Non-Residential, per the NTIA program office.
- Checked CB spreadsheet for duplicates, none found
- Duplicated provider name in DBA Name field for all data pieces
- Mapped street segments using a python script that plots a point at regular intervals between the min and max address ranges submitted and then joins to the 2010 tigerline street segment associated with those ranges and attributes.
- Verified FRN 0003753787 in FCC FRN online search system.

MI-Connection

Data from Fall 2013 was transferred, which was previously mapped as follows:

- Ran address sorting script to transfer over previously geocoded addresses with updated attributes and generate table with additional addresses to be geocoded this round. (32,281 out of 38,524 found a match).
- Those not matched were geocoded, merged with those that did, and duplicates were removed.
- Typical speeds were adjusted based on phone call with contact at MI Connection in spring 2013
- Removed 7 duplicate records from address data

Morris F14

- Address data sorted via script to update previously geocoded locations and compile separate table for geocoding locations new or previously unmatched. New/unmatched locations put through manually-assisted geocoding process.
- Addresses checked duplicates, 7 removed.
- Verified FRN 0018570887 in FCC FRN search system online.
- Last mile elevation values reported as height above sea level rather than above grade level, replaced with -9999
- Provider name was standardized to be the same throughout, adding "LLC" to the name where it was missing.

NC Wireless F14

- Used propagation model output from UNCG Center for GIScience, and clipped output to within dissolved radii of 14 miles after comparing with towercoverage.com model output with provider staff.
- Simplified output using point removal with 10 foot max allowable offset.
- Eliminated polygon parts (islands and donut holes) less than 0.125 square miles per instructions from the program office.
- Converted raw speed values to NTIA speed codes, and merged like values within the same spectrum and end user category code.
- For towercoverage.com comparative layer: Manually georeferenced KML using bounding coordinates, and vectorized the georeferenced PNG. Ran the generalization tool of "Aggregate Polygons" to not only remove the islands and holes, but also to set a tolerance, whereby the islands were combined instead of deleted outright. Tolerance was set at 100m, because the resolution of the towercoverage.com analysis appears to be 90m. This way, one pixel of not-covered was not enough to divide up an area. Merged all remaining separate features into single, multipart polygon.
- Verified FRN 0014898977 in online FCC FRN search system.

North State F14

Spring 2014 data was carried forward, which was processed in the following way:

- This provider submitted a combination of census blocks and street segments when in the past, the entire service area had been submitted at the address level.
- Corrections for missing FIPS digit and inserted leading zeroes for tracts.
- Census block data checked for duplicates, none found.
- Joined street shapefile given by provider to 2012 TIGER for appropriate street and FIPS fields.
- Ran script to update existing and geocode new address records reporting broadband coverage.
- Middle Mile, Last Mile: Added negative sign to longitude values
- Changed EndUserCat values of 3 and 4 to 2.
- Verified FRN 0003745734 in the FCC's online search system

Northland Cable F14

- Added EndUserCat field populated with code 5. 4254 addresses were dropped and 4628 new ones added.
- Found and removed 200 duplicates in address records
- 21462 carried over from S14

- Verified FRN 0001568971 for Northland Cable Properties and 0001579747 for Northland Cable Television in FCC FRN search system.
 - Corrected FRN in address records to match corresponding parent company name
 - Adjusted DBA name in last mile data to match other components of data submission
- Last mile: replaced raw elevation values with -9999 placeholder value

Randolph TMC F14

- Formatted text information and consolidated into one Excel file
- Fixed three street segments with maximum and minimum addresses reported backwards.
- Streets method:
 - Used a python script to create addresses at intervals of 100 between the min and max along streets reported by Randolph, and linked via spatial join to Census 2012 Tigerline street polylines.
 - Removed duplicate points where the Transtech and TLID were identical (speed was not an issue, as each Transtech had the same speed codes respectively)
 - Verified FRN 0001951284 in online FCC FRN system search tool.

Red's Cable

- Used scanned PDF drawing from provider to digitize a service area polygon, and confirmed accuracy of interpretation with the provider.
- Selected Tigerline 2010 street segments inside service area polygon using intersect criteria. Manually removed one street segment that was included only because of its endpoint at an intersection along service area border.
- Formatted fields (via Join Field with template geodatabase feature class) and attributed based on information in emails with the company owner.
- Used python script to calculate overall max and minimum street numbers per street segment.
- Checked for duplicates, none found.

RidgeComms F14

- Obtained KML and PNG files from towercoverage.com
- Could not successfully import KML using the data conversion tool in ArcToolbox, so manually georeferenced the PNG footprint using bounding coordinates and georeferencing toolbar.
- Vectorized the resulting coverage representation. Deleted background shapes by value field. Merged feature parts into a single footprint.
- Clipped output by Tigerline state boundary.
- Eliminated polygon parts less than 0.125 square miles.
- Duplicated the footprint to create a separate layer for each spectrum range reported by the provider.
- Populated broadband attributes according to information provided in CSV files via towercoverage.com
- Ran repair geometry tool to ensure no spatial errors in coverage footprint shapes.

RST Global Communications F14

- Geocoded address-level data for service area (19 new addresses were added since spring 2014)
- Edited typical speeds to match max advertised speeds, after follow up with the provider to determine that this reflects actual capacity at peak hours versus current subscription trends.

- Manually removed 1 duplicate address from Shelby (not exact syntax but same address). Checked for other duplicates using frequency tool, none found.
- Carried forward spring 2014 overview and middle mile data, continuing to exclude one middle mile point that is located in South Carolina.
- FRN 0021750799 confirmed in FCC registration system
- Changed EndUserCat values of 3 or 4 to values of 2 for non-residential in the current data transfer model.

Sprint F14

- Confirmed that middle mile connection point information matches previously submitted, and moved that data over to new transfer geodatabase, after updating the provider name and FRN to match current data submission.
- put the shp in the appropriate format and dissolved correctly.
- Simplified polygons with point removal at a max offset of 50 feet.
- Eliminated polygon parts less than 0.125 square miles
- Ran repair geometry to ensure no topological errors, none found.
- Confirmed FRN 0022117618 in FCC FRN Search System.

Star Telephone Membership Corporation F14

This provider reported that no changes have occurred, so previous data was carried forward, which was processed in the following way:

- Address data formatted in back end Excel template
- 396 duplicates with same speed removed from the spreadsheet.
- Used field calculator to make the contents of Provider Name and DBAName fields consistent and spelled out in every feature class rather than sometimes abbreviating Corporation to Corp.
- Corrected FRN to have sufficient number of digits/leading zeroes.
- Added lat/long coordinates to middle mile point reported, based on communication that Star TMC, Starvision, and Interstar all share this connection point.

Starvision F14

- This provider sends census block data in addition to address-level data, but the census block records are just duplicates of the address data and only the address records are used for better granularity.
- 950 duplicate census blocks removed. Mapped via geocode and spatial join, then extracted the blocks 2 square miles in area or smaller. It appears that implementing the census blocks would cause overstatement of coverage along some roads that do not yet have access.
- Address records came with lat/long coordinates. Three needed manual adjustments from minor typos. Parsed street information in address data
- Applied max speed codes in the typical speed fields as well for fiber records
- Removed 249 duplicates from address data.
- Spatial join of address points with census block numbers.
- This provider only has records for active customer locations, so previously reported addresses from spring 2014 that were not already included in the newer data were carried forward. After combining, 817 duplicates removed.

- Verified FRN 0018515676 in the FCC's online search system.

Skybest and Skyline F14

- Spatial join with Tigerline 2010 streets WGS84 by location inside newly created polygons (using streets was found to be more accurate, with less overstatement, than an overlay with census blocks).
- Manual touch up, deletion of streets that only touch the boundary of served polygons.
- Used VB script in Field Calculator to derive max/min address range information
- Excluded 1 midmile point and 2 last mile points from skyline that located outside the state boundary.
- Removed 287 duplicates from street data using all necessary attributes and geometry comparison in Delete Identical tool.
- Ran Repair Geometry, no errors found.
- Verified FRN 0001952555 for Skyline and 0004274890 for Skybest

SkyeNet Wireless Communications F14

- Provider does not participate in data collection. Information was gleaned from the provider's website in previous data collections, by selecting and merging the relevant census blocks corresponding to served areas indicated on the provider's online map. This footprint was checked for currency using the company website on 9/28/2014.
- Unlicensed spectrum is assumed and no match could be found on the FCC FRN system.

Skyrunner F14

Fall 2012 data was used, which was processed in this way:

- Corrected footprint using most current wireless equipment specs and -80 dbm (previous signal threshold change had been done on older data by mistake).
- Added Sky Catcher data to the footprint to reflect the recent acquisition of their network.
- Last Mile: assumed Ownership by Skyrunner in the Ownership field, wireless type for backhaul, and capacity codes equivalent to max advertised speed of the surrounding wireless footprint.

Suddenlink F14

- Removed records without speed codes, as per the provider these indicate blocks and street segments without Suddenlink broadband service.
- Checked census block data for duplicates, none found
- Added provider type code 1 to all records. Added EndUserCat code 5 to census block data. Changed EndUserCat of 3 to 2 for address data. Added provider type code 1 to all records. Added EndUserCat code 5 to census block data
- HOUSE_NBR was the unique ID in the past. Used it for table joins to the F14 address data.
- Started with the S14 dataset as a foundation. For all addresses that joined to S14, used the S14 location, but updated the BB attributes (if there were changes) – 4,354 addresses matched. For all F14 addresses that did NOT join to S14, geocoded and added to the S14 dataset – 709 new addresses. Addresses that existed in S14 data, but not in F14, were not deleted. Combined matched and new addresses, and removed 48 exact duplicates. Used frequency tool to check for other duplicates, none found.
- 99.97% of addresses have coordinates

- Confirmed with provider that all of the network is DOCSIS 3.0 capacity, but that they have not yet increased their advertised speeds, they have determined that their market does not currently support it
- Since Overview data has not been updated, the transtech code was edited to reflect the network change to DOCSIS 3.0. Weighted speed values not updated.
- Verified FRN 0014848808 in FCC FRN search system online.

Surry TMC and Piedmont Communications F14

- Added zeroes to FRN for 10-digit format.
- Corrected typo in provider name and DBA name fields for Surry Telephone Membership Corporation (lastmile and overview). Standardized provider name and DBA name fields in midmile.
- Checked CB data for duplicates, none found
- Used script to create hypothetical incrementally within the address ranges supplied in Excel format.
- Spatially joined the geocoded points to polyline street segments, then dissolve to remove duplicates. Used max of speeds as statistics fields.
- Used Tigerline address attributes for the in street attribution, parsed accordingly.
- Removed 13 CBs where streets were given (they were double reported)
- Noted that 29 CBs greater than 2 square miles were reported instead of street segment data.
- Verified FRN 0001952605 for DBA Surry Telephone Membership Corporation, and 0004329280 for DBA Piedmont Communications.

TDS Telecom F14

- Data submitted as geodatabase feature classes, availability at address level. No duplicates found. There are 41 new addresses.
- Added EndUserCat of 5.
- Duplicated max advertised speed codes in typical speed fields of address data.
- Added ZIP code values for 39 address records. Corrected other ZIP code values in the process. Re-concatenated Address values to incorporate the new ZIP values and commas to allow for comma delimited parsing later.
- Checked that all address points were in NC.
- Previously confirmed FRN's 0003767662 for Saluda Mountain, 0003767712 for Service, and 0003766714 for Barnardsville in the FCC FRN Search System.

Tele-Media

- Carried forward previously reported footprint except for updated speed codes, per instruction by the provider based on a recent network upgrade.

Time Warner Cable F14

- Changed DBA Name to proper case to match ProvName field and other datasets
- CB and Streets:
 - Reprojected into WGS 1984
 - Added Provider Type field and coded as a "1"
 - Added EndUserCat field and coded as "5"
 - Input Max Advertised speeds as Typical Speeds as well, since they were not included.

- Streets: no min or max address ranges of any kind were included in the data, so a spatial join with Tiger 2012 street centerlines was done to attach address ranges based on “center contained in” criteria. Used script to calculate absolute min and max address values.
- Checked census block layer and street segments for duplicates, none found.
- Ran geometry repair on census blocks and street segments (no errors found)
- Previously mapped middle mile data for which no changes were reported this round. and which contained nationwide connection facilities TWC chose to include as middle mile. None of these fall within North Carolina’s boundaries, so none were added to the transfer geodatabase.
- Confirmed FRN 0007556251 in FCC Search System.

T-Mobile F14

- Middle mile missing elevation, substituted -9999
- Reprojected shapefiles into WGS 1984.
- Added Notes field to categorize by technology type/T-mobile service tier (LTE, U1900, HSPA21, HSPA42, UTMS).
- Attributed manually from information sent in a text file from T-Mobile.
- Eliminate Polygon part tool to remove features <0.125 square mile.
- Added spectrum info based on follow up with provider, duplicated footprints that utilize more than one category of spectrum (per provider email Spring 2014).
- Verified FRN 0006945950 in FCC FRN search system
- Ran repair geometry to check for any errors in topology, none found

Tri-County F14

- 31 exact address duplicates were removed from data in Excel, and 30 more exact duplicates minus differing lat/long values provided.
- Addresses for availability were geocoded where coordinates were missing (three addresses were still unmatched afterward).
- Address data for wireline service and wireless service were separated for mapping.
- Addresses for wireline availability that had coordinates were mapped from an XY Event layer.
- Addresses within CBs <2 square miles were separated from address within CBs > 2 square miles
- For addresses inside CBs < 2 square miles, *addresses with lat/longs submitted and geocoded addresses merged together, then aggregated to corresponding census blocks, using spatial joins with max merge rule for speed fields.*
- For addresses inside CBs > 2 square miles, spatially joined to obtain census block numbers and submitted as address level.
- Final check for duplicates among census block and address records, using Frequency tool.
- Adjusted syntax for consistency in Provider Name and DBA Name throughout submission
- *Addresses for wireless subscribers mapped using existing lat/longs and minimum bounding polygons created (using Convex Hull option). Convex hull vertices manually edited from last round to include several addresses that mapped outside of the previous polygons. Buffer polygons of 500 feet from street segment centerlines adjacent to two outlier customer locations were also added to the multipart wireless service polygon. Insufficient information was available to create accurate footprints via wireless propagation modeling.*
- Spectrum code of 6 inserted.

- LastMile - missing ownership, inserted 0. Also, the last mile points were being reported some distance away from their availability locations. The coordinates reported by provider were found to be incorrect. The provider then supplied addresses for central offices, which were used to correct most locations by geocoding, and four locations for wireless towers were corrected using coordinates supplied separately from the provider, then one record was located using range-interpolation in the Google geocoding API. Two locations could not be corrected with confidence, so these were excluded. Resulting data was the same as in previous round.

Verizon Wireless F14

- Created new, single-feature layers for "evdo", "aws" and "lte" shapefiles, using a dissolve by state abbreviation field.
- Added spectrum code field and populated accordingly, duplicating dissolved 3G/EVDO/CDMA feature for PCS and Cellular spectrum codes.
- Merged the dissolved "evdo", "aws" and "lte" files into one shapefile and filled in the appropriate attribution, using accompanying document from provider specific to each spectrum code.
- Duplicated "aws" footprint to reflect different speed tiers offered with this spectrum range in 3G versus 4G coverage.
- Simplified wireless polygon to remove extraneous vertices, max offset 150 ft.
- Eliminated polygon parts less than 0.125 square miles
- Confirmed FRN 0003290673 in FCC FRN Search System.

Wilkes F14

- Worked together with the provider to reflect ongoing transitions from copper to fiber network. First, provider sent remote boundaries as shapefile.
- Remote boundaries were converted to polygons. Broadband characteristics were added to these using table join with a spreadsheet compiled by the provider, with remote name as the linking field. After checking with the provider, typical speeds were edited to match the max speeds, better reflecting typical user experience at the max tier during peak hours, rather than factoring in subscribers of lower speed tiers.
- Intersect function linking the remote boundary attributes to the street segment within each one, and excluding partial street segments that extend outside the remote boundaries.
- 2957 duplicate records removed using Delete Identical tool, taking geometry and attributes into account.
- Updated weighted speeds, and middle mile connection points to reflect recent changes from copper to fiber network. Converted middle mile coordinates from degrees, minutes, and seconds using the formula: $\text{Degrees} + \text{Minutes}/60 + \text{Seconds}/3600 = \text{Decimal Degrees}$

Windstream F14

- Windstream submitted census blocks and addresses with lat/long coordinates for census blocks greater than two square miles.
- Concatenated address field in address data to include city, state, and all ZIP information.
- Address data was formatted and mapped by creating XY Event Layer and exporting to a permanent shapefile. Checked for duplicates in Excel, none found.
- Once mapped, confirmed census block numbers for address locations. All were correct.
- 999 typical download speed values were changed from 0 to 3 (or 5 if max advertised down/up speeds were 7 and 5 respectively) to make consistent with accompanying values.

- Census block data was searched for duplicates and, finding none, was mapped via attribute join to the 2010 census block template shapefile.
- 1127 typical download speed values were changed from 0 to 3, making consistent with accompanying values.
- Middle mile data was not submitted, and was carried over from previous rounds, after updating the provider and DBA name fields to match syntax with the new data.
- Verified FRN 0003762010 for Windstream Concord Telephone, and 0004967634 for Windstream North Carolina in the FCC FRN search system.

Yadtel F14

- Structures file represents where service is available, rest of submission represents actual subscribers
- Consolidated into one dataset of copper and fiber using the address. Where structures had both copper and fiber indicated, there are two entries with the respective transtechs.
- All address points were geocoded due to observed errors with the provider-reported coordinates.
- EndUserCat based on structures file. If Occupant is not null, then 2, otherwise 5. If address did not appear in structures (as was the case for much of the copper), then EndUserCat = 5
- FRN for Structures populated according to instructions from the provider. In structures file, FRN varies by EXCHANGE column. If EXCHANGE = MOCKSVILLE or YADKINVILLE, then FRN = clec, all others are ilec.
- Copied typical speeds from advertised speeds
- Filled in ProvName and DBAName fields where missing (availability addresses). This time the provider was consistent with those names in both ilec and clec.
- Final review of Address duplicates removed 1,615 records.
- Last Mile: Replaced height above sea level elevation values with -9999

Providers for which typical speed information was not supplied to NC Broadband:

- AT&T (FRN: 0001857952)
- Barnardsville Telephone Company (FRN: 0003766714)
- Comcast (FRN: 0013431911)
- Frontier Communications of the Carolinas, Inc. (FRN: 0018802660)
- Greenlight/City of Wilson (FRN: 0015950934)
- Saluda Mountain Telephone Company (FRN: 0003767662)
- Service Telephone Company (FRN: 0003767712)
- Time Warner Cable (FRN: 0013430244)
- Verizon (FRN: 0001962588)
- ViaSat Communications (FRN: 0007843766)
- Yadtel (FRN: 0004341285 and 0003747847)

For these providers listed, the coded values for maximum advertised speeds were duplicated in the typical speed fields, since the placeholder code “ZZ” to indicate missing information is no longer

accepted in the data model. When typical speed information is not supplied by the provider, a comprehensive and accurate substitute is not available, particularly since speed test data does not necessarily reflect the throughputs of the highest speed tier available.

Post-processing Functions for Final Integration

Census Block

After Census Block data was loaded into the transfer geodatabase feature class, FIPS code fields were calculated using commands in the Field Calculator and contents of the FullFIPSID field. The following calculation formulas were used:

STATE FIPS = Left ([FULLFIPSID],2)

COUNTYFIPS = Mid([FULLFIPSID],3,3)

TRACT = Mid([FULLFIPSID],6,6)

BLOCKID = Right ([FULLFIPSID],4)

- Duplicate records were identified using the ArcToolbox Frequency tool and various field combinations. Duplicates were resolved by editing Pineville Telephone Company's FRN field to avoid confusion (this provider uses the same FRN for two DBA's).
- Warnings on speed values were identified and either edited or explained after follow up with the provider and/or further investigation.
- Ran repair geometry tool 2x and confirmed that no features were deleted.

Road Segment Data

- Warnings on speed values were identified and either edited or explained after follow up with the provider and/or further investigation.
- Ran repair geometry tool and confirmed that no features were deleted.

Address Data

- Warnings on speed values were identified and either edited or explained after follow up with the provider and/or further investigation.
- Ran Repair Geometry tool and features that could not be accurately geocoded were removed for null geometry.
- Manually corrected some missing values in several component address fields, and was able to populate from contents of the full address field.

Wireless

- Duplication of multipart coverage polygons to reflect multiple speed combinations or spectrum ranges used, per NTIA/FCC instruction.
- Warnings on speed values were identified and either edited or explained after follow up with the provider and/or further investigation.

- Ran Repair Geometry tool 2x and confirmed that no features were deleted.

Overview

- Field Calculated “Geographic Unit Type” field to CO, and “StateAbbr” field to NC.
- Deleted records of information for wireless technology types.
- Verified that all FRN’s were either 9999 or 10 digits with leading zeroes.
- Ran Repair Geometry tool 2x and confirmed that no features were deleted.

Last Mile

- Field Calculated “Ownership” field to -9999 for records null in this field. Calculated “StateAbbr” field to NC.
- Ran Repair Geometry tool and confirmed that no features were deleted.

Middle Mile

- Spatial join with census block layer to derive the 15-digit FIPS code, then reload features into middle mile feature class including the new values for populating the “FullFIPSID” field.
- Replaced Null Elevation values with -9999 “default” value using Field Calculator.
- Populated State Abbreviation column with “NC”.

Community Anchor Institutions (CAI)

- Parsed address components for some records that still had null values (street name and city fields)

Verification Implemented Prior to Fall Data Submission

Data verification methods implemented by NC Broadband in time for submission at the federal level followed generally along the lines of quality control. Methods most often used are outlined below. Time constraints on existing staff did not allow for the execution of some more complex verification approaches, but verification involving multiple data sources is in use and will continue to develop as part of NC Broadband’s ongoing work.

Standardizing

The files from datasets received from each provider, except for those few submitted in shapefile format, were manually transferred to a back end Excel-format template with field headers, to create a single-file, standardized field structure for each provider’s data that could be used for quick reference and map feature creation. This step also helped staff to ensure that all required components were either present or requested in follow up to the provider, and that the components were reported in the correct format.

Lat/long coordinates

Some information was submitted to NC Broadband with lat/long coordinates included for the location of point features. This location information was checked during the mapping process, and values were corrected if the provider had made mistakes such as reversing the latitude with the longitude, or forgetting to include the negative sign for the longitude value. In addition, NC Broadband followed up with providers on point features that showed up in the map outside the state and/or outside the provider’s reasonably expected service area. Point features that mapped outside the state after follow

up with providers, including those that mapped to zero degrees latitude and longitude due to an unknown location, were deleted from the geodatabase for submission at the federal level. For fixed wireless data generated by propagation model from antenna specs, the latitude/longitude coordinates of the antenna locations reported by the provider to NC Broadband were verified by NC Broadband's university GIS research contractor (UNCG Center for GIScience) using high-resolution orthoimagery.

FRNs

In several instances, providers reported multiple FRN's that increased in numerical increments of one for each record of data, and this was found to be a simple error when the providers were trying to paste their organization information down the rows applying to a list of broadband data records. This was checked for and corrected after confirming that the lowest/first reported FRN was the correct one. In some cases, the provider did not include an FRN in their data. The FCC's online FRN search tool (<https://apps.fcc.gov/coresWeb/publicHome.do>) was used to verify all reported FRN's as well as to look up FRN's by business name key words, to accompany reported coverage data.

Correct technology type codes

Knowledge from our technical staff and online research was sometimes used to supplement data that NC Broadband had relevant to a provider that was unresponsive or otherwise did not supply this specific piece of the information. For example, a provider may have gaps in their transmission technology field and these were filled in when technical staff could confirm that the provider operates with only a single technology type. Or the staff may know which technology type is used by a provider who left this field blank on all records.

Subscriber-weighted nominal speeds

Weighted nominal speed values were checked, and staff followed up with the provider if all values were the same for multiple counties, as this could result from either a single speed tier for a given transmission technology across counties, or in some cases providers were not following the formula provided and had manually entered the same value regardless of differences in subscriber numbers. When these cases were discovered, technical assistance was offered and a new subscriber-weighted nominal speed dataset created to reflect variation between counties.

Wireless model fieldwork

For fixed wireless provider data that was generated as coverage area output from models based on technology and environmental factors, the data was verified by "ground-truthing" with measurements of signal strengths at sample locations within a provider's service area, observation of the influential ground conditions in each location, and comparison to the expected signal strengths at the same locations in the model. Some calibration of the model was then performed so that the resulting polygons could more accurately reflect what would be found in real life.

Check Geometry

After compiling all datasets into the geodatabase feature classes, the check geometry process in Arc Toolbox's Data Management section was used on each feature class to identify and repair any geometry errors in the features.

Provider Feedback

Mapped data sets from previous rounds can be viewed securely by any provider using their browser and login information provided by NC Broadband. Also, a map for review is sent back to the provider for all

fixed wireless providers, and others if a question arises during the mapping process, or if a provider is participating for the first time, or by request on the part of the provider. Mapped data can be sent as a high-resolution PDF (for zooming in on details), a KMZ file, or ArcGIS Explorer interactive map.

Comparisons with Citizen-Sourced Data

NC Broadband maintains a mapped database of input from citizens who report having no access to broadband at their location from any broadband provider (or possibly just mobile or satellite options that don't meet the user's needs or budget from their perspective). Input is collected throughout the year directly from local citizen advocates, from NC Broadband's website feedback form, and from locally conducted surveys. Comparison of provider-sourced data with this information has allowed for targeted follow up with providers in order to promote access to broadband for these citizens, as well as to pursue refinement of our statewide broadband data. FCC deadzone and speed test data was also retrieved and processed for inclusion in data comparison, although this information is now dated and an update to this information by the FCC would be of great help.

North Carolina continues to work with the North Carolina Department of Public Instruction and State Board of Education to look at how to best partner on ways to obtain more granular citizen-sourced data of unserved areas. With the move to online textbooks in NC by 2017, we are examining how we can better work with the school systems to identify these unserved pockets, for verification of the FCC's 477 deployment data collection efforts and for demand aggregation pockets for our last-mile work under our Technical Assistance program. Mapped survey results would be used for data comparisons and verification, shared with providers that serve the areas, and discussed in locally-based broadband planning teams with technical assistance staff provided by NC Broadband.