Universal Service Administrative Co.

Geolocation Methods

A guide to successfully collecting broadband deployment data

Carriers participating in modernized Connect America programs must file complete, reliable geolocated broadband deployment data with USAC's High Cost Universal Broadband (HUBB) portal. This data will show where you are building out mass-market, high-speed Internet service. To help you prepare, we have created this guide describing three methods for gathering geolocation data (latitude and longitude coordinates), with the pros and cons of each approach.

You can use any method or combination of methods to gather the correct coordinates for the locations you serve. Be mindful that accurate data is key to filing successfully with the HUBB. This data will show the impact of Connect America funding and will appear on a public-facing map to display progress in expanding broadband throughout rural America.

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Overview of Geolocation Methods

Geolocation is the process used to collect latitude and longitude (lat/long) coordinates that represent a specific location. We describe three geolocation methods:

- **Geolocation with GPS in the field.** (Best results)
  This process involves going out in the field, standing at a location with a smartphone, tablet, or other mobile device enabled with GPS technology and capturing the lat/long coordinates.

- **Desktop geolocation using web-based maps and imagery.** (Very good results)
  This approach uses secondary resources, such as web-based maps and imagery, to identify specific locations and look up the corresponding lat/long coordinates.

- **Automated address geocoding.** (Good results)
  This method, which can be used to process large batches of street addresses, uses an address geocoder program to convert addresses into lat/long coordinates.

Geolocation Data Collection Guidance

When collecting geolocated deployment data for the HUBB, follow this guidance:

- Whenever possible, location coordinates should represent the structure being served and should be collected at some point inside the structure's footprint, also called a "rooftop" coordinate. Ideally, you should gather coordinates at a spot unambiguously associated with the structure, such as the network connection point or the front door.
- At a minimum, coordinates should represent a point on the correct property or parcel of land where service is being delivered. You should try to collect coordinates as close as possible to the structure being served.
- Do not submit coordinates at the network node or pedestal used to serve a location.
- For all location data collection methods, latitude and longitude coordinates must be reported in decimal degree format, to at least six decimal places. For example, the coordinates for the USAC office in Washington, DC are:

  Latitude: 33.898618
  Longitude: -77.028845

Geolocation with GPS in the Field

The most precise method for collecting lat/long data is to go into the field and capture coordinates at each individual location using a GPS-enabled device. This method will produce the most reliable results with the fewest errors, ensure that coordinates are gathered for the correct location, and reduce the need for additional data collection, verification, and/or clean-up.

Recommended Collection Method

There are several easy-to-use GPS apps on the market that you can install on a smartphone or tablet either for free or at a very low cost. Equipping your installation, inspection, and repair crews already in the field with GPS-enabled devices can minimize the need for specific trips to collect data.

When collecting geolocations in the field, make sure you capture the lat/long coordinates from a point on the correct property or parcel of land where service is actually being delivered. Ideally, you should capture coordinates at a point within the footprint of the actual structure being served, such as the network connection point or the front door.

Things to Consider

Field work can be time-consuming and expensive. To be as efficient as possible using this method:

- Outfit field crews with GPS technology to collect location coordinates during routine maintenance, repair, and construction,
- Minimize technology issues by performing setup, testing, and any needed training before heading out in the field, and
- Plan the field work in advance. Determine an optimal route, or a set of locations to be collected during the same trip, to make the most effective use of time and resources.

Desktop Geolocation Using Web-Based Maps and Imagery

Desktop geolocation uses secondary resources, such as web-based maps and imagery, to identify specific locations and look up the corresponding lat/long coordinates. Although this is typically a manual process, it can produce accurate results, assuming that the web-based maps and imagery are good quality and that the location can be properly identified.

Recommended Collection Method

Below is a typical workflow for collecting lat/long coordinates from a web-based map. Please note that there are many different methods and resources for this type of process.

1. Open a web-based map and navigate to the location you want to geolocate. This can be done by either searching for an address or zooming and panning in the map.
2. Turn on the imagery (i.e., aerial photo view) and zoom in to the specific location/structure.
3. Once at the location, identify the lat/long coordinates within the application. (With many applications this requires placing the cursor over the location and right clicking).
4. Copy and paste the lat/long coordinates into the appropriate columns in your file for uploading to the HUBB.

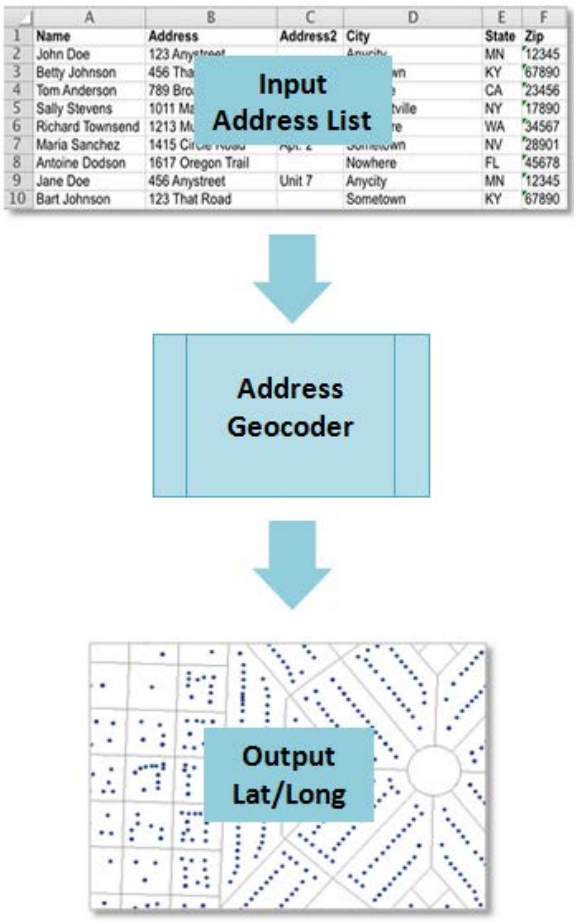
Things to Consider

When it is not feasible to go into the field to visit network locations with a GPS device, desktop geolocation offers a viable alternative. This approach can be highly reliable, but be aware that:

- This method relies on available maps and imagery, which in some cases may be out of date, particularly in rural areas. Finding locations of new structures, for instance, can pose a challenge if the only available maps and images predate construction. These types of situations introduce uncertainty and may require verification using another geolocation method.
- It may be difficult to identify specific structures if there is a lot of tree cover or if other nearby buildings have the same footprint and look very similar from above.

Automated Address Geocoding

Geocoding is an automated method that uses an address geocoder program to convert address information into lat/long coordinates. This approach can process large batches of addresses in bulk and at a low cost. But the results can vary in accuracy, based on the quality of the address input data and the underlying reference data.



Geocoding programs work by deciphering the parts of an address and attempting to provide matching lat/long coordinates based on underlying reference data. The reference data may contain an exact match to an address, producing a dependable result. But in many cases, particularly in rural areas, geocoding programs may not be able to find a match for every address and instead "interpolate" (or estimate) coordinates, leading to less reliable outcomes. In some cases, geocoders may not be able to find matches at all if locations are missing from the underlying reference data.

At times, geocoding can even produce coordinates that are far removed from the actual location being mapped, particularly in rural areas where the reference data is often unreliable or simply out of date. This means that you will need to review and clean up geocoding results – and potentially reprocess some of them – to ensure accuracy.

Recommended Collection Method

There are several different types of geocoders on the market that can process large batches of data, including a number of commercial products. Costs and data output quality vary.

A number of state GIS (geographic information systems) agencies have also published free geocoders. Government agencies are continually working to improve address data for 911 emergency response purposes and therefore often have high-quality geocoders. Here is a partial list of available, government geocoders:

State	Geocoder URL
Arkansas	http://gis.arkansas.gov/?product=arkansas-statewide-geocoder
Delaware	https://firstmap.gis.delaware.gov/pdfs/public/FirstMapGeocoder.pdf

Indiana	https://gis.in.gov/arcgis/rest/services/Indiana_Composite_Locator/GeocodeServer
Montana	http://ftp.geoinfo.msl.mt.gov/Documents/Applications/UsingMSLGeocodingService.pdf
New Jersey	https://njgin.state.nj.us/NJ_NJGINExplorer/jviewer.jsp?pg=Address
New York	http://gis.ny.gov/gisdata/inventories/details.cfm?DSID=1278
Utah	https://gis.utah.gov/using-the-mapserv-utah-gov-api-to-geocode-address/
Vermont	http://vcgi.vermont.gov/warehouse/web_services/geocoding
Washington, DC	http://octo.dc.gov/service/master-address-repository

Things to Consider

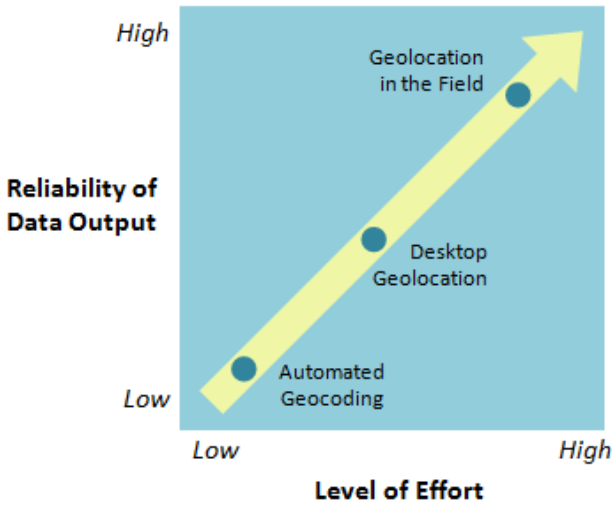
The output of geocoders is only as good as the address input data and the underlying reference information (which varies by geocoder). Here are some things to keep in mind:

- Be sure that addresses are accurate, complete, and consistent before submitting them to a geocoding program. Missing or incorrect ZIP Codes, for example, can lead to serious errors.
- Be aware of geocoder limitations. Automated processes often have difficulty handling certain situations, such as:
    - Ambiguous addresses
      (i.e., 214 Elm Terrace vs. 214 W Elm Terrace)
    - Inconsistent address formatting
      (i.e., 742 West Main Street vs. 742 W Main St vs. 742 Main St W.)
- Keep in mind that rural addresses can be difficult to accurately geocode since reference data may be unreliable or incomplete. When this is the case, geocoders typically use an interpolation process which assigns lat/long coordinates to a location along a street segment based on street address range. For instance, if the addresses along a length of street range from 100 to 200 and the address your geocoding is 150, the geocoder will place the location halfway down the length of the street. This approach can lead to incorrect results, such as:
    - Lat/long located far from the actual location. The geocoder's reference data may include the maximum range of potential addresses on a street segment (1-99) even if there are fewer actual addresses assigned in the real world (57-89). This can result in the interpolation of an address to an incorrect point along the road and possibly in an area not eligible for support.
    - Lat/long located on the wrong side of the street. Geocoders often assume that all even-numbered addresses are on one side of the street and all odd-numbered addresses are on the other side of the street. But this is not always the case in the real world, so the resulting coordinates may be on the wrong side of the road and possibly in an area not eligible for support.

- Cascading to less granular geographic levels. If the geocoder is unable to make a match to a street address, it may cascade to a match at the ZIP Code level and assign lat/long coordinates for the centroid of the ZIP Code area. The HUBB will reject points matching ZIP Code centroids.

Comparison of Methods

The diagram below shows the general relationship between the reliability of data output and the level of effort put in for each of the three geolocation methods. In short, the best data requires more up-front effort but pays off in the long term with reliable, high quality data.



This table summarizes the differences between the methods.

Method	Data Confidence	Level of Effort Needed	Pros	Cons
Geolocation with GPS in the Field	**Best Results:** Yields extremely reliable and highly consistent results since the data collection is performed at the location in the field	**Highest:** Coordinates are captured by physically traveling to the location, although effort is reduced if coordinates are collected when crews are already in the field	Best accuracy and highest confidence that the lat/long represent the actual deployment location	Time consuming to travel to each location and requires some minimal setup/training for data collection via mobile app
Desktop Geolocation using Web-based maps/imagery	**Very Good Results:** Output is generally very reliable, but depends on quality of imagery and ability to properly identify locations on a web-based map	**Medium:** Coordinates are captured by reviewing imagery on a desktop/laptop and placing a point for each location	High confidence in results and you only need a computer with an Internet connection	Manual process to find each location on map, and then click and capture coordinates for each one
Automated Address Geocoding	**Good Results:** Results depend greatly on the quality of the address input data and the underlying reference data	**Lowest:** Addresses are automatically geocoded in batches, although results may need to be reviewed and potentially re-run or field verified (which would require more effort)	Able to quickly process large batches of data	Results may vary in completeness and accuracy, and some may not match actual location. May need software and expertise to run the geocoding process. Data clean-up and verification may be needed after addresses are geocoded

Examples

The diagrams below display two different rural locations, and illustrate how the methods described above can produce different lat/long coordinates.

Example 1: An address in Vermontville, NY 12989

Example 2: An address in Saranac Lake, NY 12983