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Delaware Broadband Data and Development

Fall 2013 Data Submission White Paper

Submitted by:

GeoDecisions
A Division of Gannett Fleming

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Table of Contents

1 Introduction

As part of the American Recovery and Reinvestment Act (ARRA), the National Telecommunications and Information Administration (NTIA) released its State Broadband Data and Development Grant Program[1] Notice of Funds Availability (NOFA). The NTIA then awarded the State of Delaware funding to create a database of broadband deployment (Project) in the State of Delaware (State). GeoDecisions and its team partner CBG Communications, Inc. (CBG) have been retained by the State of Delaware (collectively referred to as the "State Parties") to perform a variety of tasks as part of the Broadband Data Development process, with the goal being creation of maps of the State showing where broadband is available, Providers' names, and speeds or bandwidth provided to citizens, businesses, and anchor institutions throughout the State.

The NOFA requires mapping of facilities-based Providers' availability of broadband speed internet access in the State. The NTIA, in the NOFA, defined broadband as "Broadband service is 'available' to an end user at an address if a broadband service provider does, or could, within a typical service interval (7 to 10 business days) without an extraordinary commitment of resources, provision two-way data transmission to and from the Internet with advertised speeds of at least 768 kilobits per second (Kbps) downstream and at least 200 Kbps upstream to the end user at an address."

The following specific project tasks were to be performed and completed by GeoDecisions and CBG with oversight by State staff:

- Drafting, negotiation, establishment, and status reporting of all Non-Disclosure Agreements (NDAs) with broadband service Providers to support the Delaware broadband expansion initiative.
- Mapping of broadband Providers and service attributes, including technologies utilized and advertised speeds available to end users.
- Support of field verification of broadband mapping.
- Development of web-based mapping applications.
- Project, task, and contract management.
- Review of Provider marketing materials.
- Assistance in developing criteria for web-based surveys and speed tests.
- Quality Control and review of all deliverables.
- Assistance in the development of a data maintenance document.
- Identification and assessment of broadband infrastructure.
- Participation in weekly status and project meetings with internal staff, NTIA, the University of Delaware, the State of Delaware, Providers, and all other stakeholders or as required.
- Submission of weekly status reports or as required.

[1] http://www2.ntia.doc.gov/SBDD

The Project began with meetings with the State, GeoDecisions, and CBG to map out the processes that needed to occur in order to produce an accurate map that included all known broadband Providers that were willing to participate in the project. It should be noted that broadband Providers (Providers) were not required to participate in the Project but were encouraged to provide data specific to their networks so the State would have maps that were as accurate as possible. Providers that applied for federal grant funds for network expansion or upgrades, however, would be eliminated from consideration for these grants if they did not cooperate with the State on this project.

1.1 List Compilation

The first task was to compile a list of all known broadband Providers throughout the State and contact information for each of these Providers. Information from FCC databases, Internet research, and the State Parties' overall understanding of the broadband industry was utilized to compile the list. Updates are made to the list each round based on these sources and/or provider interaction.

1.2 NDA Negotiation

Contact was then made to each of the Providers to determine whether they had facilities in the State that provided broadband to end users. If so, the Providers were encouraged to participate in the project by providing the pertinent data needed to create the State's maps. Many Providers believe that some of the information required from them for participation is confidential and cannot be released to the general public. To overcome this obstacle, the State Parties created a Non-Disclosure Agreement (NDA) template whereby information deemed confidential by the Providers would not be released publically by the State Parties. The NDA also ensured that all information requested from the Providers is available for release to the NTIA as required by the NOFA. Based on the variation among Providers on what information is deemed confidential and varying interpretations of the template NDA, negotiations were held with many of the Providers to modify the NDA to meet the Providers' needs while still allowing the State Parties to utilize and share the information as required in the NOFA. Once the Providers and the State Parties signed an agreed-upon NDA, the data gathering process proceeded. When Providers change, an NDA is created as required.

1.3 Data Gathering

As each Provider signed an NDA with the State Parties, they were referred to GeoDecisions' mapping department where they were asked to provide specific data in formats that would be compatible with the State's mapping process. Although many of the Providers had previously provided system data to the Federal Communications Commission (FCC), those submissions showed availability at the Census Tract level. The requirements of this Project were for mapping of network availability at the Census Bock level, which is more granular than previously submitted data. Furthermore, in Census

Blocks that are larger than 2 square miles, data was gathered at the street segment level (eg. From # 1 First Street to #111 First Street).

Prior to each round, NTIA provides the database schema specification in which providers should provide their data to the the State Parties; NTIA may choose to not adjust the schema from the prior round. In January 2013, NTIA requested providers submit their data as overlapping polygons in areas where multiple speeds and spectrum bands are used. In previous submissions only the highest speed polygon was required for areas with multiple tiers. This previous submission approach - called clipping polygons - is no longer desired.

As Providers supplied their data, GeoDecisions created maps of the State showing where each of the Providers' footprint(s) was located, as well as other required attributes such as advertised speeds available in these areas and the technologies utilized to provide service to end users.

1.4 Provider Data Submittal

NTIA 8th data submission included data from 19 Broadband providers, where 11 of the providers have submitted new data updates; the following is a brief description of the data provided:

1- AT&T Mobility LLC.

DBA Name: AT&T

FRN	0004979233
Date of submission	8/22/2013
Type of Data Submission	• 3 Coverage Shape files. • Excel Sheet.
Census Blocks	N/A
Road Segments	N/A
Middle Mile infrastructure	No
Technology of Transmission	Terrestrial Mobile Wireless
Data description	AT&T provided 3 shape files that showed coverage of: • 3G • 4G • 4G-LTE Over the three counties of the state of Delaware. The excel sheet contained speed data, Technology of transmission & Mobile Spectrum.

2- Comcast Cable Communications, LLC.

DBA Name: Comcast

FRN	0004441663
Date of submission	8/9/2013
Type of Data Submission	• Excel Sheet of block coverage. • Excel Sheet of street coverage. • Excel Sheet with speed information.
Census Blocks	13329 Technology 40
Road Segments	723 Technology 40
Middle Mile infrastructure	No
Technology of Transmission	Cable Modem - DOCSIS 3.0
Data description	Three excel sheets, which included: Comcast blocks coverage, Street coverage, and speed information.

3- MegaPath Corporation.

DBA Name: MegaPath

FRN	0003753787
Date of submission	8/12/2013
Type of Data Submission	• Text file tab delimited with block coverage. • Text File with Subscriber-Weighted Nominal Speed. • Text file with a note “No Middle Miles in DE”.
Census Blocks	3292 Technology 10 2805 Technology 20 6544 Technology 30
Road Segments	No
Middle Mile infrastructure	No
Technology of Transmission	Asymmetric xDSL Symmetric xDSL Other Copper Wireline
Data description	Two text files tab delimited, and a read me file. One text file contains only block coverage data for blocks less than 2 square miles. The other text file contains data of subscriber-weighted nominal speed.

4- T-Mobile USA, Inc.

DBA Name: T-Mobile.

FRN	0006945950
Date of submission	8/19/2013
Type of Data Submission	• Four shape files with Coverage Areas for the different speeds. • Text file with technology and Spectrum and speed. • Excel sheet with Subscriber Weighted Nominal Speed. • No Middle Mile Notice.
Census Blocks	N/A
Road Segments	N/A
Middle Mile infrastructure	No
Technology of Transmission	Terrestrial Mobile Wireless
Data description	Four shape files that provide Broadband coverage with four different speed ranges for upload and download; the Technology and spectrum were provided by a different text file; Nominal speed came from an excel sheet.

5- Cellco Partnership and its Affiliated Entities

DBA Name: Verizon Wireless.

FRN	0003290673
Date of submission	7/17/2013
Type of Data Submission	• Shape file for 4G Coverage (LTE). • Shape file for 3G Coverage (EVDO). • Email with Spectrums and speed.
Census Blocks	N/A
Road Segments	N/A
Middle Mile infrastructure	No
Technology of Transmission	Terrestrial Mobile Wireless
Data description	The two shape files provided Coverage area for different speed range (4G – 3G), an email provided the speed and spectrum.

6- Verizon Communications, Inc.

DBA Name: Verizon Delaware, LLC.

FRN	0003271798
Date of submission	9/2/2013
Type of Data Submission	• Text file tab delimited with block coverage. • Text file tab delimited with street segment coverage. • Text file with Weighted Nominal Speed by technology and county. • Notice with no middle mile.
Census Blocks	11687 Technology 10 6793 Technology 50
Road Segments	1170 Technology 10 457 Technology 50
Middle Mile infrastructure	No
Technology of Transmission	Asymmetric xDSL Optical Carrier/Fiber to End User
Data description	Two Text files with Census blocks and Street segment coverage; weighted nominal speed came in a separate text file.

7- Sprint Nextel Corporation.

DBA Name: Sprint.

FRN	0003774593
Date of submission	8/26/2013
Type of Data Submission	• One Shape file with two Coverage areas with different spectrums and speeds. • A Readme file explaining the coverage area.
Census Blocks	N/A
Road Segments	N/A
Middle Mile infrastructure	No
Technology of Transmission	Terrestrial Mobile Wireless
Data description	One Shape file specifying the spectrum and speed of two coverage areas.

8- Hughes Communications, Inc.

DBA Name: Hughes Network Systems.

FRN	0018483073
Date of submission	7/28/2013
Type of Data Submission	• A Text file with Zip codes of the coverage area.
Census Blocks	N/A
Road Segments	N/A
Middle Mile infrastructure	No
Technology of Transmission	Satellite
Data description	Email with coverage and speed.

9- Clearwire Corporation

DBA Name: Clear (WiMAX markets), Clearwire (Expedience Markets)

FRN	0017775628
Date of submission	8/22/2013
Type of Data Submission	• One Shape file with Coverage. • A Word document with FRN, Technology, and Speed information.
Census Blocks	N/A
Road Segments	N/A
Middle Mile infrastructure	No
Technology of Transmission	Terrestrial Fixed wireless-licensed
Data description	One Shape file with coverage information, and a document for FRN, technology and speed information.

10- Atlantic Broadband (Delmar), LLC.

DBA Name: Atlantic Broadband

FRN	0009596875
Date of submission	8/29/2013
Type of Data Submission	• Text file tab delimited with block coverage. • PDF file with FCC 477 form.
Census Blocks	1342 Technology 41
Road Segments	215 Technology 41
Middle Mile infrastructure	No
Technology of Transmission	Cable Modem - Other
Data description	Text files tab delimited, contains block coverage, and FCC 477 form contains FRN, and technology of transmission.

11- Level 3 Communications, LLC.

DBA Name: Level 3 Communications, LLC

FRN	0009596875
Date of submission	8/26/2013
Type of Data Submission	• Text file tab delimited with Address point availability. • Text file with Middle mile information.
Census Blocks	164 Technology 50
Road Segments	No
Middle Mile infrastructure	No
Technology of Transmission	Optical Carrier/Fiber to the End User
Data description	Text files tab delimited, contains two address point service locations, and a middle mile text file contains 4 middle miles locations.

1.5 Data Processing

The method for processing the data varies depending on the data received from each provider; the following is a brief summary of the steps taken to process the data for each provider for the 8th round.

1-AT&T Mobility LLC.	
Processing Mobile Coverage Area	• Apply Repair Geometry on coverage Shape file. • Load Repaired Shape file into Transfer data model using append. • Use excel sheet values to calculate technology, spectrum, and speed for three speed tiers (3G-4G-4G-LTE). • Result is stored in “BB_Service_Wireless”.

2- Comcast Cable Communications, LLC.	
Processing Census Block Coverage Area	• Census block coverage excel sheet exported into dbf after adjusting column name (less than 11 characters). • Template of 2010 Census block < 2SQM joined Technology 40 dbf file (create Census block coverage of Cable Modem-DOCSIS 3.0. • Census Block Coverage is loaded to Transfer Data model using append. • Result is stored in "BB_Service_CensusBlock".
Processing Service Overview	• Template County feature class is loaded into ArcMap. • Subscriber Weighted Nominal speed is calculated in each county. • County layer is loaded into Transfer Data model using append. • Result is stored in "BB_Service_Overview".

3- MegaPath Corporation	
Processing Census Block Coverage Area	• Load provided text file into excel. • Export text file into dbf after altering columns names. • Separate dbf file into 3 technologies dbf files (Asymmetric xDSL - Symmetric xDSL -Other Copper Wireline). • Perform Join 3 times with Template census 2010 census block (one join per technology). • Merge the 3 feature classes into one coverage feature class. • Load the output feature class into the transfer data model. • Result is stored in "BB_Service_CensusBlock".
Processing Service Overview	• Template County feature class is loaded into ArcMap. • Three Overview county layers are produced, one layer per technology. • County layers are merged. • County layers are loaded into Transfer Data model using append. • Result is stored in "BB_Service_Overview".

4- T-Mobile USA, Inc.	
Processing Mobile Coverage Area	• Apply Repair Geometry on four coverage Shape files. • Load the two Repaired Shape files into Transfer data model using append. • Calculate technology, spectrum and speed. • Result is stored in "BB_Service_Wireless".

5- Cellco Partnership and its Affiliated Entities. (Verizon Wireless)	
Processing Mobile Coverage Area	• Apply Repair Geometry on coverage on both Shape files (4G-3G). • Load Repaired Shape files into Transfer data model using append. • Calculate technology, spectrum and speed, for each type of coverage. • Result is stored in "BB_Service_Wireless".

6- Verizon Communications, Inc.	
Processing Census Block Coverage Area	• Load provided text files into excel. • Census block coverage excel sheet exported into dbf after adjusting column name (less than 11 characters). • Select statement on the dbf file to separate Technology coverage 10 blocks & Technology Coverage 50 blocks. • Template of 2010 Census block < 2SQM joined twice, one time with Technology 10 dbf file (create Census block coverage of Asymmetric xDSL), second time with Technology Coverage 50 (create Census block coverage of Optical Carrier/Fiber to End User). • Merge is applied on both Census blocks to create Census Block Coverage. • Census Block Coverage is loaded to Transfer Data model using append. • Result is stored in "BB_Service_CensusBlock".
Processing Service Overview	• Template County feature class is loaded into ArcMap. • Two Overview county layers are produced, one layer per technology. • County layers are merged. • County layers are loaded into Transfer Data model using append. • Result is stored in "BB_Service_Overview".

7- Sprint Nextel Corporation.	
Processing Mobile Coverage Area	• Apply Repair Geometry on coverage Shape file. • Load Repaired Shape file into Transfer data model using append. • Use excel sheet values to calculate technology, spectrum and speed. • Result is stored in “BB_Service_Wireless”.

8- Hughes Communications, Inc.	
Processing Satellite Coverage Area	• Prepare a table of all Zip codes served. • Join the Zip code shapefile with zip code table. • Select Coverage Zip codes. • Dissolve the coverage to firm Coverage area. • Assigned technology download and upload speed to the shape file. • Result shape file is stored in “BB_Service_Wireless”.

9- Clearwire Corporation	
Processing Mobile Coverage Area	• Apply Repair Geometry on coverage Shape file. • Load Repaired Shape file into Transfer data model using append. • Calculate technology, spectrum and speed. • Result is stored in “BB_Service_Wireless”.

10- Atlantic Broadband	
Processing Census Block Coverage Area	• Load provided text files into excel. • Census block coverage excel sheet exported into dbf after adjusting column name (less than 11 characters). • Template of 2010 Census block < 2SQM joined with Technology 41 dbf file (Cable Modem - Other). • Census Block Coverage is loaded to Transfer Data model using append. • Result is stored in “BB_Service_CensusBlock”.
Processing Service Overview	• Template County feature class is loaded into ArcMap. • Technology is calculated in each county. • County layer is loaded into Transfer Data model using append. • Result is stored in “BB_Service_Overview”.

11-Level 3 Communications, LLC	
Processing Census Block Coverage Area	• Load provided text files into excel. • Census block coverage excel sheet exported into dbf after adjusting column name (less than 11 characters). • Template of 2010 Census block < 2SQM joined with Technology 41 dbf file (Cable Modem - Other). • Census Block Coverage is loaded to Transfer Data model using append. • Result is stored in "BB_Service_CensusBlock".
Processing Service Overview	• Template County feature class is loaded into ArcMap. • Technology is calculated in each county. • County layer is loaded into Transfer Data model using append. • Result is stored in "BB_Service_Overview".

1.6 Map Creation / Interactive Web Application

An interactive web application was developed to enable the general public to view a map of Delaware's broadband availability in each of its three counties. Users will be able to see which forms of broadband exist in each area of the State and can also search for Providers by address. This web application is necessary in order to access and employ the data collected. In essence, the data collected is in a static state; this web application will move the data into dynamic, usable form.

With the creation of the web application, the State has moved forward in meeting the requirements of this project's grant as outlined in the NOFA. The web application was created in a manner that honors the guidelines established in each NDA executed with each respective Provider. A publically accessible, interactive website is the best means by which the citizens/taxpayers can be informed of broadband availability and options. The applications serve as a hub of broadband coverage information. The resultant functionality is expected to improve service for several user groups. From a citizen standpoint, the application will serve as a gateway to access or improve access to broadband services. Citizens can use the application to gain knowledge of providers, technologies, and access level at their residence or place of business. Planners can use the site to aid in infrastructure construction plans to improve broadband access and capabilities to their assigned region of the State. The State Legislature can use the application to notify politicians of district relevant broadband capabilities and as a catalyst in policy making and a various array of legislative actions.

1.7 Backlab Verification

As the first version of maps covering each of the State's Providers was completed, the State Parties performed backlab verification of the data gathered and input onto the maps. This backlab verification included researching the Providers' websites to verify that the advertised speeds on the websites were consistent with those documented by the Providers as part of their submission to the State. In addition, the team made phone calls to some of the Providers to further verify service availability and speeds where necessary to gain the highest level of confidence in the data gathered.

1.8 Provider Review

After the backlab process was completed for each of the Providers, the data was sent back to the Providers for their review and acknowledgement of the data as being accurate. This phase of the project also allowed the Providers to update their data if changes had occurred since the initial gathering of data by the State Parties. Each of the Providers' data was pulled out from the aggregate data base prior to sending it to the Provider for their review. This ensured that the State Parties maintained the agreed-to confidentiality of each of the Providers' data.

1.9 Field Verification

The final step for the State Parties to verify the accuracy of the data was to perform a field verification process. Prior to beginning the original field verification activities in the summer of 2010, The State parties developed a field verification guide for use by each member of the field verification team. The guide included systematic instructions and a checklist related to verification of each broadband system, technology, and service type. The guide and checklist were drafted, reviewed by all State Parties, and finalized prior to the beginning of field verification activities.

The goal of field verification was revised from the original methodologies to only include verification of updated information from the providers in the State. For example, areas previously verified, which had no reported changes in technology or speed, were not re-verified as part of this round of verification.

New areas of broadband system coverage or where technologies and/or speeds changed from the previous submissions were verified by sampling whether services were available at various points shown on the Providers' system coverage maps that were randomly chosen from all of the census blocks that are within the Providers' systems. Points were chosen to represent areas throughout the Providers' new or upgraded service territory, including system boundary edges.

The State Parties team sample looked to provide a sampling of all broadband Providers who have made changes in coverage, technology or speed in the State, including large and small Providers across the State, being sure to include each of the three counties.

In May, 2013, Team members spent a total of 3 days performing Field Verification functions including testing of cellular networks at more than 40 locations. In addition, the team performed approximately 100 speed tests of Cellular based wireless broadband provider networks. Most of the test results confirmed the data submitted by the providers was accurate and that Broadband is offered in the areas they claim it is. There are a few instances (with multiple tests performed at each) where the State Parties Team could not verify that Broadband was available in areas where a provider claimed it to be. However, if Broadband and a specific technology and speed are present in any part of a Census Block, the entire Census Block is said to have availability. The State Party Team will work with Providers to reduce these data anomalies.

1.10 Speed Tests

As part of the field verification process, State residents and businesses were given a business card-sized handout that briefly explained the project and pointed them to the state-specific speed test website. The State utilized a project-specific speed test web site[2] run by Ookla in order to gain Information on users' addresses, satisfaction, and the upstream and downstream speeds associated with their broadband connection. Ookla is a company that provides a private web-based reporting portal where customer-specific testing can be performed and documented over time. The results of the speed tests performed on the Ookla site are stored and available to the State Parties at any time. Ookla tracks the end users' Provider name, technology of connection, downstream and upstream speeds, and other parameters such as IP address.

In addition, testing similar to that done by residents and businesses was performed by State Party representatives on five of the six major cellular-based broadband providers' networks. Cricket Wireless' network has not been upgraded since previous speed tests performed by the State Parties and therefore was not tested during this round of field verification. This again verified availability and speeds on each of the remaining major cellular-based broadband Providers in the State where changes were reported on their data submissions. All speed test locations for this round are shown on Attachment 3.

[2] http://www.delawarespeedtest.com/

Note: The Following Sections discuss data description and field verification for the fall 2013 data submittal. The fall submittal field verification will occur before the spring 2014 submittal.

1.11 Presentation to the NTIA

The data submitted in the State Broadband Data and Development (SBDD) project is governed by the Notice of Funds Availability (NOFA) first published in volume 74, number 129, on page 32545 of the Federal Register and subsequently clarified in volume 74, number 154, on page 40569 of the Federal Register. According to the NOFA, an NDA may be executed with broadband Providers prior to data collection. The NTIA has proposed a National States Geographic Information Council (NSGIC) data model as a means to store the collected broadband data. The NSGIC model includes five main feature classes as follows:

1.11.1 Broadband Service by Census Block (Less than 2 square miles in area)

This feature provides the atomic unit for mapping provider services that, when tied to census demographic and socio-economic data, can provide guidance for the build-out and adoption of broadband. The Census Block feature class is generated by different methods, depending on the data submitted by the Broadband service Provider. The main methods for generating census block data are as follows:

- Broadband providers submit a list of served Census Blocks. In this case, the blocks are joined to the State's Census Block data to obtain its spatial location. Finally, the data are loaded into the Geodatabase model, and attributes are either transferred or filled in manually.

- Broadband Providers submit a list of end users. In this case, an overlay is needed between the submitted geocoded end user points and the State of Delaware Census Block feature class to obtain the list of Census Blocks.

- Broadband providers submit shape files or drawings with their boundary(s) of coverage. The boundary(s) is intersected by the Census Block feature class to obtain Census Block coverage.

1.11.2 Broadband Service by Census Block (greater than 2 square miles in area)

In order to provide a more granular representation of availability in Census Blocks larger than 2 square miles in area, these Census Blocks are described at a street segment level of detail.

There are two methods utilized to garner the data needed to generate street segment coverage maps. Depending on the data submitted by the providers, these methods can be summarized as follows:

- The broadband Provider submits a list of end user addresses. The nearest road segment is then selected, based on the attributes of the end user point.

- The broadband provider submits a shapefile or drawing showing their coverage area. In this case, street segments are selected based on the intersection of its coverage area and street segment feature class.

1.11.3 Broadband Service - Wireless

The maps of wireless technologies provide a representation of the expected, modeled, or field-verified service areas associated with wireless carriers, their service levels, and their utilized spectrums. The data in this feature class are generated based on a drawing (shapefile) submitted by a wireless technology service Provider (Terrestrial Mobile Wireless - Terrestrial Fixed wireless [licensed or unlicensed] - Satellite), as well as through field verification of wireless data.

1.11.4 Broadband Service - Overview

This feature provides a coarse view of speeds at a county level so that any regional or systematic patterns of service and speed can be assessed and mitigated.

The State of Delaware has three counties. The technology has been updated for each cable provider in a county level. Most providers were reluctant to provide pricing data, but some have provided data for weighted nominal speed.

1.11.5 Broadband Connection Points – Middle Mile

The purpose of broadband Connection Points, known as Middle Mile locations or points, is to give the locations and elevations of Interconnection points for service Providers working in the State of Delaware. Gathering infrastructure components (Middle Miles) helps leverage opportunities for network deployment after assessing gaps in broadband availability in the State.

The locations of Middle Mile points were provided by Providers either by their geographic coordinates (Latitude & Longitude) or by their street address(s), which are geo-coded to their spatial locations. Intersection between the Middle Mile points and Census block layer is needed to obtain Full Block ID (FULLFIPSID).

The above mentioned processes provided the State with the raw data to develop maps of the State showing where broadband is available, the maximum advertised levels of service, or speed offered to end users, and areas of the State that are unserved or underserved. This information will be updated every 6 months to show changes made by Providers that will impact the broadband landscape throughout the State. This report details some of the most pertinent information derived from the project and can be utilized to help the State during its Broadband Planning Project currently underway.

2 Areas of Delaware Unserved/Underserved by Broadband Providers

One of the main objectives of the NTIA, the State of Delaware, GeoDecisions, and CBG was to determine where broadband is not currently available in the State of Delaware. Having areas where broadband is not available to potential end users helps create a phenomenon known as a Digital Divide. The Digital Divide is defined as the inability of residents to access broadband and Internet services based on economic, educational, or geographic reasons.

The NTIA defines an unserved area as: "An area composed of one or more contiguous census blocks where at least 90 percent of households in the service area lack access to facilities-based terrestrial broadband service, either fixed or mobile, at the minimum broadband transmission speed (set forth in the definition of broadband above). A household has access to broadband service if the household can readily subscribe to that service upon request."

Furthermore, the NTIA defines an Unserved Area as "A service area is defined as consisting of one or more contiguous census blocks, where half the households lack access to minimum broadband service, or an area where no land or mobile service offers broadband with at least 3 Mbps, or areas where less than 40% of households subscribe to any service."

To obtain information about where broadband is not available in the State, the State Parties performed the above tasks to determine where broadband is available in the State and where it is not available to potential end users. After determining where broadband is not available, the State is in the process of utilizing this information to determine what may be done to expand existing networks to provide service to these unserved areas or how new Providers may be enticed into building networks to serve these parts of the State. This is being undertaken by the State and the University of Delaware as part of their planning activities in the next phase of this project.

Although some services delivered by satellite-based Providers meet the requirement for broadband of 768 Kbps downstream and 200 Kbps upstream, for the purposes of this report, we have not included them when detailing broadband availability. While any location within the State is capable of receiving satellite based service as long as there is a clear unobstructed view of the southern sky, the reasoning for not considering satellite-based Internet here is that often times realized speeds on satellite-based networks fall significantly below 768 Kbps in the forward direction and 200 Kbps in the upstream direction. That being said, satellite Internet is an option for citizens and businesses in the State when other high speed connections are not available.

The State of Delaware has the 6th highest population density of the 50 states in the US. This helps the State's overall broadband availability in that broadband Providers are apt to serve high density areas because the cost to build a network is lower on a per-address passed basis. In other words, the amount of infrastructure needed to connect a given address to the Internet lessens as density increases. Conversely, the cost of building a network to more rural areas increases on a per-address (potential customer) basis to the point of not providing the broadband Provider the minimum potential return on their investment that they have established. Large companies have minimum potential customers per mile that must exist or they will not build infrastructure to an unserved area. For instance, a Provider may require a minimum of 20 homes or businesses be passed per mile of new infrastructure before they will build it. Some providers will require a minimum number of homes passed per mile, of new infrastructure, to be in excess of 30 homes. In rural areas, there may be as few as 1 or 2 homes per mile. Therefore, the area will not be built out.

Although the State of Delaware has a relatively small number of areas, and therefore citizens, that do not have broadband available to them, this should still be a concern for the State and its planning group. As in other locales, the State will likely find during its planning project that broadband is a driving force in many aspects of life today, including economic development, health care, all areas of business and institutional users, education, and entertainment to name a few. Consequently, the State will also likely find that encouraging expansion of broadband into the unserved areas of the State will have a positive impact on all of these aspects. Areas of the State that do not have access to broadband are shown on the map included as Attachment 1.

In addition to determining which areas of the State do not have access to broadband, demographics and socio-economic characteristics can be analyzed in areas of the State that do not have broadband availability. For instance, the State Parties have over-laid age, minority status, and income data onto the maps to determine which groups may be most impacted by the lack of broadband service in their areas. This information may prove valuable as the State's planning project moves forward. In addition, maps including other demographic and socio-economic characteristics can be created by the State Parties to show other groups that are impacted by the lack of broadband availability in areas of the State. The maps showing each of these parameters are included as Attachments 5, 6, and 7.

3 Areas of Delaware Served by a Single Broadband Provider

Similar to areas of the State that are unserved or underserved by any broadband Provider, the NTIA and the State desired to know what areas of the State are only served by a single Provider.

Areas that have a single broadband Provider imply that service is available in these areas but that there is no competition. Therefore, associated benefits that competition may bring, including lower pricing, higher speeds, and better customer service, are also not available in these areas. This project did not ask for or document any of these parameters, and therefore, other than speed and pricing information included in the Broadband Service Tiers – Residential, Business Governmental and Academia section of this report, they are not included in this report.

Similar to the unserved/underserved areas of the State, the State's high density makes it a good business decision for broadband Providers to build out the networks throughout most of the State since even with competition; these Providers can make a good return on their investment. As Attachment 2 shows, in addition to the areas of the State with no broadband availability, there are only a few small areas in the State that are not served by at least three Providers. Some of the areas served by fewer than two Providers include:

- The area northeast of Smyrna to Highway 9
- The area east of Hay Point Landing Rd
- The Bombay Hook National Wildlife Refuge area
- A small area east of Dover Air Force Base
- North of the Milford Wildlife Area
- The Prime Hook National Wildlife Refuge
- The area north east of Selbyville in Sussex county
- The area east of Laurel in Sussex county
- The area east of Farmington in Kent county

As a percentage, the areas of the State with fewer than two broadband Providers equates to less than 0.25% of the Census Blocks in the State. Furthermore, the estimated total number of households in the State that are not served by a broadband Provider is 1,029 or 0.25% of all households. This is based on the total number of homes in Census Blocks where broadband does not exist as an option to residents. However, as these areas are utilized by residents of the State and as housing and other developments reach these areas, they will not be broadband ready. The lack of broadband availability may hamper expansion into these areas as the need arises in the future.

4 Areas of Delaware Served by Multiple Broadband Providers

The large majority of the State of Delaware has multiple broadband Providers, serving addresses within the area, with over 50% of the State having six or more Providers of broadband service. When including all areas of the State with two or more broadband Providers, over 99% of the State's Census Blocks are offered broadband service by multiple Providers. A map of the State of Delaware with color codes showing the number of Providers is included as Attachment 2 to the report.

Having multiple Providers helps promote competition among the Providers in given areas and should translate into the highest level of speed the Providers can offer at affordable costs. Having multiple Providers in an area also promotes higher customer service standards from Providers as they attempt to keep their existing customer base and increase their numbers of customers.

5 Types of Technology Used to Provide Broadband in Delaware

The NTIA classified broadband technologies into 11 categories plus a 12th category labeled "All Other". These categories represent both hardline cable networks (cable, phone lines, or fiber optic infrastructure connected to the residence or business) and wireless networks (signals are transmitted to and from an address or location). The NTIA further defined each of the technologies into more specific categories. The technologies utilized in Delaware are listed and defined below:

- **Asymmetrical xDSL**
  DSL is a telephone system-based data communications service that utilizes modulation schemes that allow high-speed transmission of data on copper or phone lines. Asymetrical xDSL is a design characteristic where return speed is lower than forward speed. This allows for more of the network's bandwidth capability or throughput to be utilized by the forward portion of the network allowing for faster downloads than uploads. This technology is utilized widely by telephone companies in the State to provide broadband service to end users.

- **Other Copper Wireline**
  Non-DSL telephone system-based data communications service such as T-1 (1.54 Mbps). Other Copper Line technologies tend to be utilized more for business and anchor end users, as bandwidths are often gauranteed verses "up to" speeds.

- **Cable Modem – DOCSIS 3.0**
  A cable modem is a device that converts information from one device (computer) to a usable form for another device (cable TV network). Specifically, information from a computer is converted to a useable format for transport on the cable TV network and converted back to a format useable by a computer at the receive site modem. DOCSIS 3.0 provides for multiple channels on the cable TV system to be combined and the combination used to enable higher data communications speeds or bandwidths. DOCSIS 3.0 is widely utilized by cable television network-based Providers throughout the State. Cable TV systems currently utilizing previous versions of DOCSIS will likely migrate to DOCSIS 3.0 in the near term to utilize its higher bandwidth capabilities.

- **Cable Modem – Other**
  Similar to DOCSIS 3.0, except these are all prior versions and revisions of DOCSIS including 1.0, 1.1 and 2.0. These versions offer lower bandwidth or speed than DOCSIS 3.0. Only one Provider reported using Cable Modem – Other in the State. This Provider is primarily DOCSIS 3.0 and will likely migrate the remaining areas of the State from earlier versions of DOCSIS to DOCSIS 3.0 in the near future.

- **Optical Carrier/Fiber to the End User**
  A communications network utilizing fiber optics up to or into a household, business, or other facility – also called Fiber to the Home (FTTH) or Fiber to the Premise (FTTP). Fiber optic cables allow for transmission of modulated light along an optical fiber for significant distances. Fiber optic cables are utilized throughout communications systems due to their ability to transmit signals over longer distances with higher bandwidths, while having significant reductions in noise and distortion effects compared to other wireline and wireless networks. This technology is replacing other traditional telephone technologies throughout more densely populated areas of the State. The local phone company in these areas will likely phase out the traditional phone system over the long term.

- **Satellite**
  Wireless service provided between satellites and the end user. A dish-shaped antenna, similar to those used for satellite TV, is utilized at the end user's location to receive the downstream signal and to transmit the signal upstream. Satellite is available anywhere in the State where a clear view to the southern sky exists. Trees, buildings, and other obstructions are the only obstacles that may keep end users from accessing satellite internet.

- **Terrestrial Fixed Wireless – Unlicensed**
  Broadband service typically provided in a point-to-point configuration from a central tower location, or through a series of towers (hops) as part of a mesh network, to an end user location. The frequencies utilized are not licensed by the FCC and therefore are susceptable to interference or competition for bandwidth from other non-licensed networks. The only system to report utilization of Fixed Wireless – Unlicensed is located in and around the Rohoboth Beach area of the State. This is a WiFi-based system that requires a subscription and is password protected.

- **Terrestrial Fixed Wireless – Licensed**
  Broadband service typically provided in a point-to-point configuration from a central tower location, or through a series of towers (hops) as part of a mesh network, to an end user location. The frequencies utilized are licensed by the FCC and therefore are more immune to interference and competition for bandwidth from other networks.

- **Terrestrial Mobile Wireless**
  Broadband service typically provided in a point-to-multipoint configuration from multiple tower locations, as part of a mesh network, to end user locations. The mesh configuration allows for mobile access to the broadband network. These networks are most commonly known as cellular data networks. The frequencies utilized are licensed by the FCC and therefore are more immune to interference and competition for bandwidth from other networks. Terrestrial mobile based, or cellular, broadband is available throughout the State with the exception of a few areas. These are shown on the accompanying maps as unserved areas of the State.

6 Advertised Upstream and Downstream Transmission Speeds

Broadband Providers often advertise both downstream and upstream speeds as “up to” speeds. In other words, a Provider will advertise speeds “up to” 4 Mbps in the downstream direction and “up to” 1 Mbps in the upstream direction. Consumers may believe that those are the speeds they will most often realize when utilizing the Provider’s network for internet access. However, in reality, the actual speeds offered on the network may be significantly less than the advertised “up to” speeds.

Many broadband networks deployed today utilize a shared bandwidth design whereby the network is developed based on customers sharing the total available bandwidth on the network. This is an effective way for a Provider to offer fast speeds to large areas while minimizing the amount of infrastructure needed and thereby reducing the cost of deployment. In many cases, this design provides speeds sufficient for most subscribers’ needs that are well within the definition of broadband. However, the actual speeds will most often be lower than the advertised speeds because of the shared bandwidth design, and in some cases they will fall below the threshold stipulated for broadband.

An example of this is – if a network has a total available bandwidth equating to a download speed of 10 Mbps and one person is accessing the network, they will realize speeds at or near 10 Mbps. However, if 10 people are accessing the same network at the same time, they will divide the available network bandwidth among them. Although the actual results will vary, based on the level of utilization of bandwidth by each of the users, for purposes of this example, the result would be approximately 1 Mbps available to each of the 10 people accessing the network. In this example, we assume all 10 users are accessing significant amounts of bandwidth that may be required to download music, video, and large files or that may be required to watch live video. In reality, all 10 users will likely be utilizing differing levels of bandwidth at any given time. This phenomenon makes it difficult to evaluate advertised speeds within a given system, between systems, and throughout the State and beyond.

The Providers that supplied speed information, as verified during the backlab verification process, reported the following ranges of speed by technology:

- **Asymmetrical xDSL**

  Speeds between 768 Kbps to 25 Mbps in the downstream direction with speeds between 200 Kbps to 1.5 Mbps in the upstream direction[3].

- **Symmetric xDSL**

  Speeds between 768 Kbps to 6 Mbps in the downstream direction with speeds between 768 Kbps to 6 Mbps in the upstream direction.

- **Other Copper Wireline**
  Speeds between 768 Kbps to 25 Mbps in the downstream direction with speeds between 200 Kbps to 25 Mbps in the upstream direction.

- **Cable Modem – DOCSIS 3.0**
  Speeds between 50 Mbps to greater than 100 Mbps in the downstream direction with speeds between 10 Mbps to 25 Mbps in the upstream direction.

- **Optical Carrier/Fiber to the End User**
  Speeds between 50 Mbps to greater than 1 Gbps in the downstream direction with speeds between 10 Mbps to greater than 1 Gbps in the upstream direction.

- **Satellite**
  Speeds between 768 Kbps to less than 25 Mbps in the downstream direction with speeds between 200 Kbps to less than 3 Mbps in the upstream direction.

- **Terrestrial Mobile Wireless**
  Speeds between 768 Kbps to 25 Mbps in the downstream direction with speeds between 200 Kbps to 6 Mbps in the upstream direction.

[3] These speeds have decreased from previous submissions based on providers' updated data.

7 Samples of Actual Upstream and Downstream Transmission Speeds

Several methods were used to obtain a sampling of the actual broadband transmission speeds achieved by residents, businesses, and institutions[4]. For example, State residents and businesses were given a business card-sized handout that briefly explained the Project and pointed them to the State-specific speed test and survey website. This round of verification focused on areas of the State where providers have reported new technologies and speeds compared to previous data submissions. The State utilized a Project-specific Ookla speed test website[5] and survey in order to gain information on users' technology type and upstream and downstream speeds associated with their broadband connection. In addition, the State Parties' team members performed more than 100 speed tests, on wireless networks. The locations of these speed tests are included on Attachment 3.

In May 2013, approximately 40 speed test cards were handed to residents and at business locations such as business strip malls, restaurants, and gas stations. These cards encouraged the residents to visit the State speed test and survey website, as listed on the card, to assist the State in gathering actual speed data. From mid-2010 until now, approximately 7,000 speed tests have been performed by both State Party team members on site and residents and business personnel at their locations throughout the State. Approximately 950 of these 7,000 speed tests have less than broadband speeds being achieved in the downstream, upstream or in both directions.

There are many variables that can affect speed test results. Of these, the most significant are the technology reportedly utilized and the performance characteristics of the computer or device being utilized by the end user performing the test, the number of computers or devices at a location accessing the internet at the same time, the level of throughput being utilized by each, and the day and time of day when the tests are performed. Additionally, speed tests are often performed multiple times on the same computer and the same network.

For these reasons, speed tests are best analyzed in the aggregate to give an understanding of typical speeds being realized. In other words, all cellular tests should be averaged to get an understanding of actual speeds that can be expected from that given technology. Furthermore, speeds for a given Provider can be averaged to again get a better understanding of the actual speeds available from that Provider.

Of the approximately 7,000 speed tests performed since mid-2010, nearly 650 were performed in the first half of 2013. These results include tests showing locations in states surrounding

[4] This information has been updated based on spring 2013 field verification tasks.
[5] http://www.delawarespeedtest.com/

Delaware because the ISP may be located outside of Delaware. Speed tests were removed that showed locations in remote states, such as the State of Washington and the State of Indiana.

These tests provided broadband speed results, the overall average speeds of all technologies and Providers were approximately 16.1 Mbps downstream and 9.0 Mbps upstream. These results are significantly higher than in the past in part because more tests have been performed on campus networks such as the State of Delaware's network and the University of Delaware's network. These networks tend to have speeds significantly higher than the average residential service and therefore have raised the overall average speeds throughout the State. The table below shows overall average speeds; and includes average speeds broken down by technology with state campus network results excluded. It is important to note that some of the test broadband technology may be categorized incorrectly by the speed test data, and that these results should be verified in the future.

Technology	Downstream	Upstream
Results including State of Delaware and University of Delaware		
All Speed Tests With All Technologies Combined	16.1 Mbps	9.0 Mbps
Results excluding State of Delaware and University of Delaware		
All Speed Tests With All Technologies Combined	13.0 Mbps	5.4 Mbps
Mobile Wireless (Cellular)	3.8 Mbps	1.3 Mbps
Cable Modem – Residential	20.3 Mbps	6.6 Mbps
Cable Modem – Business class	22.4 Mbps	6.7 Mbps
DSL	3.4 Mbps	1.9 Mbps
Satellite	1.8 Mbps	300 Kbps
Fiber To The Premises/Business	19.7 Mbps	12.5 Mbps

As described above, these are aggregate numbers that represent an average of these tests taken by end users. Actual speeds at a given location will vary from these speeds. Overall, the speed tests indicate speeds comparable to those advertised by the providers. For example, mobile wireless providers offer speeds between 768 Kbps to 15 Mbps (some offer a lower maximum speed) in the downstream direction. The speed tests show an average mobile wireless speed of 3.8 Mbps in the downstream direction. These numbers are low, in part, because many test results for wireless networks come in below Broadband speed. Further explained, of the 100 speed tests taken on wireless networks, 40 of the results were below 768 Kbps (Broadband). If these test results are taken out, the average speed for wireless networks nearly doubles to 6.1 Mbps.

Cable modem DOCSIS 3.0 is advertised to offer speeds between 3 Mbps and 105 Mbps. The average tested speed was 20.3 Mbps. This is on the lower third of what is advertised and may reflect end users with a lower than maximum speed plan. In other words, although speeds up to 105 Mbps may be offered to residential end users, many may be signed up for a service with a maximum throughput of 20 Mbps or less, which brings the aggregate average speed for cable modem DOCSIS 3.0 down. Fiber to the premise is similar to cable modem DOCSIS 3.0 in that the tested speeds are lower than the advertised maximum speeds of 500 Mbps. These higher end speeds are more costly and therefore not likely to be the highest selling tier of service. Therefore, the speed tests done on the lower tiered service will bring the overall aggregated average speed down from the advertised "up to" speeds. DSL speed test results were significantly lower than previously reported. In fact, the advertised maximum speeds for DSL are between 768 Kbps and 10 Mbps, and the tested speeds for DSL came in at 10.3 Mbps.

8 Broadband Service Tiers – Residential, Business and Anchor Institutions

One of the goals of the project was to find the maximum downstream and upstream speeds offered by the various Providers in the State. The goal was not to determine the various levels of service or speed being offered but rather the maximum level of service offered by the Providers. However, speed tiers or levels are an important component of determining what services are available to end users, as many will not require or be able to afford the fastest available speeds but do want or need a higher speed connection than is available via a dial-up connection.

Broadband service is provided in many different speed tiers through the various technologies. Most Providers offer more than one level of service or speed whereby end users who need or desire faster connectivity can opt for the highest level of service, and end users who only need lower levels of service can elect to purchase a slower connection at a reduced cost. Speed tiers differ considerably between Providers and are dependent on the technology utilized to provide the service. For instance, Providers using cable modem DOCSIS3 technology offer maximum speeds of between 3 Mbps to 105 Mbps in the downstream direction, while mobile wireless Providers in the State offer maximum downstream speeds on 4G networks as high as approximately 17 Mbps (4G networks are capable of higher speeds but because they are shared networks the advertised rates are lower).

Making exact comparisons between broadband service Providers is difficult for a variety of reasons, the most significant of which is that most Providers offer "up-to" speeds. As an example, an end user on one Provider's network with "up-to" speed of 1.5 Mbps may realize close to that maximum speed at most times. However, a customer on another Provider's network with "up-to" speed of 1.5 Mbps may only realize half of that speed at most times. This makes it difficult to accurately determine which Provider has the speeds that will consistently provide the level of service needed by the end user. Other issues that can make shopping for a broadband Provider difficult are introductory pricing, bundled pricing (where broadband service must be purchased with another service such as phone or TV) and long-term contracts. Introductory pricing may provide a benefit in the short term, while offering less competitive pricing in the long term. Long-term contracts can lock an end user into a plan they may not need over the course of the contract term or lock them into a plan that does not fulfill their needs in the future. Additionally, some Providers such as mobile broadband and satellite services have established throughput limits. These limits are as low as 250 MB per month with higher limits for a higher monthly fee. After a customer hits that level of throughput, they may be charged additional fees or their service level is cut back significantly for the remainder of the month (such as is done by some satellite based Providers).

Providers are also continually changing their service offerings and pricing. As end users needs for speed continue to increase, Providers continue to offer higher levels of speed with new additional features as discussed elsewhere in this report. Another aspect that must be considered by potential end users is installation, equipment, and activation fees. These can

vary from $0.00 to well over $300.00. Many Providers that require installation or equipment fees run promotions where these fees are waived or reduced for a limited time.

Other add-ons or extras, which may or may not offer value to the end user, that some Providers offer as a part of their service are security tools such as anti-spam and anti-virus software, home networking, specific web content free such as Disney, ESPN3, and others.

Some examples of available plans and non-introductory, non-bundled pricing as researched on Providers' websites over the last two submittals include the following:

Cable Modem Providers (all "up-to" speeds)		
Downstream Speed	Upstream Speed	Price per Month
3 Mbps	512 Kbps	$29.95
3 Mbps	768 Kbps	$29.95
6 Mbps	1 Mbps	$34.95
15 Mbps	1 Mbps	$44.95
20 Mbps	2 Mbps	$54.95
20 Mbps	4 Mbps	$62.95
50 Mbps	10 Mbps	$74.95
105 Mbps	10 Mbps	$99.99
105 Mbps	20 Mbps	$114.95

Fiber To The Premise (FTTP all "up-to" speeds)		
Downstream Speed	Upstream Speed	Price per Month
15 Mbps	5 Mbps	$49.99
50 Mbps	25 Mbps	$59.99
75 Mbps	35 Mbps	$69.99
150 Mbps	65 Mbps	$129.99
300 Mbps	65 Mbps	$209.99

Satellite (all "up-to" speeds)		
Downstream Speed	Upstream Speed	Price per Month
12 Mbps	3 Mbps	$49.99 - $129.99*
10 Mbps	1 Mbps	$59.99
10 Mbps	2 Mbps	$79.99
15 Mbps	2 Mbps	$99.99
* Prices based on amount of throughput used per month		

Mobile Wireless (all "up-to" speeds)		
Downstream Speed	Upstream Speed	Price per Month
3G	3G	$14.99 for 250 MB
3G/4G	3G/4G	$50.00 for 5 GB
4G	4G	$30.00 per 3GB
4G	4G	$50.00 for 5GB

DSL (all "up-to" speeds)		
Downstream Speed	Upstream Speed	Price per Month
1 Mbps	768 Kbps	$19.99
3 Mbps	768 Kbps	$29.99
7 Mbps	768 Kbps	$29.99
15 Mbps	768 Kbps	$29.95

Fixed wireless (Licensed all "up-to" speeds)		
Downstream Speed	Upstream Speed	Price per Month
1.5 Mbps	500 Kbps	$49.99
6 Mbps	1 Mbps	$34.99

As the tables above show, shopping for the plan that meets the specific, consistent needs of an end user can be confusing. Many other options and additional features are offered by Providers that are not shown in the examples above, including virus protection, spam filters and pop-up blockers, and subscription only websites. In addition, end users must decide if long-term commitments are a concern for them prior to signing up for many types of broadband service offerings.

Some Providers such as the cable modem, DSL, and wireless Providers also offer business class service. These services may be identical to residential service with additional add-on services, such as Outlook for e-mail, and may include a higher level of, or faster, service response when problems arise.

In addition, some Providers offer faster speeds as business class service at a higher monthly cost. These Providers also will offer business class and residential class services to Anchor Institutions. Some Providers will offer higher speeds on a per site basis, such as fiber optic connections, with speeds as high as 1 Gbps symmetrical (or higher) such as those supplied to the cities of Dover and Wilmington and the University of Delaware.

As shown below in the Broadband Availability at Anchor Locations section, Anchor locations' requirements vary significantly based on their size, the number of internet users, and the applications being run at the location. Costs will vary on these services based on speed and necessary infrastructure expansions needed to connect the Anchor Institution.

9 Locations of Towers Utilized to Provide Broadband

During each Field Verification portion of the project, the State Parties note the locations of towers that are utilized by cellular Providers and for other radio communications. Any changes are plotted onto a map for potential future reference.

These locations can serve as transmit and receive sites for wireless broadband Providers. As a potential wireless Provider evaluates whether to deploy a network to offer broadband to residents and businesses, one of the most significant costs can be construction of a tower that is high enough to provide service to the surrounding areas. These existing towers may have space available that can be leveraged for placement of broadband related antennas at a significantly lower cost than building new towers and therefore may allow a Provider to deploy a network where one may not otherwise exist. The available space must be at a height on the antenna that will meet the needs of a new occupant on the tower. Furthermore, like any business, the Provider must recoup their investment over a set period of time. Using a lower cost option such as existing towers may allow a Provider to offer service at a lower monthly cost to the end user.

The goal during the initial Field Verification phase of the project was to document all towers passed while performing the more pertinent task of verification of broadband availability where the Providers indicated service was available. This process did not identify all towers in the State but does provide a useful database that can be built upon over time. The Towers that have been located are shown on the map included as Attachment 4.

10 Wireless Spectrums Utilized to Provide Broadband

Several wireless frequency spectrums are being utilized by the various wireless Providers to offer broadband service. These include both fixed and mobile wireless Providers. As part of the data request sent to all of the Providers, they were asked to include which frequencies they are utilizing to offer broadband service in a wireless format. The spectrums utilized, as reported by the Providers, are as follows:

Cellular Providers are using several spectrum ranges including:

- 700 MHz band
- 698 – 758 MHZ
- 775 – 788 MHz
- 805 – 806 MHz
- 824 – 849 MHz
- 862 – 869 MHz
- 1.850 – 1.915 GHz
- 1.930 – 1.995 GHz
- 1.710 – 1.755 GHz
- 2.100 – 2.155 GHz
  2.496 – 2.690 GHz

Satellite Providers are using licensed frequencies as provided by the FCC in the L-band, Big LEO, Little LEO, and 2 GHz spectrums.

11 Broadband Availability at Anchor Locations

The NTIA's NOFA required that "Awardees shall provide NTIA with a list of community anchor institutions in their state, along with the associated information described below." The information gathered includes address data, Provider name, technology, and speeds of broadband connection. The NOFA defined Community Anchor Institutions (CAIs) in the following manner: Schools, libraries, medical and healthcare Providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and entities.

The State tasked the Institute for Public Administration at the University of Delaware (IPA) with performing the tasks of gathering the information needed related to Anchor Institutions.

The IPA first compiled a master list of all CAIs throughout the State. This list was then subdivided into categories of:

- Schools – K-12 (public and private)
- Libraries
- Medical/Healthcare facilities (public and private)
- Public Safety entities (public and private)
- Universities, colleges and other post-secondary (public and private)
- Other community support – governmental
- Other community support – non-governmental

The IPA verified each CAI's name, street address, map coordinates, and proper categorization into the above groups. A few of the small municipalities only have Post Office boxes on file for addresses and were therefore mapped with the Post Offices' mailing address.

The previous list of known CAIs in the State, as reported in March 2013, totaled 903. Through the process of making follow-up contacts and obtaining additional CAI lists to identify the level of Internet connectivity the CAIs were utilizing, a September 2013 adjusted total of 879 CAIs was determined. The IPA has been able to elicit usable responses from 669 of those 879 CAIs. Of that subset of 669 respondents, 652 do have broadband connections, while 17 report that they do not have broadband. The remaining 210 CAIs have been non-responsive, to date. The IPA continues to attempt to make contact with the CAIs that have not yet been included in the study.

652 of the 669 CAIs that have been responsive to date—about 97%-- these CAIs reported they have some level of broadband connectivity to their Internet Service Provider (ISP). This leaves just about 3% of respondent institutions that indicated a lack of broadband connectivity.

The breakdown of all known CAIs is as follows:

- Schools – K-12 (public and private)
  Total = 387
  With Broadband =286
  Without Broadband = 3
  Non-responsive = 98

- Libraries
  Total = 33
  With Broadband = 33
  Without Broadband = 0
  Non-responsive = 0

- Medical/Healthcare facilities (public and private)
  Total = 30
  With Broadband = 23
  Without Broadband = 0
  Non-responsive = 7

- Public Safety entities (public and private)
  Total = 121
  With Broadband = 80
  Without Broadband = 1
  Non-responsive = 40

- Universities, colleges and other post-secondary (public and private)
  Total = 28
  With Broadband = 24
  Without Broadband = 1
  Non-responsive = 3

- Other community support – governmental
  Total = 71
  With Broadband = 61
  Without Broadband = 6
  Non-responsive = 4

- Other community support – non-governmental
  Total = 209
  With Broadband = 143
  Without Broadband = 6
  Non-responsive = 60

The speeds achieved by the CAIs vary considerably overall; there are also significant differences within categories of CAIs. For example, of the 286 K-12 schools that reported having broadband connectivity, 220 reported the use of Optical Carrier/Fiber with downstream and upstream speeds of 10 Mbps or greater; 15 reported the use of Cable Modems and 37 reported the use of Other Copper Wireline – with widely varying downstream speeds and upstream speeds in both cases; while 4 reported a reliance upon DSL connections (12 schools indicated that they had broadband connectivity but were unresponsive regarding any specifics concerning the technology being utilized). Among the libraries (all of which are on the State network and use Optical Carrier/Fiber), 3 reported downstream and upstream speeds in the range of 100 Mbps - 1 Gbps, while the other 30 reported downstream and upstream speeds in the range of 10 Mbps - 25 Mbps. The highest downstream and upstream speeds of any CAIs (greater than or equal to 1Gbps in both directions, using Optical Carrier/Fiber) were reported by the Delaware Special Olympics, the cities of Dover and Wilmington, and the University of Delaware. Of all the entities that did indicate they had broadband service, the slowest connections were reported by non-governmental community support institutions (typically Senior Centers), some of which were using DSL connections with downstream speeds as low as 768 Kbps - 1.5 Mbps and Upstream speeds of 200 Kbps or less.

In addition to determining if CAIs have broadband, the data collection for September 2013 addressed whether the CAI provides public access to WiFi. In the case of Delaware's libraries, the availability of public access to broadband via terminals far outweighs the availability of Public Wifi— while all 33 of the libraries do provide public access to broadband, only 14 reported the capability to provide public WiFi in September 2013. System-wide availability of public WiFi at Delaware libraries was, however, reported as in the process of implementation.

By allowing public access to broadband, CAIs can help serve populations in the State that otherwise may not have broadband access available to them. These include people living in unserved or underserved areas of the State or who cannot afford access at their residence. IPA plans to focus on these CAIs in its planning activities to determine how such facilities best meet the needs of population groups that do not otherwise have access.

12 Conclusion

The State of Delaware, with direction and grant funds from the NTIA, began the process of determining the level of broadband availability in the State of Delaware in early 2010. As components of the project, Providers were asked to provide data detailing where they provide broadband service, the advertised maximum downstream and upstream speeds, and the technology deployed to offer the service. The data gathered from the Providers was verified using multiple methods, including checking the data against websites; field verification and speed tests by State Party team members and the general public. The State has now completed its 8th submission within the project with updates being included in the data base each time.

Because, in part, the State has a relatively high population density, broadband providers offer service throughout much of the State. Additionally, in more than 53% of the State more than six different Providers offer broadband in the same areas. Over 99% of the State has broadband service availability from at least two Providers.

There are several technology types being utilized in the State to provide broadband to residents, businesses, and Anchors. These vary from telephone-based technologies such as asymmetrical and symmetrical DSL and other copper wireline to cable-modem based technologies, optical carrier or Fiber-To-The end user, satellite, and mobile wireless. Each of the technologies brings broadband to end users in different ways and fills various needs such as speed, price, reliability and mobility.

Determining and documenting speed offerings can be a complicated task. Most broadband providers offer “up to” speeds. The actual speeds of these networks at a given time may vary drastically from the “up to” speed that is advertised. In addition, Providers often include other services such as virus protection, anti-spyware, and others or require a customer to bundle their broadband service with other services such as phone or TV to get the best price. Consumers need to weigh all aspects of the Providers’ service prior to signing up for service and potentially signing a long-term contract.

As a part of the Project, the State Parties documented existing cellular and other communications towers throughout the State. These locations may provide a potential cost reduction for future broadband providers to enter the broadband marketplace. This may allow the State to encourage build out of existing wireless networks or deployment of new networks where broadband service is lacking today.

The Institute for Public Administration at the University of Delaware (IPA) has had contact with 669 of the 879 known Anchor Institutions in the State. Of these, only 17 do not have broadband service today. The State should continue to make efforts to contact the Anchors that have not responded thus far. The State should then work with the Anchors during its Planning Project to determine if the broadband services available to the Anchors are meeting their needs today, as well as being able to meet their anticipated short- and long-term needs in the future.

The State can utilize availability documentation gathered and updated throughout this Project to continue to help direct the Planning Project that is currently underway. During the Planning Project, the State and the University of Delaware's Institute for Public Administration will determine broadband-related needs of the general public, businesses, and Anchor Institutions throughout the State in today's environment as well as into the future.

13 Glossary of Terms

Access Point (AP) – Transmitter and receiver utilized to create a wireless connection between devices. End users connect wirelessly to the network via an Access Point.

Asymmetrical Speeds – A network system design characteristic where return speed is lower than forward speed. This allows for more of the network's capability or throughput to be utilized by the forward portion of the network allowing for faster downloads than uploads.

Broadband – (as defined in the NTIA's NOFA) – Data transmission technology that provides two-way data transmission to and from the Internet with advertised speeds of at least 768 kilobits per second (Kbps) downstream and at least 200 Kbps upstream to end users, or providing sufficient capacity in a middle mile project to support the provision of broadband service to end users within the project area.

BPL (Broadband-Over Powerline) – A network utilizing electrical conductors (a power Provider's lines) as its transport medium.

Cable Modem – A device that converts information from one device (computer) to a usable form for another device (cable TV network), i.e., Information from a computer is converted to a useable format for transport on the cable TV network and converted back to a format useable by a computer at the receive site modem.

Community Anchor Institutions – Schools, libraries, medical and healthcare Providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and entities.

Digital Divide – The inability of residents to access broadband and Internet services based on economic or geographic reasons.

Digital Subscriber Line (DSL) – A telephone system-based data communications service that utilizes modulation schemes that allow high-speed transmission of data on copper or phone lines.

Downstream, also known as "download" or "forward direction" – Connectivity path from a network service Provider, or ISP, to the customer's location.

Fiber Optic Cable – Cable made from glass that provides the medium for transmission of light along a designated path. Single mode fiber is utilized to transport light over long distances.

Fiber To The Premises (FTTP) – A communications network utilizing fiber optics up to or into a household, business or other facility, also called FTTH or Fiber To The Home.

Fixed Wireless – Broadband service typically provided in a point-to-point configuration from a central tower location, or through a series of towers (hops) as part of a mesh network, to a customer premise location.

Gigabits per Second (Gbps) – One billion bits of information transmitted between devices in one second, i.e., 1 Gbps = 1,000,000,000 bits of information transported over a network per second.

Internet Protocol (IP) – Internetworking protocol used to transmit data across and between switched networks. Also specifies the formatting and addressing scheme of information packets.

ISP – Internet Service Provider – Private company or other organization offering connectivity to the Internet.

Kilobits Per Second (Kbps) – One thousand bits of information transmitted between devices in one second, i.e., 256 Kbps = 256,000 bits of information transported over a network per second.

Megabits per Second (Mbps) – One million bits of information transmitted between devices in one second, i.e., 1.5 Mbps = 1,500,000 bits of information transported over a network per second.

Middle Mile/Backbone/Backhaul – Transmission media utilized to connect APs or network nodes within a system to each other and to the main network and to the Internet. Backhauls can consist of fiber optic cables, WiMAX, and other wireless technologies.

Symmetrical Speeds – A system design characteristic allowing equal speeds in the forward and return paths of the network.

Upstream – Also known as "upload" or "return direction" – Connectivity from the customer back to the network service Provider or ISP.

Voice over IP (VoIP) – Transmission of voice communications as IP packets, allowing for transportation of voice over the Internet, LANs and WANs.

Wi-Fi (Wireless Fidelity) – Wireless local area networks based on the IEEE's (Institute of Electrical and Electronics Engineers, Inc.) 802.11 standards. 802.11 refers to a group of standards in place today as well as standards that are currently being developed.

WiMAX (**Worldwide Interoperability for Microwave Access)** – Wireless wide area networks based on the IEEE's 802.16 standards. Capable of transmission speeds up to 70 Mbps over 70 miles with actual speed and coverage far less based on applications and terrain.

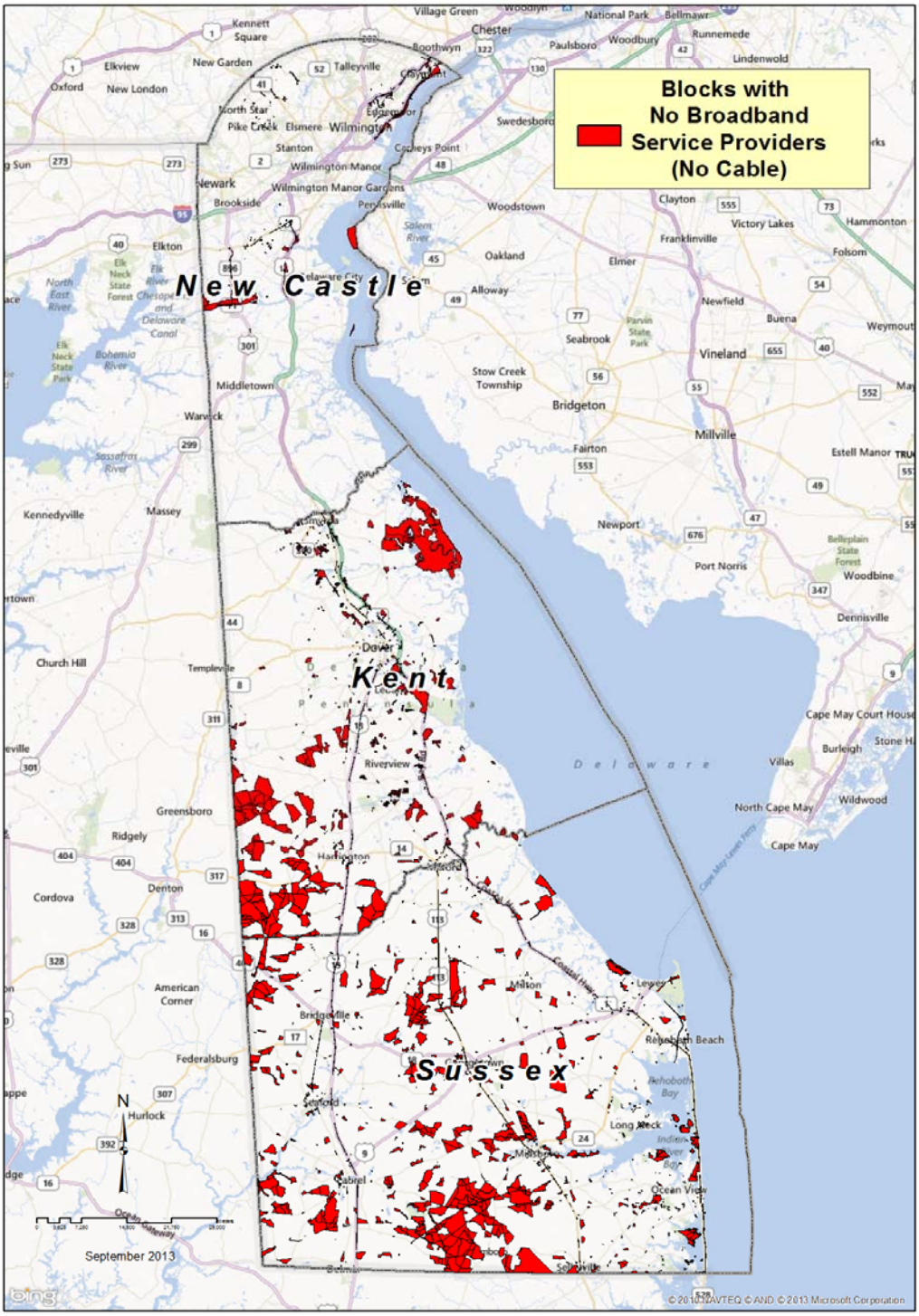
Version Information

Version Num.	Edit Date	Edited By	Comments
0.1	12/07/10	Nielsen, Robinson	Draft Document
1.0	12/10/10	Jensen, Conway	Draft Document Revisions
1.1	04/26/11	Jensen	Spring 2011 Updates
1.2	06/13/11	Tuttle	Updated 2011 Anchor Stats
2.0	09/22/11	Cloud	Updated 2011 CAI Stats for Fall submission from UD-IPA
2.1	01/25/12	GeoDecisions	Fall 2011 Updates
3.0	03/20/12	GeoDecisions	Spring 2012 Updates
3.1	03/29/12	Cloud	Minor edits, Updated CAI Stats for spring submission from UD-IPA
4.0	03/28/13	GeoDecisions Team	Spring 2013 Updates
5.0	09/25/13	GeoDecisions Team, UD-IPA (CAI Stats)	Fall 2013 Updates (Round 8)

Attachments

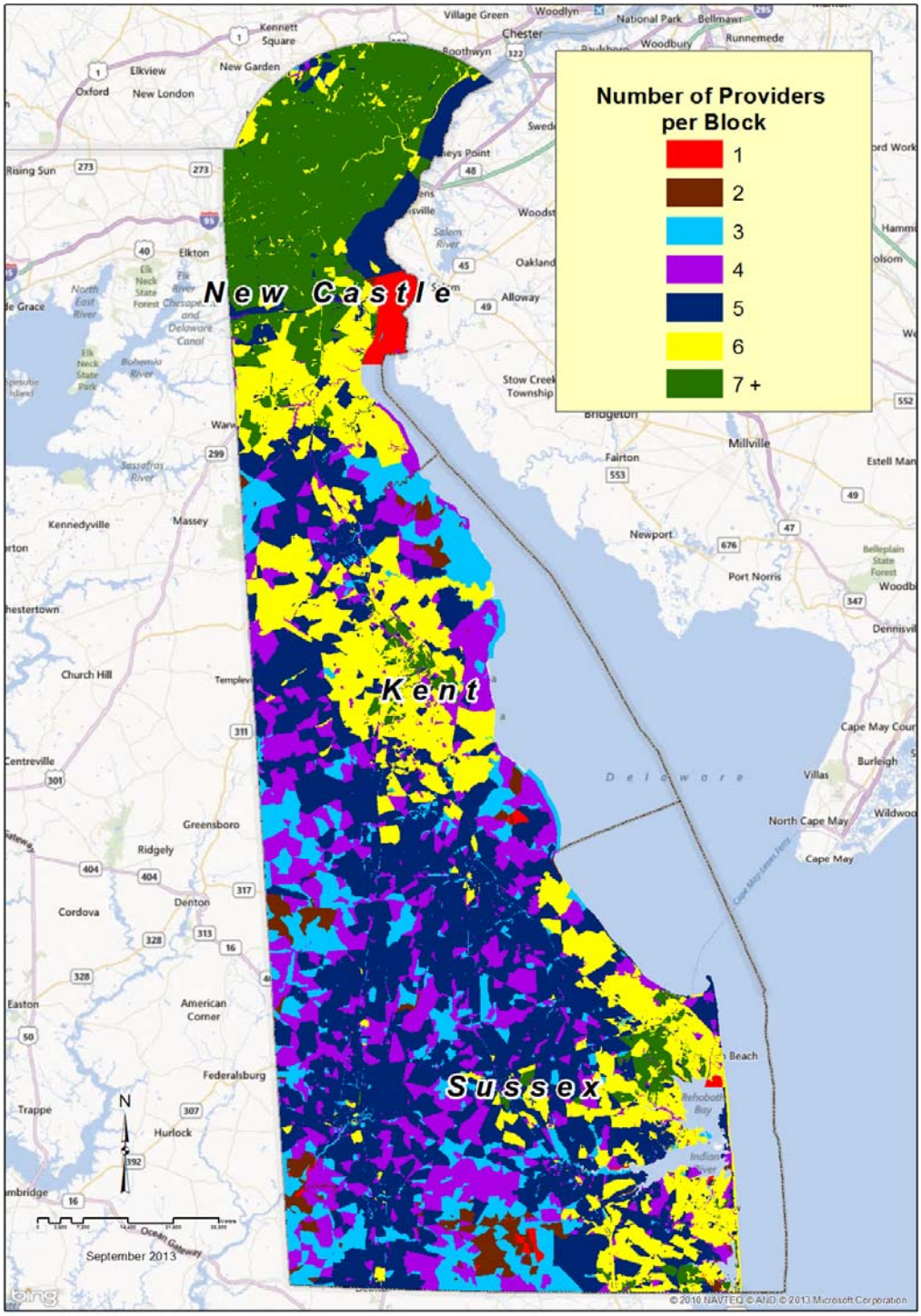
Attachment 1

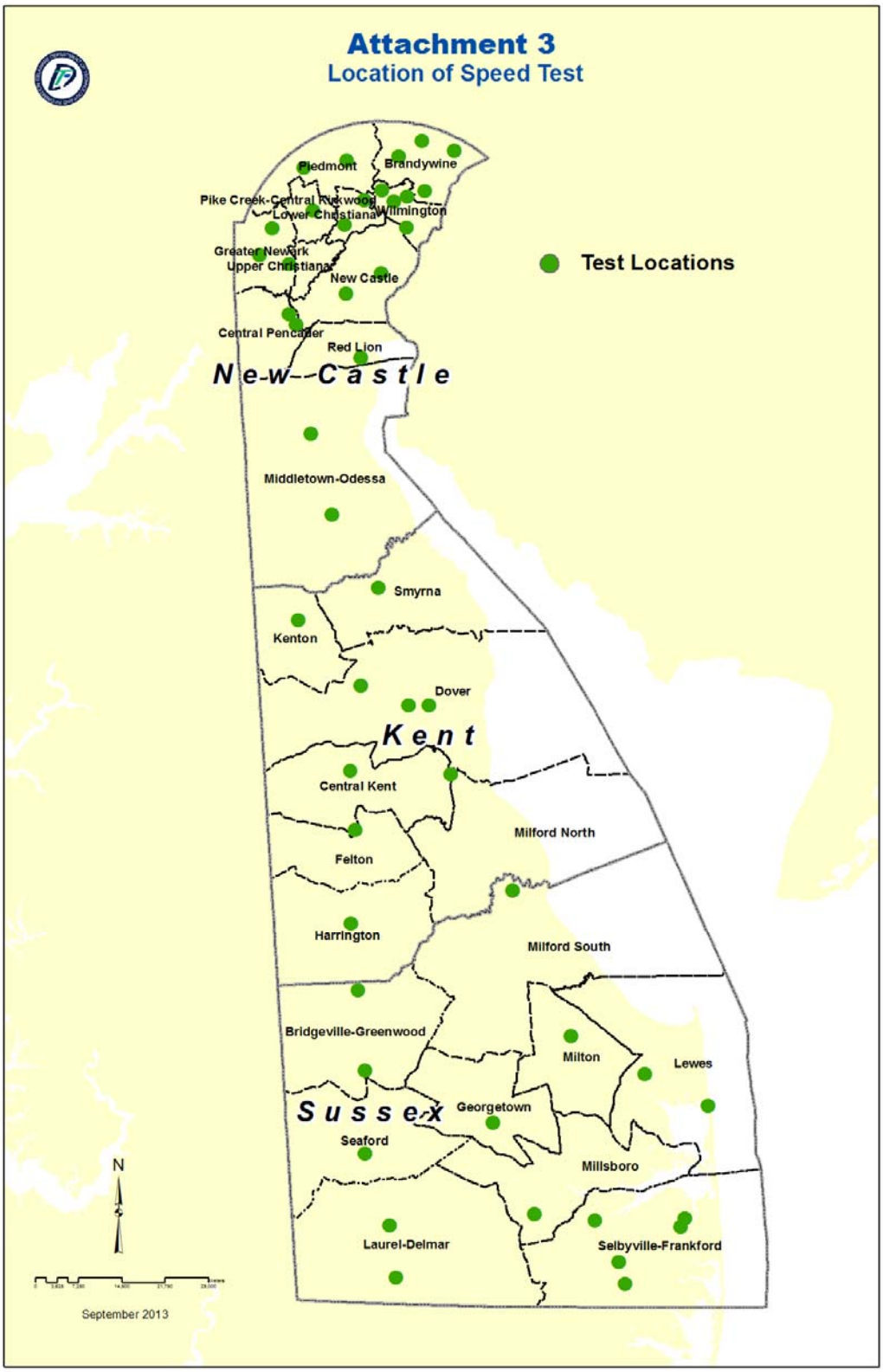
Areas with No Access to Broadband

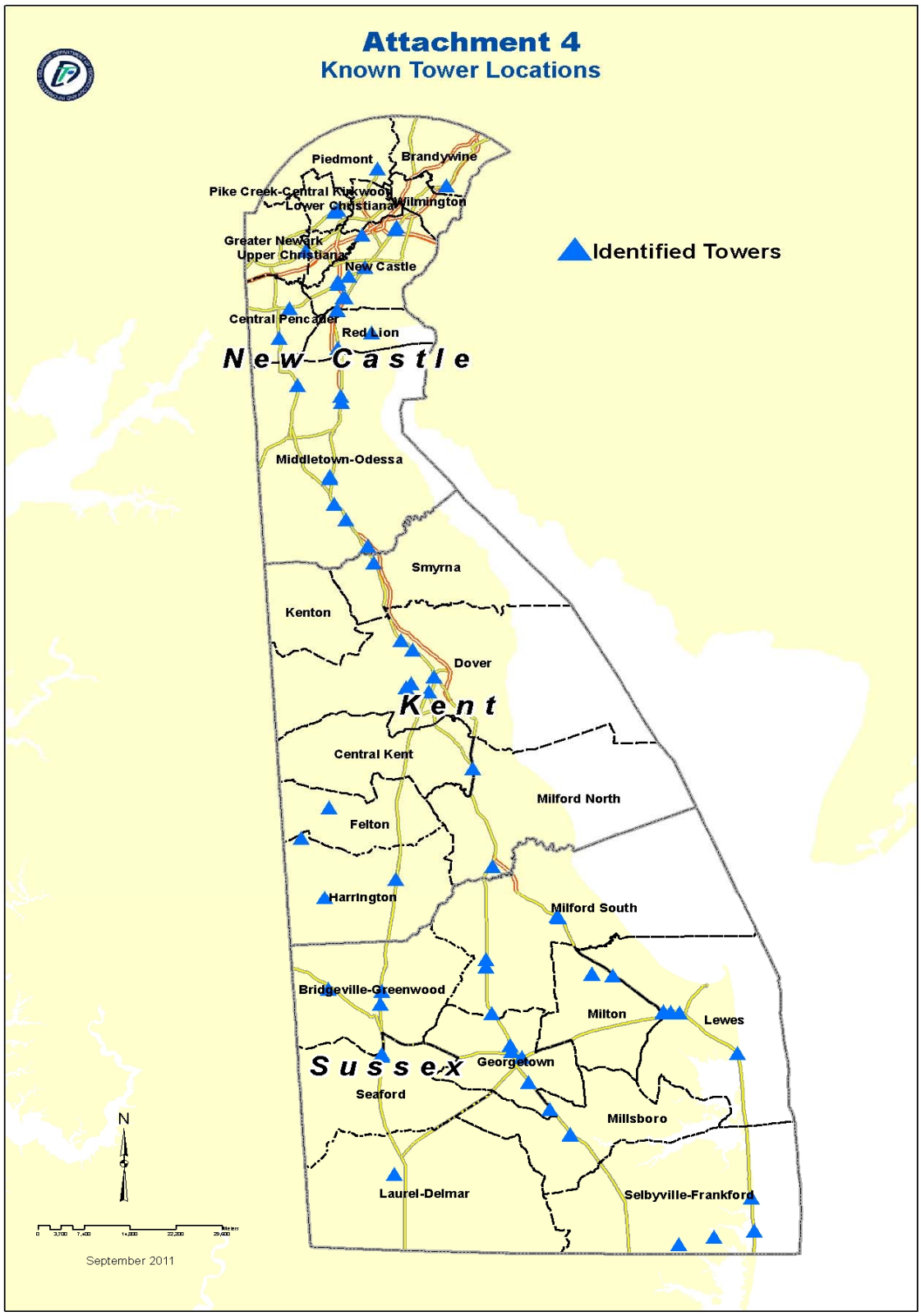


Attachment 2

Number of Broadband Providers per Block

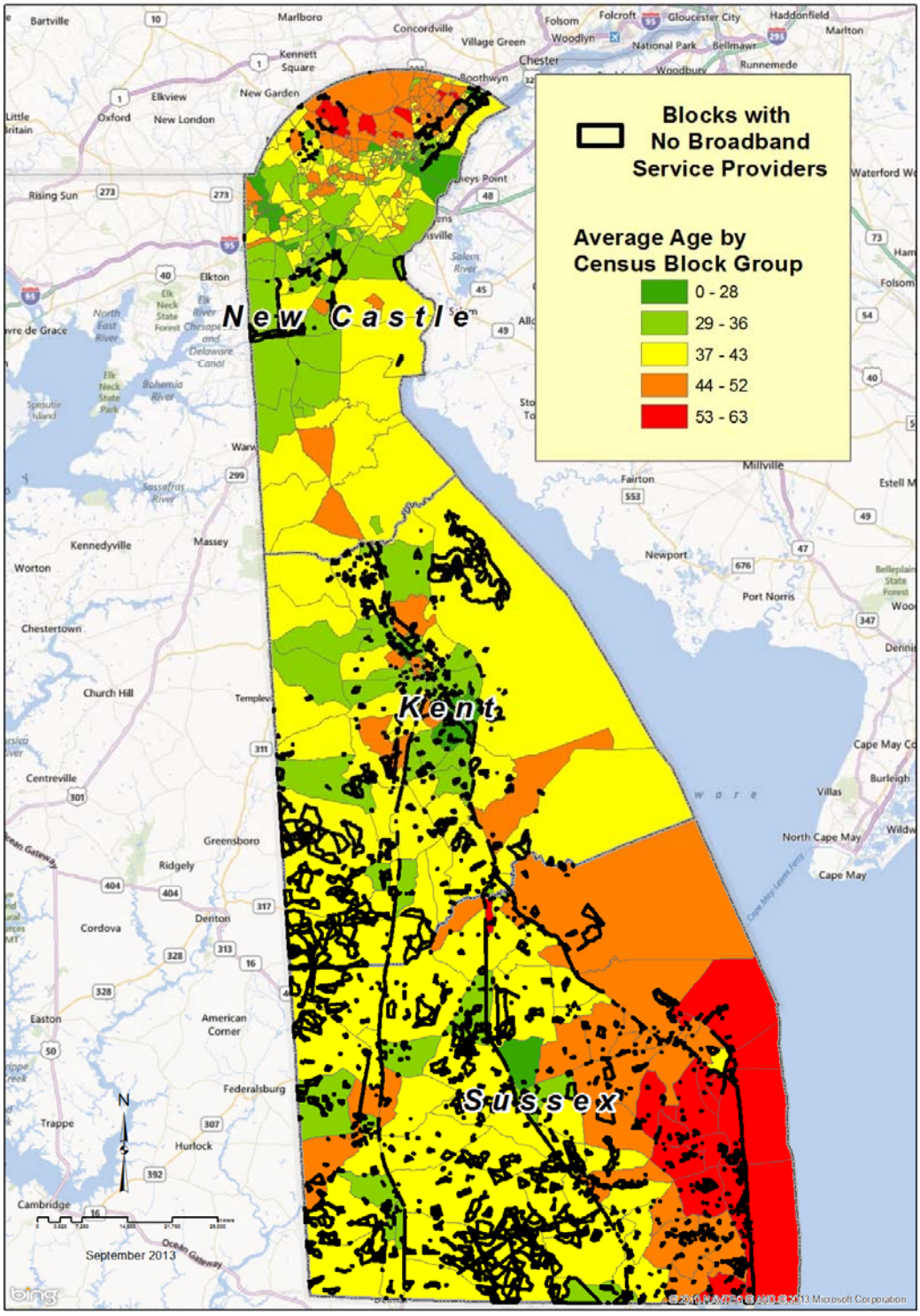



Attachment 3
Location of Speed Test
Piedmont
Brandywine
Pike Creek-Central Rockwood
Lower Christiana
Wilmington
Greater Newark
Upper Christiana
New Castle
Central Pencader
Red Lion
New Castle
Test Locations
Middletown-Odessa
Smyrna
Kenton
Dover
Kent
Central Kent
Milford North
Felton
Harrington
Milford South
Bridgeville-Greenwood
Milton
Lewes
Sussex
Georgetown
Seaford
Millsboro
Laurel-Delmar
Selbyville-Frankford
N
September 2013

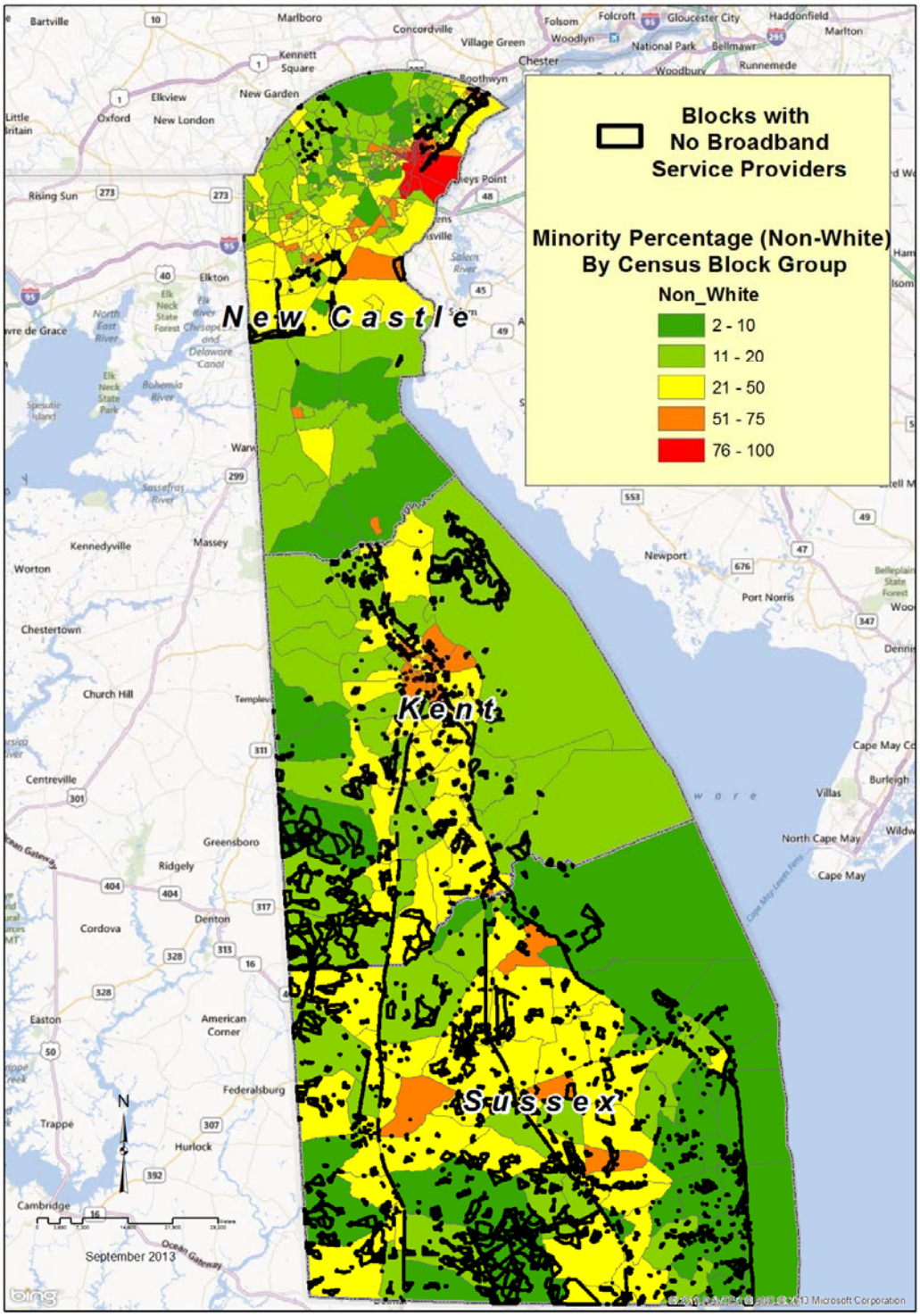

Attachment 4
Known Tower Locations
Identified Towers
Piedmont
Brandywine
Pike Creek-Central Kirkwood
Lower Christiana
Wilmington
Greater Newark
Upper Christiana
New Castle
Central Pencader
Red Lion
New Castle
Middletown-Odessa
Smyrna
Kenton
Dover
Kent
Central Kent
Milford North
Felton
Harrington
Milford South
Bridgeville-Greenwood
Milton
Lewes
Georgetown
Sussex
Seaford
Millsboro
Laurel-Delmar
Selbyville-Frankford
N
September 2011

Attachment 5

Average Age by Census Block Group



Attachment 6
Minority Percentage (Non-White) By Census Block Group



Attachment 7

Average Income By Census Block Group