VIRGINIA'S 2016 BROADBAND DEMAND CAMPAIGN

PREPARED FOR VIRGINIA'S SECRETARY OF TECHNOLOGY

NOVEMBER 2, 2016

EXECUTIVE SUMMARY

Virginians must have broadband access to participate in the new Virginia economy, expand educational opportunities, benefit from advances in health information technology, reduce environmental impact by teleworking, and facilitate entrepreneurship and innovation while living in a safe environment no matter where they reside in the Commonwealth. Virginia must expand broadband access and capacity to meet the broadband demands of today and ensure the infrastructure is in place to support the future bandwidth demands in the most efficient and cost effective way. To meet this challenge we must understand what we have, where we are deficient, and implement a comprehensive broadband plan for Virginia's future.

Virginia's Secretary of Technology, Ms. Karen Jackson, convened a meeting of stakeholders in the spring of 2016 to identify strategies to expand broadband access in unserved and underserved areas. In that discussion, it became apparent that in order to effectively and efficiently expand broadband access we must first identify where the greatest unmet demand exists (citizens and businesses that need Internet access and currently have no options). Virginia maintains a statewide broadband availability map that is based on data reported biannually by Internet service providers to the Federal Communications Commission (FCC). However, the reported coverage is overstated due to federal reporting rules and the overstatement is greater in the very areas which tend to be unserved or underserved. In order to clearly identify the areas with unmet demand the Center for Innovative Technology (CIT) and its partners, Virginia Tech's Center for Geospatial Information Technology (CGIT) and Virginia Geographic Information Network (VGIN), worked together to design RUOnlineVA to crowdsource broadband demand from the citizens. The campaign was officially announced by Governor McAuliffe on May 24, 2016, closed on August 15th and collected more than 15,000 responses from residents and businesses.

The RUOnlineVA campaign data indicates almost one quarter (23% which could represent as many as **782,745 homes**) of the respondents have no options for fixed Internet access. Unfortunately almost half (48%) of the respondents are relying upon technologies that are too expensive and/or too slow to support critical applications such as teleworking, health information technologies, distance learning, etc..

This report provides the details of the data collected, the analysis performed and the resulting findings of the RUOnlineVA campaign in four major sections:

- *Recommendations* –recommendations based on the demand analysis.
- *Survey Overview* – background information and the impact of local support resulting in meaningful data for those localities
- *Survey Response Analysis* -- what data was collected and the processes to validate the data for analysis
- *Demand Analysis* – what the resulting data tell us about broadband demand and how this data relates to available funding, current Internet services, existing vertical assets and current broadband initiatives.

RECOMMENDATIONS SUMMARY

The majority of broadband in Virginia and across the nation has been deployed because it was profitable for the private sector to deliver the service. In rural and less populated areas the cost to deliver the service often exceeds the potential revenue. Leaders at all levels of government realize the necessity of broadband to support many aspects of life today and into the future as we witness increased innovation and technological advancements. There is a gap between the Internet service that every home and business should have and what was profitable to build. How we bridge this gap is the basis for continued work and focus of many broadband industry experts and evangelists across this nation. This is not an easy gap to bridge and there is not one answer for every unserved or underserved area. The technologies leveraged to deliver Internet service continue to evolve and advance daily. We cannot predict what technology may resolve this gap in the future; however, we are certain there must be enough capacity coming into an area to meet the community's broadband needs to support education, public safety, healthcare and economic development. We can certainly build and deploy the infrastructure needed to deliver Internet service if there is enough funding to cover the capital expenses, however, the resulting networks must be self-sustaining and ideally profitable to fund upgrades and expansions in capacity to support future demand.

The analysis performed based on the RUOnlineVA campaign data has served to confirm that bridging this gap is going to require the following actions which are summarized here and are explained in further detail in the following Recommendations section:

- Virginia should target state broadband funding to unserved and underserved areas with priority for areas with documented unmet demand.
- Virginia should formally engage broadband service providers to help identify state and local policies that can be made more favorable for broadband deployment.
- Virginia should consider another RUOnlineVA campaign to obtain more extensive data from more localities.
- Virginia should support and promote adoption and awareness initiatives to ensure all Virginians recognize the value of broadband access.
- Virginia should formally adopt/encourage state/local Dig Once policy to facilitate further and faster expansion of broadband.
- State/local franchise agreements should be reviewed for long-drop policy, and that information should be conveyed to all new homebuilders, and real estate developers.
- Local planning departments should encourage real estate developers to consult/collaborate with local broadband service providers for provisioning service or installing conduit during the plan review process.
- Virginia should consider tax incentives to lessen the cost burden of the installation of broadband conduit in any new housing development or home build.
- Virginia should give preference (points) to localities seeking funding that have adopted favorable broadband policies. Ideally this should be applied to DHCD's new VATI program.

RECOMMENDATIONS

Virginia should target state broadband funding to unserved and underserved areas with priority for areas with documented unmet demand.

This report is focused on identifying areas of unmet demand across the Commonwealth. Unmet demand can mean two things; gaps in service or quality of service issues. For many reasons, unmet demand exists and if locally widespread, can have a serious impact on education, healthcare, public safety and economic development.

The RUOnlineVa data provides Virginia with another level of information that can be used to more accurately evaluate areas of unmet demand. For those localities that have generated significant response to the RUOnlineVA survey, the unmet demand data will be a valuable asset in helping to formulate local broadband related goals and priorities – a critical step in any expansion consideration and future investments.

Virginia is fortunate to have service providers deploying a mix of technologies including fiber, copper, cable and fixed wireless (including whitespace technology) to deliver fixed Internet access throughout the Commonwealth. Nevertheless, the RUOnlineVA campaign confirmed our rural and less populated areas are struggling with lack of access and/or limited capacity.

To underscore the level of funding that is required to expand broadband access and capacity in Virginia, CIT gathered investments made by industry, federal and state government over the past 3-5 years. **A conservative estimate of over $1 billion** has been invested by the private sector in the past three to five years to expand broadband in the Commonwealth. This total includes over $14 million by fixed wireless providers, over $191 million by incumbent wireline providers and over $800 million by the cable industry. These totals are not comprehensive as all providers were not willing and/or able to respond to our request in time for this report. Communities and providers have also successfully obtained over $7 million in federal telecommunications funding from the USDA alone over in the past 3 years. The Commonwealth has awarded hundreds of thousands in funding to localities to support broadband expansion and has allocated $1.25 million in fiscal year 2017 to fund construction of broadband infrastructure (Virginia DHCD's VATI program mentioned below). There is no doubt that the Commonwealth's citizens and businesses are benefiting from these investments, yet there remains a large segment of the population that does not have adequate Internet access.

The Commonwealth must ensure every Virginia citizen, business, school, library, first responder and health care provider has adequate and affordable access to the Internet. The new state funding for broadband expansions recently announced by Virginia's Department of Housing and Community Development (DHCD); the Virginia Telecommunication Initiative (VATI) will provide financial assistance to supplement construction costs by private sector providers to extend services to areas that are presently unserved by any broadband provider. DHCD's attention to unserved areas is an important first step in furthering the expansions of broadband into areas of need. In many unserved areas, VATI funding may be the only way to offset the economics of deploying new broadband services.

Details and Cost Estimate: Considering there are more than 52 underserved localities and the cost of expansions in rural areas, the Commonwealth should allocate whatever is feasible within the state budget as long as documented unmet demand exists. Several states have allocated funding to help offset the costs of broadband expansions such as Virginia's VATI funding: California, $10million; New York, $500million; Wisconsin, $1.5million annually, Minnesota, $35million.

Virginia should formally engage broadband service providers to help identify state and local policies that can be made more favorable for broadband deployment.

Broadband favorable policies are being addressed at the federal level (FCC). CIT is working at the local level to help localities identify policy related barriers to deployment. CIT created "The Path" as a way to help Virginia localities streamline the process of local broadband expansion. Leveraging Virginia's Broadband Toolkit, CIT's Path to improved broadband aims to eliminate as many local barriers as is reasonable to improve the economics for broadband expansions in less populated areas.

Broadband supports all sectors of the new Virginia economy and it is going to take the public and private sectors working together to further expand broadband across the Commonwealth. The public sector is best positioned to identify the broadband goals and priorities for their communities. The private sector is best positioned to deliver broadband services. There may be situations in which a locality can facilitate the delivery of new services to help offset the economics for the providers. For instance, if infrastructure is lacking, a locality may be able to fill an infrastructure gap to assist the private sector in reaching a distant location. Otherwise, more efforts to improve the economics of broadband expansions such as lowering costs through broadband friendly policies, incentives to stimulate private sector investments in areas with a longer return on investment, additional funding targeting areas of documented unmet demand or needing additional capacity and supporting and promoting awareness and adoption programs are Virginia's best path forward to further advance the benefits of broadband.

CIT currently receives $500,000 annually to provide technical assistance to local governments, staff the Broadband Advisory Council and manage and support the Governor's Office of Telework Promotion and Broadband Assistance. CIT began functioning under this funding in the spring of 2015 once the federally funded state broadband initiative ended. Because federal funding didn't end until the third quarter of FY15 therefore state funding wasn't tapped until then, there was funding remaining at the end of the fiscal year. CIT has been allowed to roll unused funding from prior years and has expended more annually than what is allocated.

Details and Cost Estimate: An estimated cost of $250,000 which is based on providing additional funding (above the current $500,000) to CIT to expand technical assistance to a greater number of localities per year. The Broadband Advisory Council should include at least one session per year dedicated to hearing state policy recommendations to lower deployment costs from the various Internet service provider industry leaders.

Virginia should consider another RUOnlineVA campaign to obtain more extensive data from more localities.

The RUOnlineVa data has already been proven to be valuable for several localities. RUOnlineVA data has provided the basis for local assessments in several counties currently engaged in broadband expansion projects. By targeting areas of unmet demand and aggregating demand across the locality three of the fourteen most responsive localities are on their way to meeting their broadband goals by partnering with the private sector.

Where sufficient, RUOnlineVA data has proven its value in helping localities to understand their broadband environment and needs. Unfortunately, many counties were not adequately represented in the data. Some of the most unrepresented are localities that appear to be deficient in broadband access based on the FCC 477 coverage data.

As with many things in life that we do for the very first time, you immediately identify things you wish you had done differently. The same is true with the RUOnlineVa campaign. This campaign ran during summer vacation months and ideally should be conducted during the winter months when people are more likely to be at home and school is in session (schools are immensely helpful is getting the message out). There were many citizen inquiries after the campaign closed, highlighting how long it took for the news about the campaign to disseminate throughout the state. Based on the feedback, there needs to be a longer lead time before launch to support a more extensive marketing and outreach campaign to stimulate greater participation. Finally, during the data cleansing and validating process it was discovered that some data should be formatted differently to lessen the effort required validating data and the survey needed additional questions to provide a more comprehensive view of the demand.

Details and Cost Estimate: The 2016 campaign leveraged the CIT staff and Virginia Tech's CGIT staff under CIT's current broadband funding. An estimated cost of $28,000 will be needed to run another RUOnlineVA campaign. This figure is based off of costs from the 2016 campaign with additional funding to support greater marketing effort to solicit wider participation, modifications to the survey format to capture additional data and longer campaign duration.

Virginia should support and promote adoption and awareness initiatives to ensure all Virginians recognize the value of broadband access.

Over 23% of RUOnlineVA respondents indicated that they have no Internet service. It is important research some of these locations and the FCC coverage data compared to RUOnlineVA "No Service" response locations because often times broadband services are available to many of those respondents. The survey did not provide the ability for a respondent to offer an explanation of why they do not subscribe to the service; this ability may be considered if the survey is repeated.

According to national studies various factors influence why citizens do not subscribe to broadband services when they are available. Some industry reports set the average subscription rate at about 40%. In rural, less populated and remote areas a low take rate works against the economics for deploying new services.

Also, affordability and age are among the most common factors that influence whether a person subscribes to a broadband service. In both cases, adoption and awareness programs can remove barriers to adoption and help change the economics of broadband expansions. These programs help citizens understand how they can leverage broadband access to improve their quality of life and enable economic, educational, and occupational and health related opportunities. It is important to ensure Virginians are realizing the benefits of broadband to improve their lives and their communities.

Details and Cost Estimate: This effort could be accomplished by leveraging CIT resources to broadly distribute the information to local governments, civic groups and libraries for an estimated cost of $25,000 of additional funding allocated to the CIT Broadband program. For reference, Nebraska and Minnesota are allocating $500,000 for adoption programs.

Virginia should formally adopt/encourage state/local Dig Once policy to facilitate further and faster expansion of broadband.

State/local franchise agreements should be reviewed for long-drop policy, and that information should be conveyed to all new homebuilders, and real estate developers.

Local planning departments should encourage real estate developers to consult/collaborate with local broadband service providers for provisioning service or installing conduit during the plan review process.

Virginia should consider tax incentives to lessen the cost burden of the installation of broadband conduit in any new housing development or home build.

The cost of constructing and expanding broadband networks is capital intensive. Much of the cost of expanding networks to bring services to new housing developments or new homes with long driveways (known as "setbacks" or "long-drops") can be attributed to the lack of preparation for broadband infrastructure by real estate developers and homeowners. The same considerations a developer or home owner uses for provisioning electrical or water infrastructure to new developments should be given to broadband infrastructure as well. It is much easier to accommodate these costs during the planning and construction than afterwards construction is completed.

The cost to the developer for providing the infrastructure for power, water or other utilities is built into the price of the home. When a fixed broadband provider has to bring their services in after other utilities have been installed, the cost escalates and may be prohibitive. The simple addition of including broadband quality conduit along roads and/or driveways for developments would enable providing broadband services to new locations much faster and at less cost. This strategy is the basis of the federal "Dig Once" policy agenda.

Dig Once is intended to help lower the costs and speed up the deployment of laying broadband infrastructure. Localities across the country have adopted dig once policies to streamline and simplify the process of installing or upgrading broadband equipment. For instance Santa Cruz California instituted a dig once policy that stipulates whenever there is construction, reconstruction, or repaving work in or adjacent to a county rights of way, provisions will be made to include "the installation of telecommunication cable, conduit or other related equipment whenever practical or feasible[1]."

Details and Cost Estimate: CIT currently works with local governments on policy reviews, franchise agreements reviews and policy recommendations are shared with the Broadband Advisory Council under current CIT broadband funding. State agencies such as DHCD and VDOT should evaluate state legislation affecting their areas to identify policy changes that can lower broadband deployment costs. Several states offer tax incentive programs such as tax credits for qualified broadband expenditures, sales tax exemption for broadband technology equipment used to expand broadband access, and tax exemption for equipment used in broadband deployments into unserved areas. The cost to the Commonwealth would be dependent on the criteria set and the current tax revenue against those equipment sales.

Virginia should give preference (points) to localities seeking funding that have adopted favorable broadband policies. Ideally this should be applied to DHCD's new VATI program.

Policies that reduce barriers for expanding broadband, establish favorable broadband environments that are attractive to service providers. Virginia's Rural Broadband Bill (HB912) is a great example of a broadband

[1] http://www.tellusventure.com/downloads/bank/santa_cruz_county_dig_once_ordinance_2015.pdf

favorable policy. The provisions of HB912 allow broadband providers to leverage areas along rural roads to deploy their infrastructure to expand into underserved and unserved areas. While seemingly a small change in law, HB912 removed a large barrier that has the potential to have a big impact on broadband expansion in Virginia's rural communities. The one service provider in Virginia, CenturyLink that accepted the FCC's Connect America Fund Phase II (CAFII) subsidy noted that without HB912 "participation in CAFII would have been put in serious risk." HB912 helped make the business case for CenturyLink to accept the CAFII funding for Virginia. HB912 represents the kind of policy change that is needed to enable the expansion of broadband services for all Virginians.

Policies at every level of government should be examined to identify ways of streamlining and decreasing the costs of broadband deployments, for example reducing or waiving permitting costs for expanding broadband. Reducing barriers with broadband favorable policy helps to improve the economics and incentivizes providers to expand broadband across the Commonwealth.

Details and Cost Estimate: This recommendation could be implemented as part of the criteria/scoring of the VATI program and any future broadband funding programs.

SURVEY OVERVIEW

BACKGROUND INFORMATION

Governor McAuliffe has stated that "Access to high-quality Internet connectivity is one of the most critical tools for communities to grow, diversify and build a new Virginia economy. Providing adequate telecommunications in a community is essential for preparing our students and workforce, attracting businesses, improving medical services and providing a better quality of life for all Virginians." During the 2016 signing of the rural broadband bill, House Bill 912 (HB912), the Governor reminded us why such legislation is important; "too many Virginia communities lack access to reliable, fast and affordable Internet connections." HB 912 was introduced by Del. J. Randall Minchew and facilitates broadband expansion to Virginians who live and work in rural and lower population density areas.

In an effort to identify strategies to expand broadband access, in mid-April 2016, Virginia's Secretary of Technology, Karen Jackson, convened a meeting of stakeholders to explore ways to increase connectivity throughout the Commonwealth. The meeting took place in the Town of Ashland and included representatives from the many of the organizations that offered support for the initiative: The Center for Innovative Technology's (CIT) broadband team, Virginia Association of Counties (VACO), Virginia Municipal League (VML), Virginia Economic Developers Association (VEDA), Virginia Planning District Commission (the VAPDC), Virginia Rural Center, Virginia Cable Telecommunications Association (VCTA), Virginia Telecommunications Industry Association (VTIA), Department of Housing and Community Development (DHCD), Department of Education (DOE), Library of Virginia, Mid-Atlantic Broadband Cooperative (MBC), and Old Dominion Electric Cooperative (ODEC.)

The goal of the meeting was to identify what the state could do to promote further expansion into underserved and unserved areas. It was agreed that the first step should be to determine areas with greatest need - citizens that need broadband today and have no access or limited access.

For years the Commonwealth, as well as the rest of the nation, has struggled with the question of 'where is broadband currently available and where is it needed most?' In an attempt to answer this question the Virginia Broadband Availability Map was created. This map is based upon provider reported broadband coverage information using the FCC's form 477 data which all broadband providers are required to submit twice per year. Virginia's Broadband map remains current with new releases of the data and is publicly available through Virginia's Office of Telework Promotion and Broadband Assistance website[2]. However federal reporting rules allow providers to overstate their coverage which means many unserved and underserved areas are being reported as served. Therefore in order to more accurately determine which areas in Virginia have the greatest need, the team decided that it needed to collect information directly from the citizens to compare to the map data.

[2] - www.wired.virginia.gov

Crowdsourced citizen broadband demand may allow a correction to overstated coverage, facilitate identification of areas with significant demand that may be prioritized for expansions, and possibly identify areas that lack infrastructure which may be prohibiting expansions.

A statewide survey, RUOnlineVA, was developed and served as the initial step to provide Virginians an opportunity to log their need for Internet service. The goal initiative was to identify, for the Governor and other policy makers, where broadband is needed most in the Commonwealth.

The survey was intentionally brief, asking only 5 questions (see: Survey Response Analysis section below for details on the specific survey questions). A toll free answering service was made available to accommodate residents and businesses not able to access an online survey to register their need. The RUOnlineVA initiative was officially announced by Governor McAuliffe on May 24, 2016 and closed on August 15, 2016.

Announcements about the RUOnlineVA initiative were distributed across the Commonwealth with the assistance of many supporting organizations, including; VACO, VML, VDOE, VAPDC, periodic press releases from CIT, local organizations, schools, local governments, libraries and outreach to newspapers requesting coverage. RUOnlineVA received national attention from organizations such as Government Technology Magazine, SpeedMatters.Org -- a project of the Communications Workers of America, and the Farm Bureau.

The RUOnlineVA initiative received more than 15,000 responses from residents and businesses. Data was collected from 129 localities (5 had no responses[3]); however, only 14 localities generated enough responses when compared to total homes (census data) to be statistically significant. Therefore statewide assumptions should not be made based on the data. However reasonable assumptions can be made regarding the 14 counties that generated significant data and are hopeful that these assumptions are applicable to other underserved and unserved areas of the Commonwealth.

The analysis of the RUOnlineVA responses will be used to stimulate broadband policy and funding discussions, and to provide localities and service providers with insight into the areas of unmet demand. Ideally the RUOnlineVA data should play a role in the Commonwealth's overall strategy to promote broadband investment and target available funding to meet the current demand as well as prepare the Commonwealth for the future. Additionally, the RUOnlineVA campaign has already served in helping to bridge the gap between the Internet service providers and the citizens. CIT collaborated with some of the incumbent providers to address inquiries about the lack of service reported within coverage areas. Being in full support of the initiative, a number of providers expended valuable resources identifying and even solving some of the issues.

[3] Falls Church, Franklin City, Manassas Park, Norton, and Williamsburg

LOCAL GOVERNMENT SUPPORT AND CASE STUDIES

While only 14 counties [4] (*Figure 1 below*) generated enough data to be significant;, the value of the RUOnlineVA data for them is that it provides information directly from citizens and businesses about where they need services. This demand information is vital as localities formulate their broadband goals and priorities.

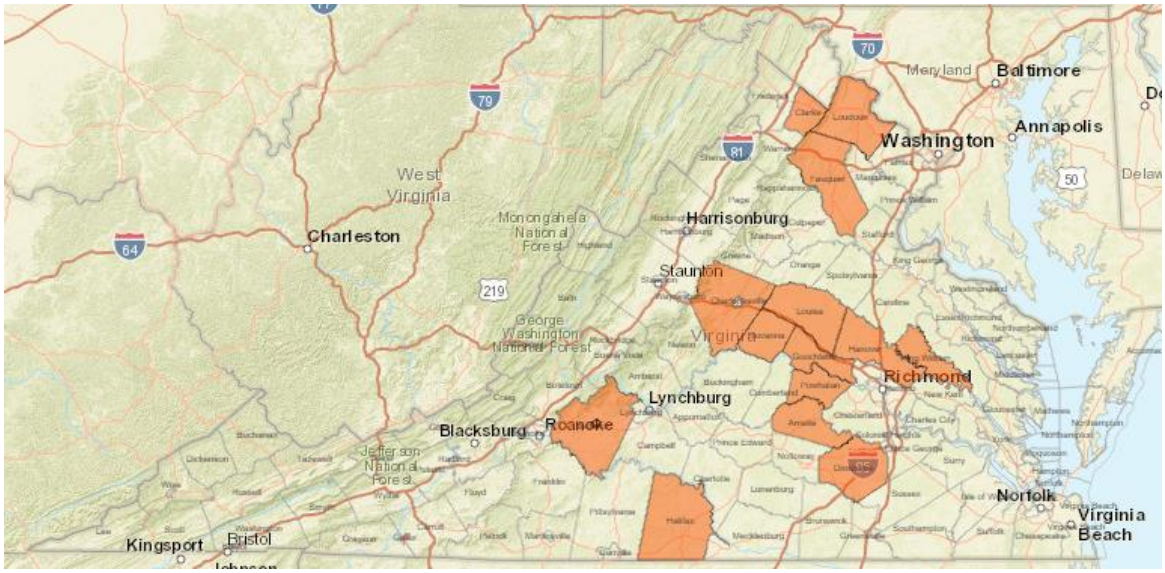

Figure 1: Map showing the most responsive localities

Two counties stood out from the rest as fully embracing the opportunity of the RUOnlineVA campaign -- Halifax and Clarke counties. Halifax County made sure the campaign was widely publicized; local schools requested participation during school registration, churches and civic organizations were also involved in getting the word out. Most impressively, for two days, even with a heat index of over 100 degrees, volunteer citizens set up booths at the local Wal-Mart to take survey information directly from shoppers.

Halifax made the RUOnlineVA initiative an "all hands on deck effort," demonstrated by the local participating entities; Turbeville Ruritans Club, Halifax County Agricultural Marketing Center, Halifax County Emergency Services, as well as community leaders, volunteers and supporters of broadband expansion in Halifax County.

[4] Halifax, Clarke, Bedford, King William, Loudoun, Powhatan, Hanover, Louisa, Goochland, Dinwiddie, Fauquier, Amelia, Fluvanna, and Albemarle

Halifax Virginia – RUOnlineVa data collectors at WalMart
Kimley A. Blanks - Halifax County Agricultural Marketing Director,
Jewell Swann Bellamy – CEO/Executive Director Halifax United Way,
Halifax resident survey taker, Carol Foster.
Photo by: Barbara Elliott, News & Record staff

The results of their efforts produced almost 2,100 responses, almost three times as many responses than any other locality and one of the two best response rates (12%) based on the number of homes using 2014 projected census data. Based on total homes, Halifax data provides 99% confidence level with +/-2.64% margin of error on any assumptions made from this data as accurately representing Halifax citizens. Halifax stands out when the address points of responses are plotted on the map and when viewing the statewide data as well.

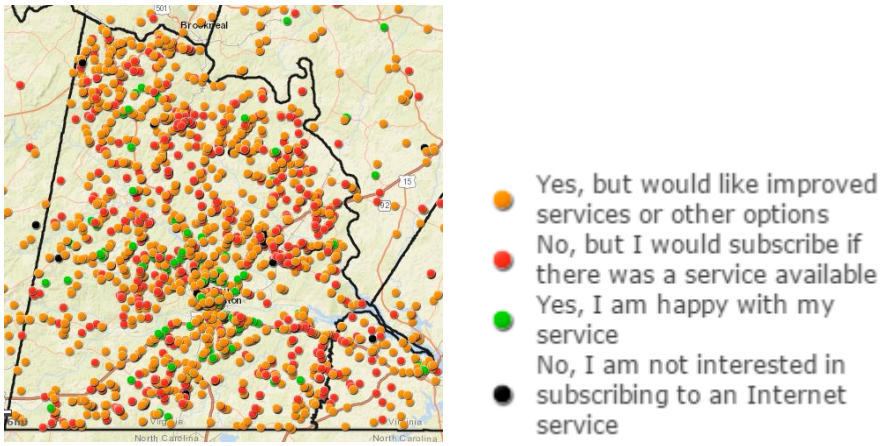

Figure 2: Halifax County RUOnlineVA data points

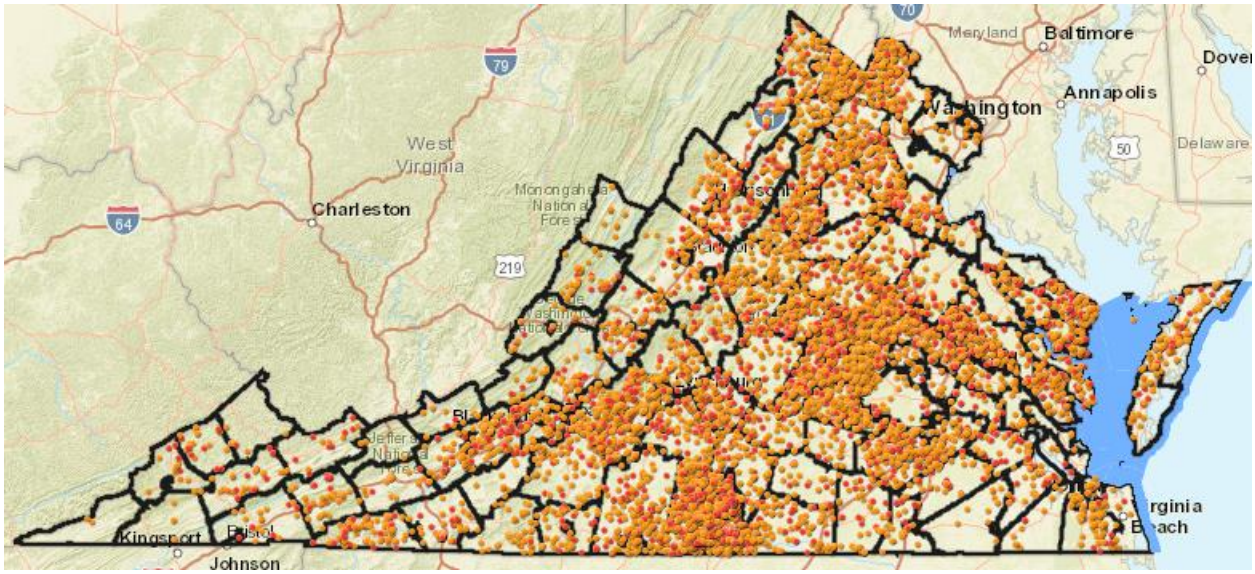

Figure 3: State view of RUOnlineVA responses

Clarke County generated the second greatest number of responses and the second best response rate (12%) based on total homes as stated in the 2014 projected census data. In an effort to relate the importance of the RUOnlineVA campaign, Clarke County leveraged their reverse 911 system to notify residents about the campaign which resulted in the second highest total number of responses. As if in recognition of the importance to the county and its citizens there was no negative feedback from subscribers about using the alert system for this purpose. Based on total households, Clarke County data produced a 95% confidence level with a 3.4% margin of error.

Local governments across the state actively promoted RUOnlineVA. For instance, Bedford County's Economic Development agency notified their citizens about the campaign by using the County's Facebook page. As a result, Bedford generated the third highest number of responses. Other local governments added notices about the RUOnlineVA campaign to their websites; many used local news sources (newspapers, radio, civic groups etc.,) to encourage participation. There were also reports that some Internet service providers were asking callers to go to the RUOnlineVA website to report their need for service.

Individual citizens played an important role in getting the word out as well. Several individuals took the initiative to notify their neighbors about the survey. Locations in Bedford, Fluvanna, Fauquier, Louisa, King William and others clearly show where entire neighborhoods voiced their need.

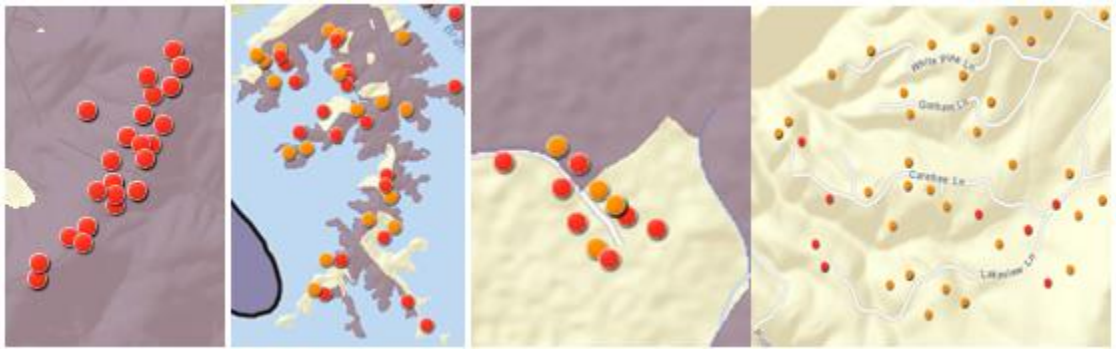

Figure 4: Clusters of broadband demand in Virginia neighborhoods

Those localities that were able to generate enough responses to show significant unmet demand (indicated by responses of "would like improved services or other options" or "would subscribe if there was a service available") will benefit when working with providers to expand services. Service providers need to know that demand exists and where before they consider expanding their services to ensure the networks will be sustainable and profitable to support future upgrades.

In addition to the answering service provided for the RUOnlineVA campaign, approximately 40 citizens called, or sent emails to the Governor's office to convey their particular circumstances that the survey did not capture. These anecdotes provided important insight into why broadband is so important to all Virginians and some of the challenges faced by residents or businesses seeking connectivity. A summary of those insights follow:

- One mother, with only a satellite Internet connection available was unable to upload a video (3.17 MB) in the middle of the night (when supposedly data usage is not measured,) to the VCU's patient portal of her child having a grand mal seizure. Had she been able to get that video to the physician on call, she could have been advised over the phone. Internet is now not only a necessity for businesses and schools, but it has become a serious health care tool for families.
- The largest tourism business in one county has poor Internet service that negatively impacts their business and their ability to run credit card sales.
- Families with school children depend on Internet access to complete homework assignments and research. Those without Internet at home routinely go to local libraries, area restaurants or other places that offer free Wi-Fi to complete their school work.
- Children without Internet at home are at a serious disadvantage if their schools leverage digital learning technologies such as Google classroom for core classes.
- Citizens are frustrated when they see crews installing broadband lines near their homes and they are told the cables or fiber are not intended to serve residential customers.
- Satellite and cellular services are too expensive and sometimes too slow for important applications such as virtual private networking to support teleworking, on-line video based classes or meetings.
- Homebound residents depend on their connectivity and feel isolated when their already poor service is degraded further due to weather and congestion during peak times.
- A number of citizen's expressed regret that they might have to move if they cannot obtain affordable and reliable Internet service. Unfortunately many citizens are faced with a limited market to sell real estate that does not have Internet access.

It was clear by the amount of data generated from the survey, calls and emails – during and after the survey closed -- and the amazing efforts that localities put into the RUOnlineVA data collection efforts, that citizen's want to, and will play a key role in expanding broadband across the state.

SURVEY RESPONSE ANALYSIS

THE SURVEY AND RESPONSE DATA

When accessing the survey, visitors were asked to provide the following data to help determine location and current broadband service:

1. Address
2. This address is for a (choose one):
    - Residence with a home based business
    - Residence
    - Business
3. Does this address currently subscribe to internet service? (choose one):
    - Yes, I am happy with my service
    - Yes, but would like improved services or other options
    - No, but I would subscribe if there was service available
    - No, I am not interested in subscribing to internet service
4. If you do currently have internet service at this address what TYPE of service is it? (choose one):
    - I don't have service
    - Cable (you purchase internet service from your cable TV provider)
    - Dial-Up
    - DSL (you purchase internet service from your landline telephone provider)
    - Fiber (most often associated with gigabit speed - typically only available in densely populated areas)
    - Fixed wireless from a wireless internet service provider (WISP) (you have an antenna or small dish on your house/business to get service from a particular tower/pole)
    - Mobile wireless (you use your cellphone or a device from a cell phone provider for accessing the internet)
    - Satellite (you purchase internet service from a satellite service provider)
    - I don't know

In order to better understand the RUOnlineVA survey responses one must first look at several points regarding the data quality of the information collected. The data was cleansed and validated taking the initial 15,000 responses down to 12,891 valid responses that were used for the analysis. More information on the details and processes used to cleanse and validate the data are available in Appendix A.

QUALITY ASSESSMENT OF SURVEY RESPONSES

After the submitted data was cleaned it was then analyzed to determine number of responses within a particular geographic area. The areas analyzed were (census) block, (census) block group, county, congressional district, planning district, and state. These analyses were based on U.S. Census data from 2010 (block) and projected U.S. Census data from 2014 (block group, county, congressional district, planning district, state).

Each geographic area was mapped and color coded to highlight density of responses. Maps for response rates by several census aggregations (block group and county) are shown below as well as maps by percentage of total population and homes. Congressional, PDC, and State level numbers can be seen in Table 3 with confidence intervals of less than +/- 5% highlighted in green at a confidence level of 95%.

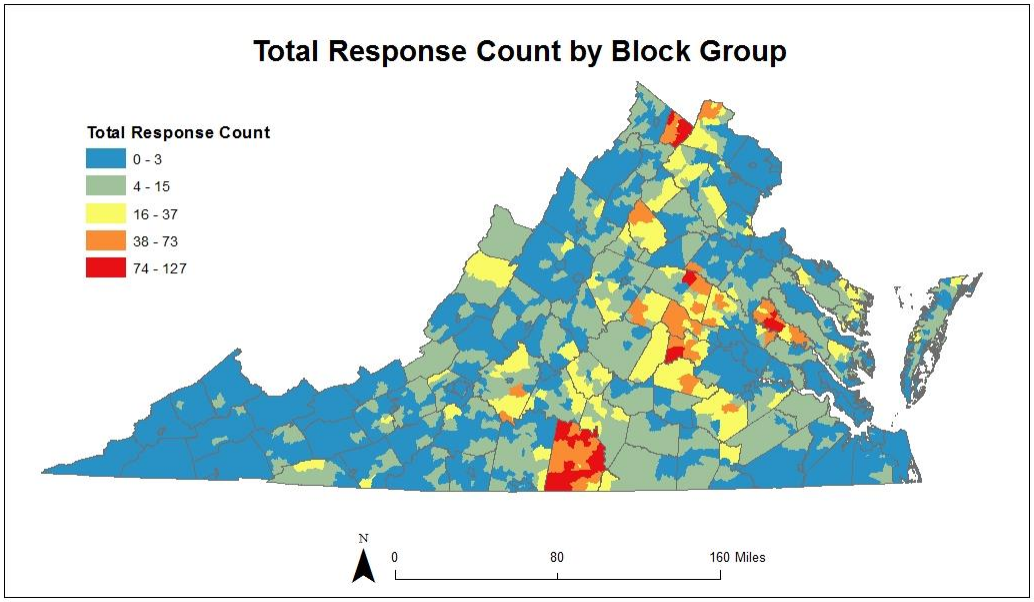

Figure 5: # Responses at the census block group level

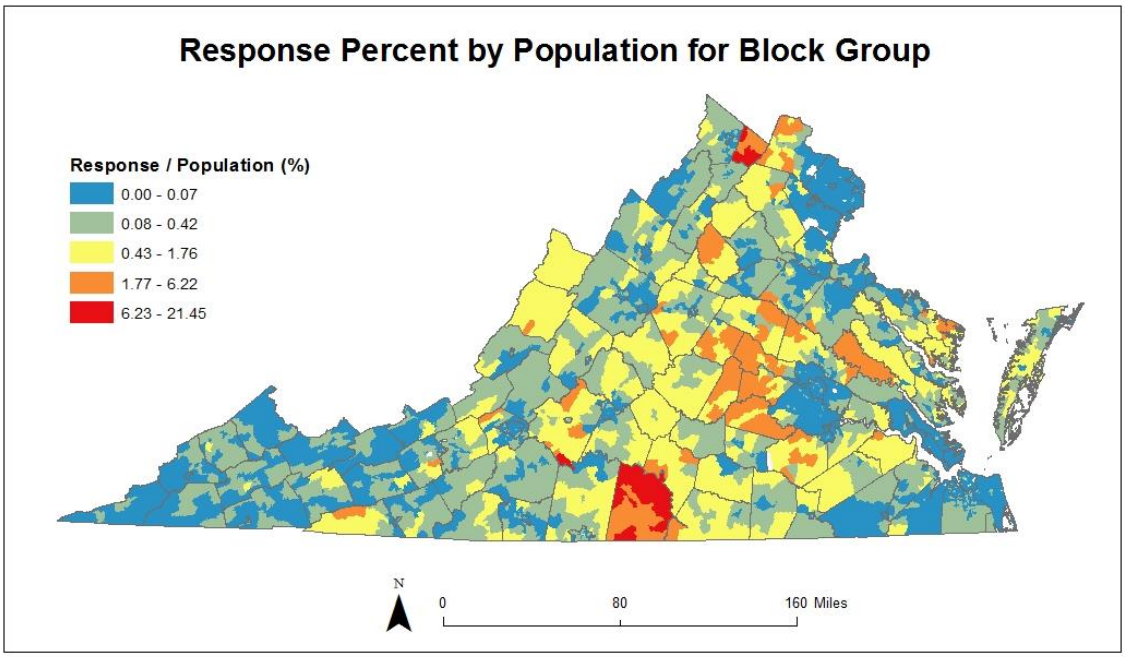

Figure 6: % Response by Population at the Census block group level

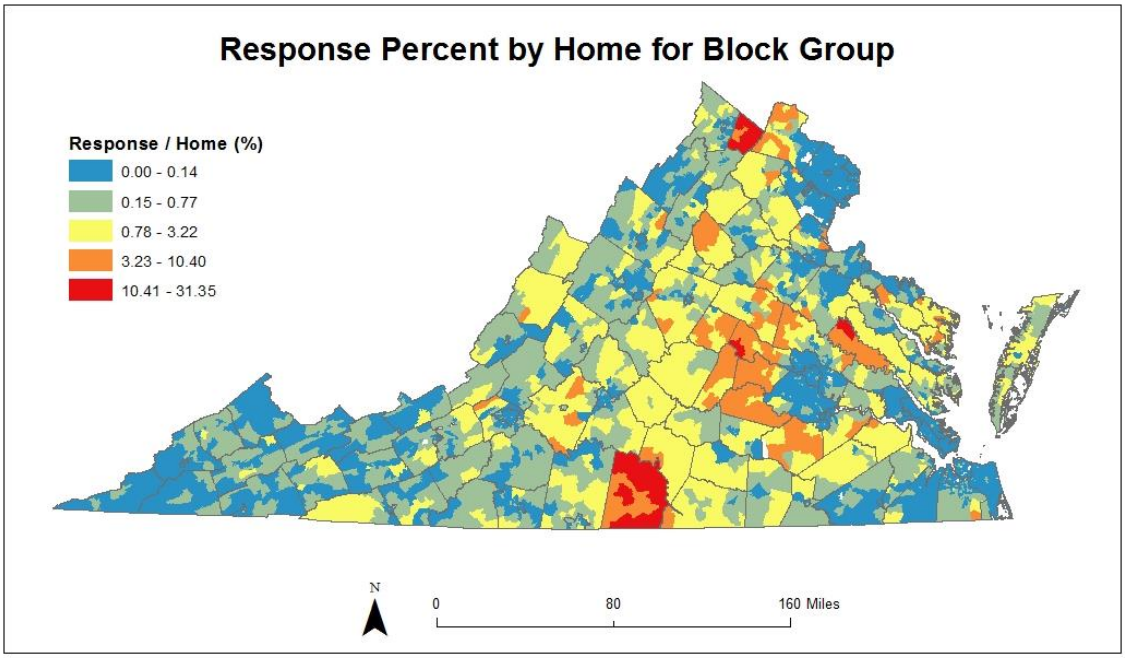

Figure 7: % Response by home at the Census block group level

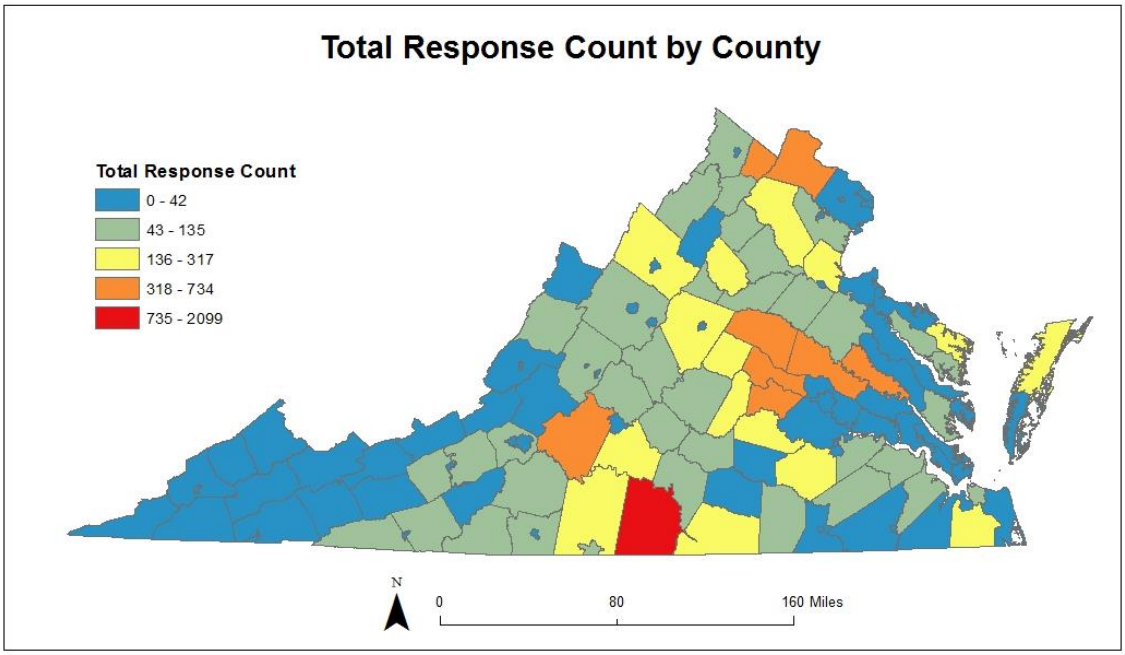

Figure 8: # Responses at the Locality level

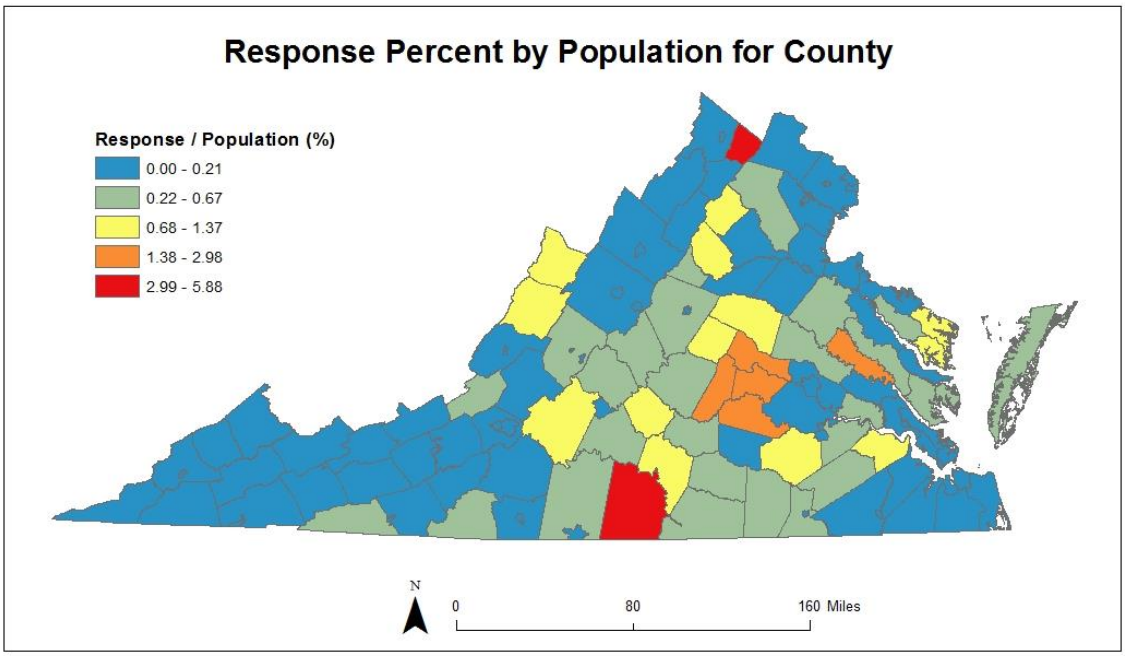

Figure 9: % Response by Population at the Locality Level

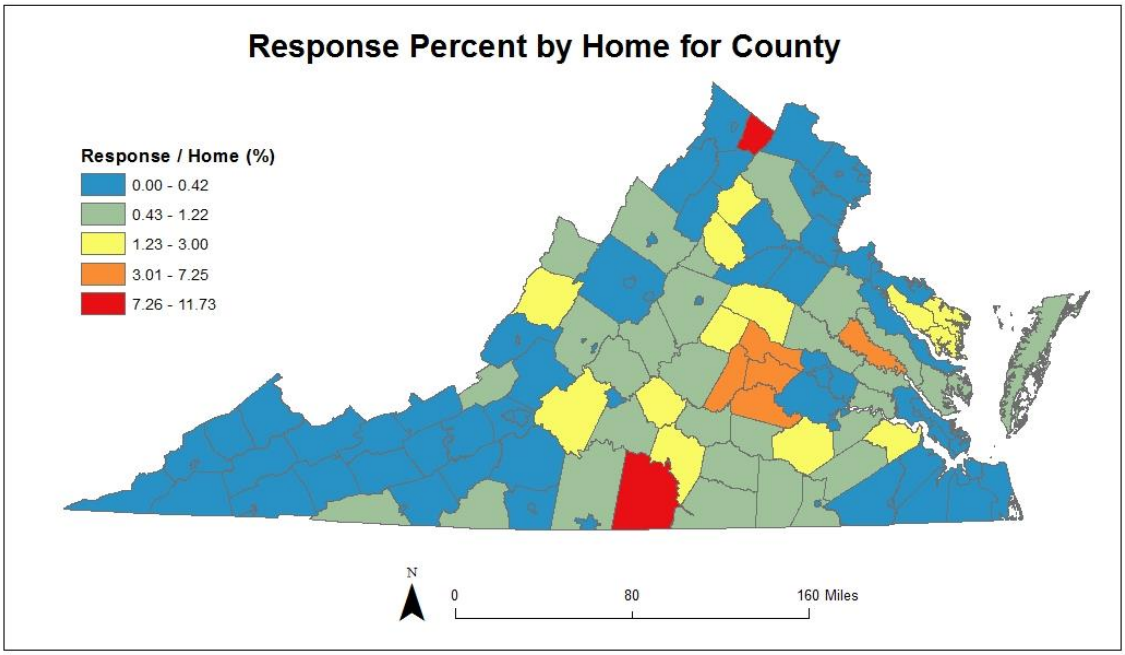

Figure 10: % Response by home at the Locality level

Table 3: Responses at Congressional, Planning District and State Levels with confidence calculations

Locality	2014 Total Population Estimate	Total Response Count	% Response by Population	Total Home Count	% Response by Home	Confidence Variance at 95% CI (+/-)
Virginia	8,185,131	12,891	0.157493	3403241	0.378786	0.86%
Planning District Commission						
Accomack-Northampton Planning District Commission	45,419	201	0.4425	28376	0.7083	6.89%
Central Shenandoah Planning District Commission	290,248	394	0.1357	126403	0.3117	4.93%
Commonwealth Regional Council	103,714	774	0.7463	45437	1.7035	3.49%
Crater Planning District Commission	173,542	549	0.3163	72636	0.7558	4.17%
Cumberland Plateau Planning District Commission	112,070	83	0.0741	53232	0.1559	10.75%
George Washington Regional Commission	341,138	393	0.1152	123375	0.3185	4.94%
Hampton Roads Planning District Commission	1,642,846	340	0.0207	666664	0.0510	5.31%
LENOWISCO Planning District Commission	93,048	26	0.0279	43388	0.0599	19.21%
Middle Peninsula Planning District Commission	90,962	681	0.7487	44691	1.5238	3.73%
Mount Rogers Planning District Commission	192,407	245	0.1273	96641	0.2535	6.25%
New River Valley Planning District Commission	179,908	209	0.1162	78784	0.2653	6.77%
Northern Neck Planning District Commission	50,134	356	0.7101	31170	1.1421	5.16%
Northern Shenandoah Valley Regional Commission	226,273	991	0.4380	98693	1.0041	3.10%
Northern Virginia Regional Commission	2,343,364	591	0.0252	879596	0.0672	4.03%
Rappahannock-Rapidan Regional Commission	169,529	659	0.3887	68383	0.9637	3.80%
Richmond Regional Planning District Commission	1,027,128	1,387	0.1350	426124	0.3255	2.63%
Roanoke Valley-Alleghany Regional Commission	276,560	177	0.0640	127110	0.1392	7.36%
Southside Planning District Commission	84,578	2,364	2.7951	44847	5.2713	1.96%
Thomas Jefferson Planning District Commission	239,734	1,017	0.4242	107642	0.9448	3.06%
Virginia's Region 2000	255,440	974	0.3813	113464	0.8584	3.13%
West Piedmont Planning District Commission	247,089	480	0.1943	126585	0.3792	4.46%
Congressional District						
Congressional District 1	751,039	1,391	0.1852	299057	0.4651	2.62%
Congressional District 3	742,508	201	0.0271	323116	0.0622	6.91%
Congressional District 10	767,831	1,392	0.1813	267449	0.5205	2.62%
Congressional District 5	729,232	5,108	0.7005	343961	1.4851	1.36%

Locality	2014 Total Population Estimate	Total Response Count	% Response by Population	Total Home Count	% Response by Home	Confidence Variance at 95% CI (+/-)
Congressional District 4	738,714	1,454	0.1968	285915	0.5085	2.56%
Congressional District 7	746,349	1,475	0.1976	302481	0.4876	2.55%
Congressional District 2	729,703	246	0.0337	306389	0.0803	6.25%
Congressional District 11	762,463	16	0.0021	275068	0.0058	24.50%
Congressional District 9	722,813	751	0.1039	343139	0.2189	3.57%
Congressional District 6	737,148	836	0.1134	326800	0.2558	3.39%
Congressional District 8	757,331	21	0.0028	329866	0.0064	21.38%

After reviewing the response maps at both block group and county level it is very apparent which localities had the most effective outreach efforts (most notably Halifax and Clarke counties). The increased response rate in these jurisdictions made it possible to evaluate those that lacked broadband coverage in a statistically significant manner (as seen in the "Demand Hotpots" section).

These maps set the stage for the rest of the analysis. Please keep in mind when reading the rest of this report, if there is a coverage need not listed it does not mean that a coverage need does not exist but rather the survey did not receive enough participation at that particular location to say with confidence that a need exists.

SURVEY RESPONSES AND CURRENT REPORTED COVERAGE

After the number of responses for a particular geographic area was calculated the reported coverage results from the RUOnlineVA survey were compared with FCC 477 reported results. Within the reported FCC 477 coverage a provider can claim that a census block is covered for a fixed broadband connection if "*the provider does, or could, within a service interval that is typical for that type of connection—that is, without an extraordinary commitment of resources—provision two-way data transmission to and from the Internet with advertised speeds exceeding 200 kbps in at least one direction to end-user premises in the census block*." [5]Additionally, a service provider may mark a census block as served even if they only serve one location in that census block.

Since 200kbps is not sufficient for most users to have a favorable internet experience two levels of FCC 477 coverage were analyzed for this report (download / upload speeds): **25/3 Mbps and 10/1 Mbps**. The first (25/3 Mbps) was chosen to coincide with the new (as of 2015) FCC definition of "Broadband" speed.[6] The second was chosen (10/1 Mbps) as the minimum reasonable speed for homes to stream video by the FCC (some claim that 5Mbps download speed is sufficient - but for only one user at a time).[7]

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[5] FCC 477 submission instructions: http://transition.fcc.gov/form477/477inst.pdf

[6] http://www.theverge.com/2015/1/29/7932653/fcc-changed-definition-broadband-25mbps

[7] http://www.consumerreports.org/cro/news/2015/06/is-your-internet-service-fast-enough-for-streaming/index.htm

Coverage results were compared at county level by counting the number of reported blocks in each county that had minimum available coverage of (download/upload): 25/3 Mb/s, 10/1 Mbps, and no coverage. These coverage results were then compared to RUOnlineVA responses with a confidence level of each response rate given by county. Maps summarizing the data can be seen below.

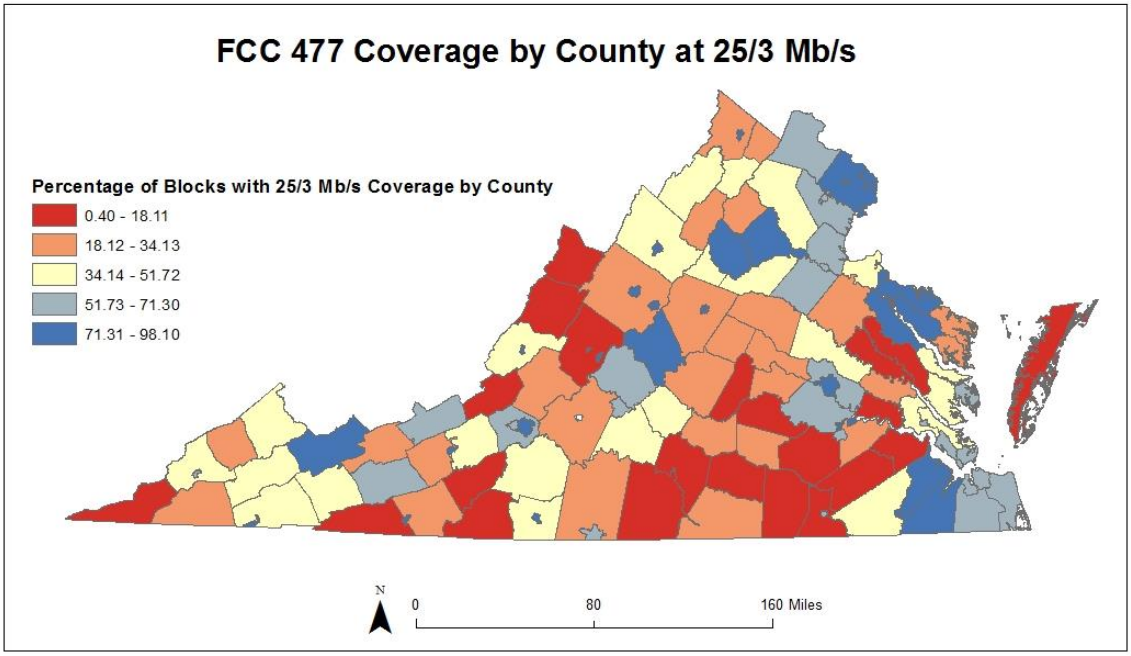

Figure 11: 477 data by county (% blocks covered at 25/3 or above)

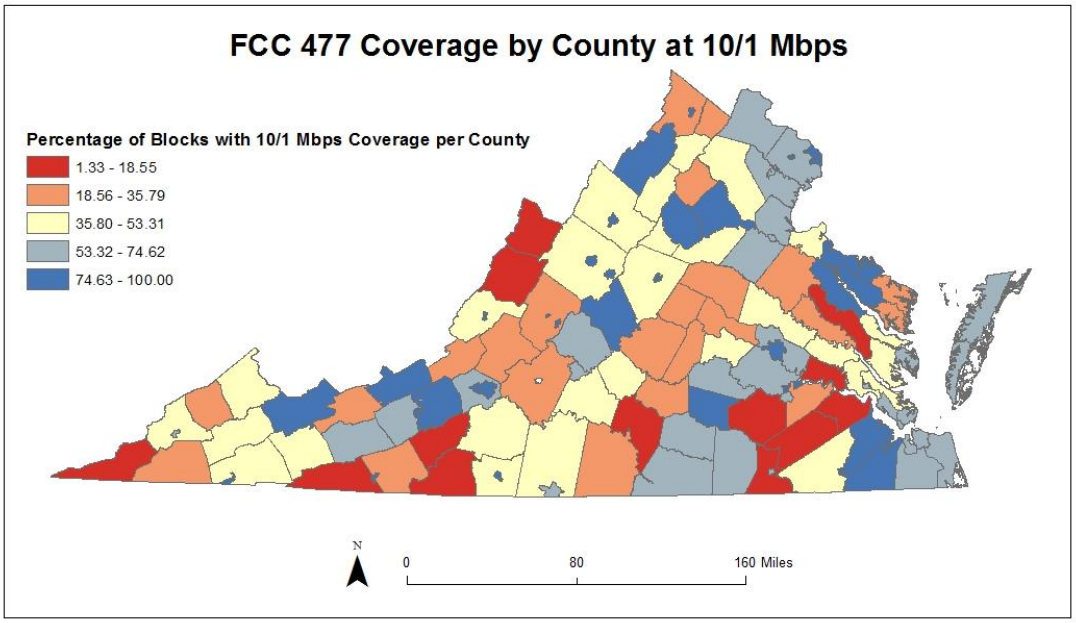

Figure 12: 477 data by county (% blocks covered at 10/1 or above)

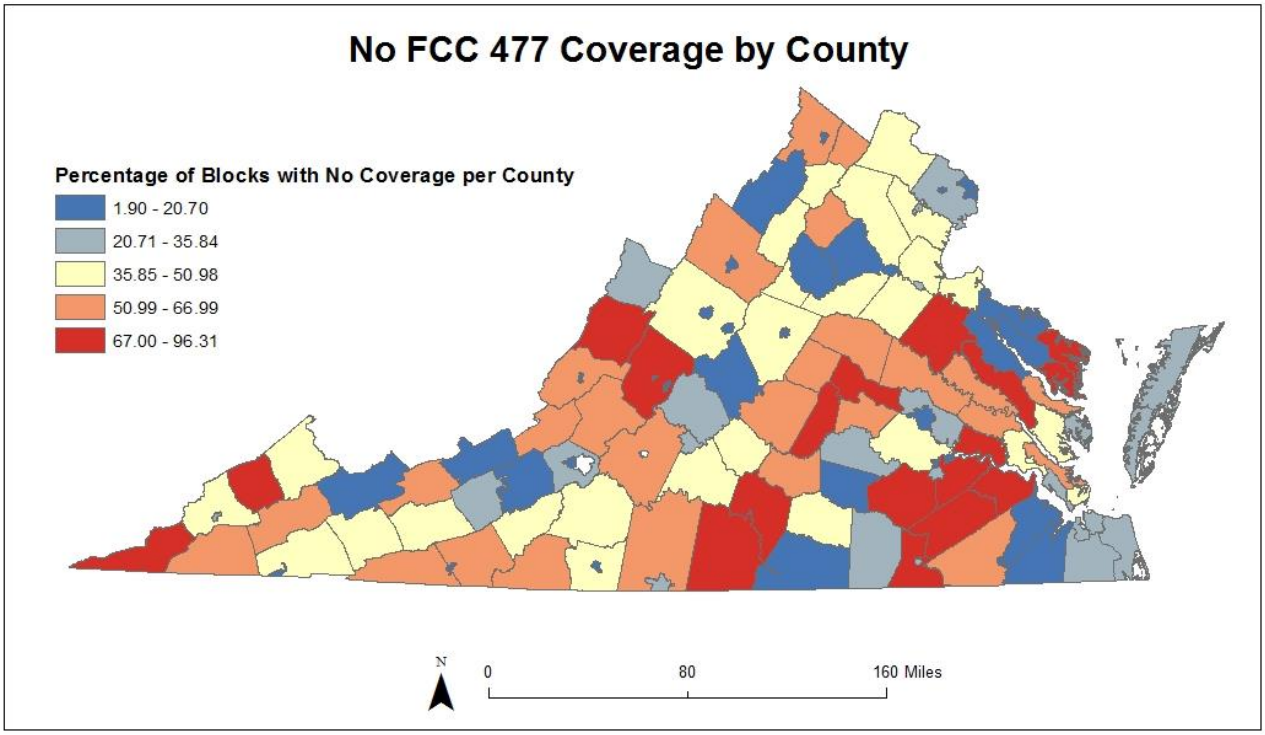

Figure 13: 477 data by county (% blocks with NO coverage – fixed access of at least 4Mbps/1)

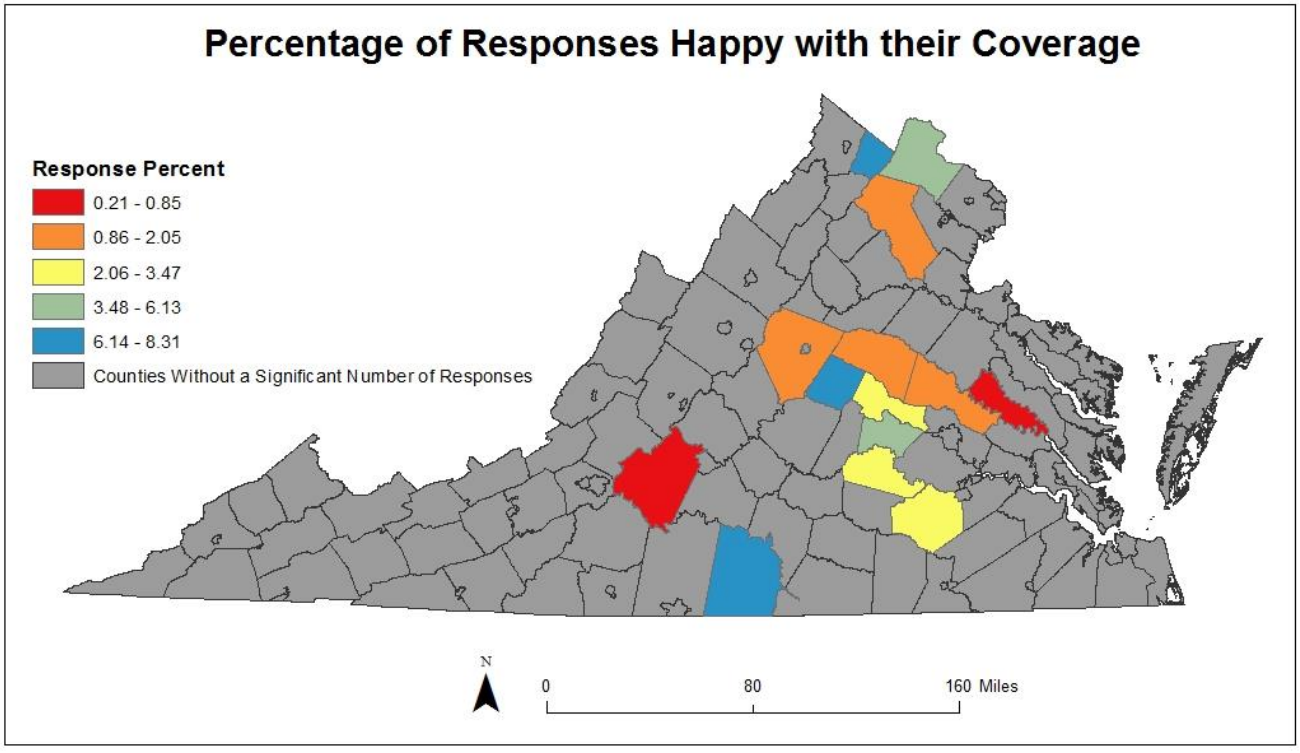

Figure 14: Response by county (% Yes, happy) -- only localities with significant response shown

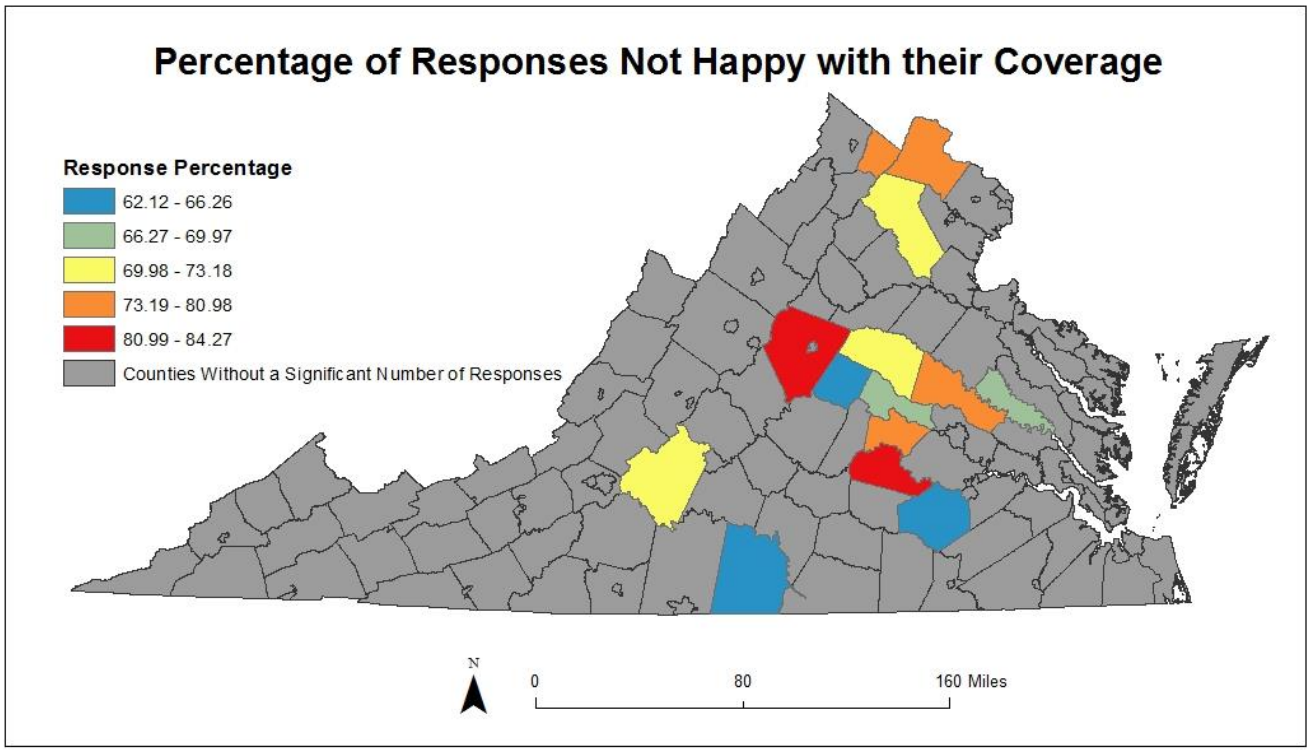

Figure 15: Response by county (% Yes, not happy)

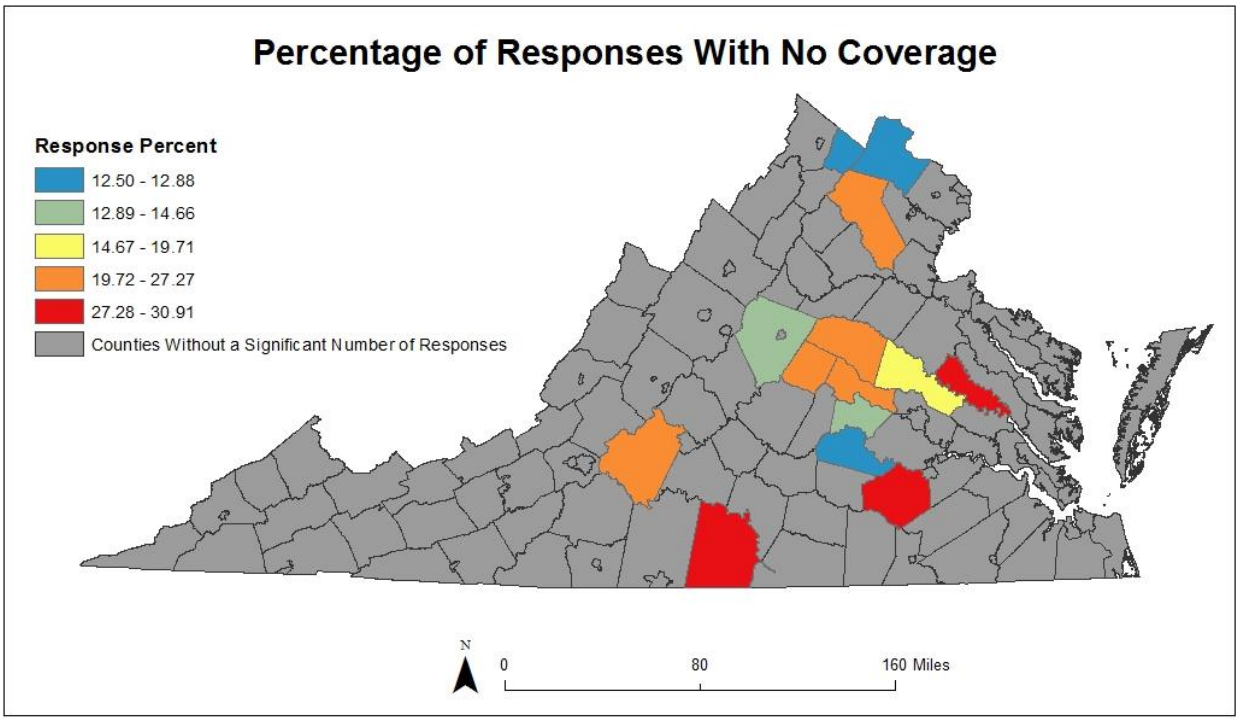

Figure 16: Response by county (% not covered)

In order to better understand these maps data can be seen in the "Statewide Response Views" section below (along with confidence values) to compare response levels within each county. Values of note in maps/tables to compare are:

1. Confidence: Let's you know if the data is statistically significant
2. 477 25/3 data vs. RUOnlineVA "I'm happy" responses. These should correlate in areas that are statistically significant. If you have 25/3 Mbps speeds then you meet the FCC definition of "broadband" and should be "happy with my service."
3. 477 Not Covered vs. RUOnlineVA "I don't have service" responses. These should correlate in areas that are statistically significant. One thing to note is that the data is comparing number of homes (by block) to number of responses received.

DEMAND ANALYSIS

STATEWIDE VIEW OF SURVEY RESPONSES

Survey response data must be compared to the targeted population to determine if the resulting sample size is significant enough to accurately represent the population. The RUOnlineVA survey is focused on broadband access at the address level therefore the population for this survey is homes across the Commonwealth. Based on the projected 2014 census data, there are 3,403,241 homes in Virginia. The response data was verified and validated (details about the survey questions and data cleansing processes are provided in the above Survey Response Analysis section) against Virginia addresses resulting in 12,891 valid responses. Comparing the survey response total to the total homes in Virginia results in the sample size being statistically significant providing a confidence level of 99% (+/- 1.13%) in any assumptions made based on this data as accurately representing Virginia citizens. Data was received from 134 localities; however, only 14 localities generated enough responses when compared to total homes (2014 projected Census) to be statistically significant. Therefore statewide assumptions should not be made based on the data. However, reasonable assumptions can be made regarding the 14 counties that generated significant data and are hopeful that these assumptions are applicable to other underserved and unserved areas of the Commonwealth. Table 4 below provides the list of the localities with significant participation and the resulting confidence level based on total homes and the number of survey responses.

Table 4: Most responsive localities with confidence level

Locality	Count	Occupied Housing Units (2014)	Confidence Level	Margin of Error
Halifax County	2099	18,041	99%	2.64%
Clarke County	735	6,259	95%	3.40%
Bedford County	573	35,308	95%	4.06%
King William County	478	6,597	95%	4.32%
Loudoun County	489	115,599	95%	4.42%
Powhatan County	463	10,195	95%	4.45%
Hanover County	411	39,026	95%	4.81%
Louisa County	384	16,590	95%	4.94%
Goochland County	363	8,726	95%	5.04%
Dinwiddie County	317	11,504	95%	5.43%

Locality	Count	Occupied Housing Units (2014)	Confidence Level	Margin of Error
Fauquier County	293	25,905	95%	5.69%
Amelia County	264	5,400	95%	5.88%
Fluvanna County	247	10,541	95%	6.16%
Albemarle County	247	43,128	95%	6.22%

The following survey findings represent the complete survey dataset which match the results of the 14 most responsive localities.

The majority of the survey responses represent residential locations (80%) with 18% representing home-based businesses. This residential majority drove the decision to compare data to the number of homes. Broadband is often discussed in terms of the importance to economic development and it is essential to remind ourselves of the need for access in residential areas to support our entrepreneurs, innovators, teleworkers and home-based businesses.

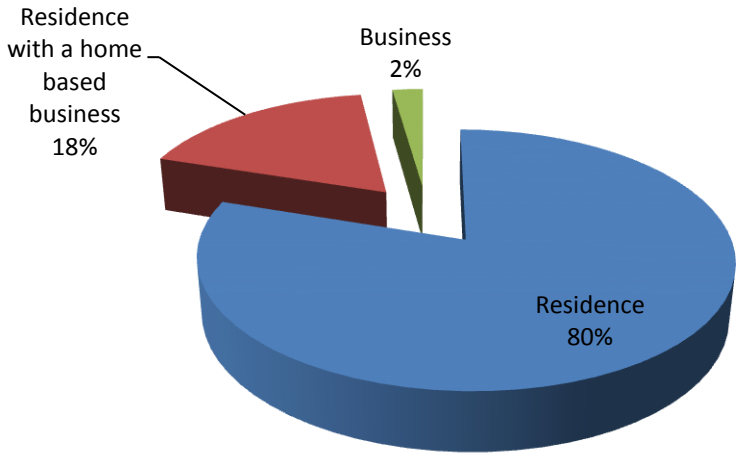

Figure 17: Type of Responder

The purpose of this survey was to assess broadband demand and what level of demand exists. The primary goal was to capture "unmet" demand – locations that need access today and currently have no Internet service available. However, it was important to not exclude citizens that may have limited access and need faster or more affordable service. **Based on the total homes in the Commonwealth, the 23% that reported having no access could represent as many as 782,745 homes.**

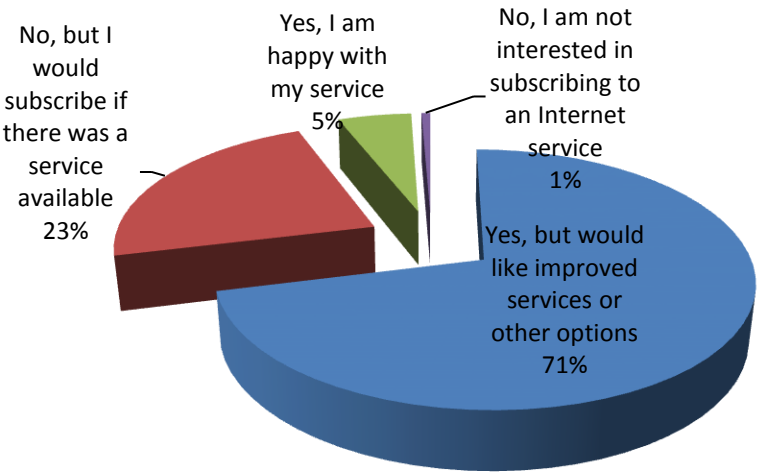

Figure 18: Broadband Demand

The majority of respondents report a need for improved services or other options. These participants provided additional information on the type of technology they currently rely on for access**. Almost half (48%) of respondents rely upon cellular or satellite services**. Satellite and cellular services have limited use because of data caps that can result in expensive overage charges. Citizens have documented that they limit their use of these technologies to avoid overage charges and control costs. Additionally, digital subscriber line (DSL) appears in the top technologies in use by respondents reporting a need for improved services. Most of our rural areas depend upon DSL technology which leverages the traditional landline copper telephone infrastructure and is often oversubscribed due to demand for Internet services. Typically private investments to upgrade DSL infrastructure are targeted to the more populated areas as those areas provide a greater return on investment.

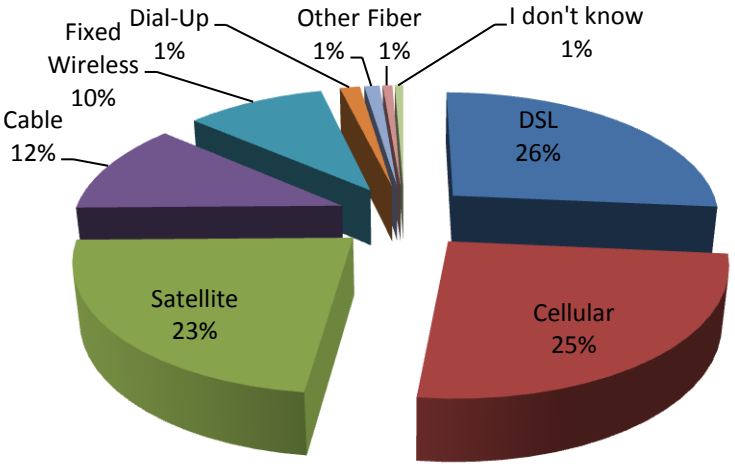

Figure 19: Current service technology for those reporting needing more options

Finally figure 20 below shows the various technologies survey respondents rely upon currently for their Internet access**. It is important to note that the majority (61.3%) of respondents are relying upon technologies that are expensive (most include data caps) and may have limited ability to meet future bandwidth demands**.

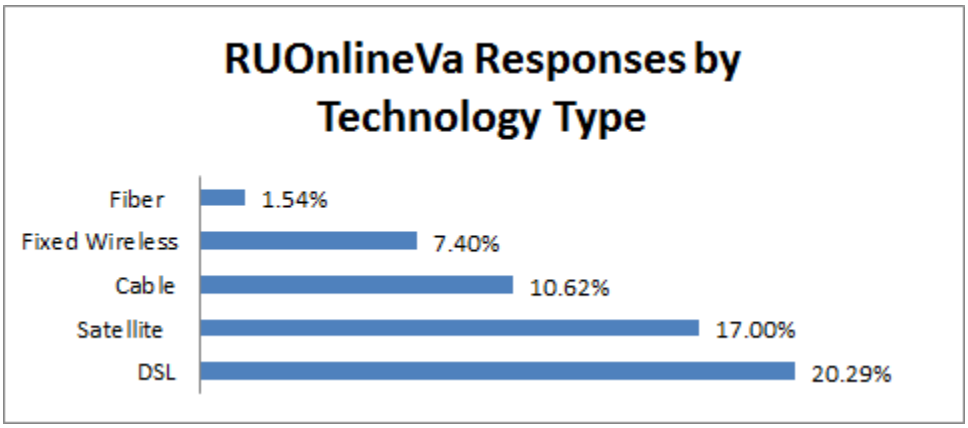

Figure 20 Responses by technology type

Figure 21 below is based on FCC 477 reported coverage data from the Internet service providers. Satellite coverage is excluded in this chart as it is reported to provide 100% coverage to all areas.

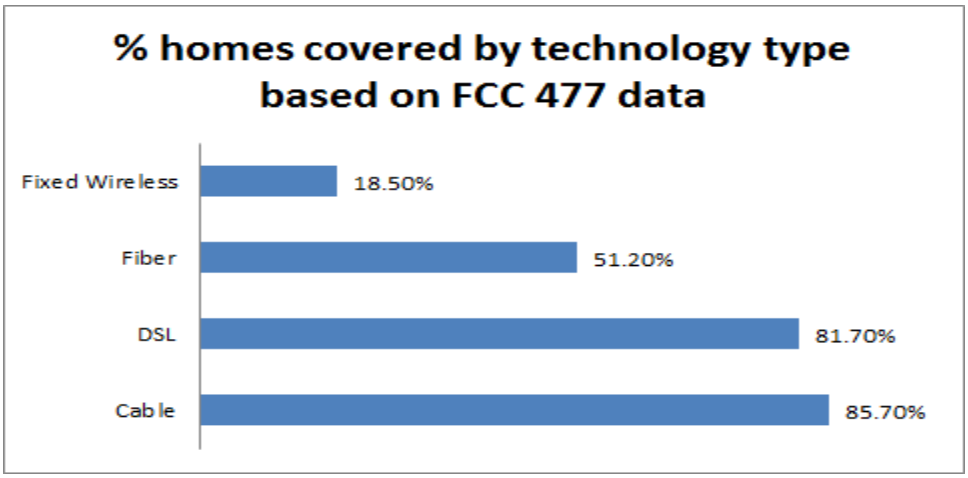

Figure 21 477 coverage by technology type

In comparing these charts they do tell a similar story in that the majority of Virginia residents are served by DSL and cable. These charts differ in the cable representation as many cable customers are happy with their Internet service and less likely to take time for a broadband demand survey. Remember that the most responsive localities (14) represent rural areas where fiber access is likely to be limited.

DEMAND HOTSPOTS ANALYSIS TO EXISTING VERTICAL ASSETS

"Hotspots" of reported non-coverage were evaluated utilizing the Getis-Ord local statistic function. This analysis focused on density of responses at different geographic levels (block and block group). This method highlights statistically significant hot-spots and cold spots in the data based on response locations nearby to other response locations. Hotspot results are shown below.

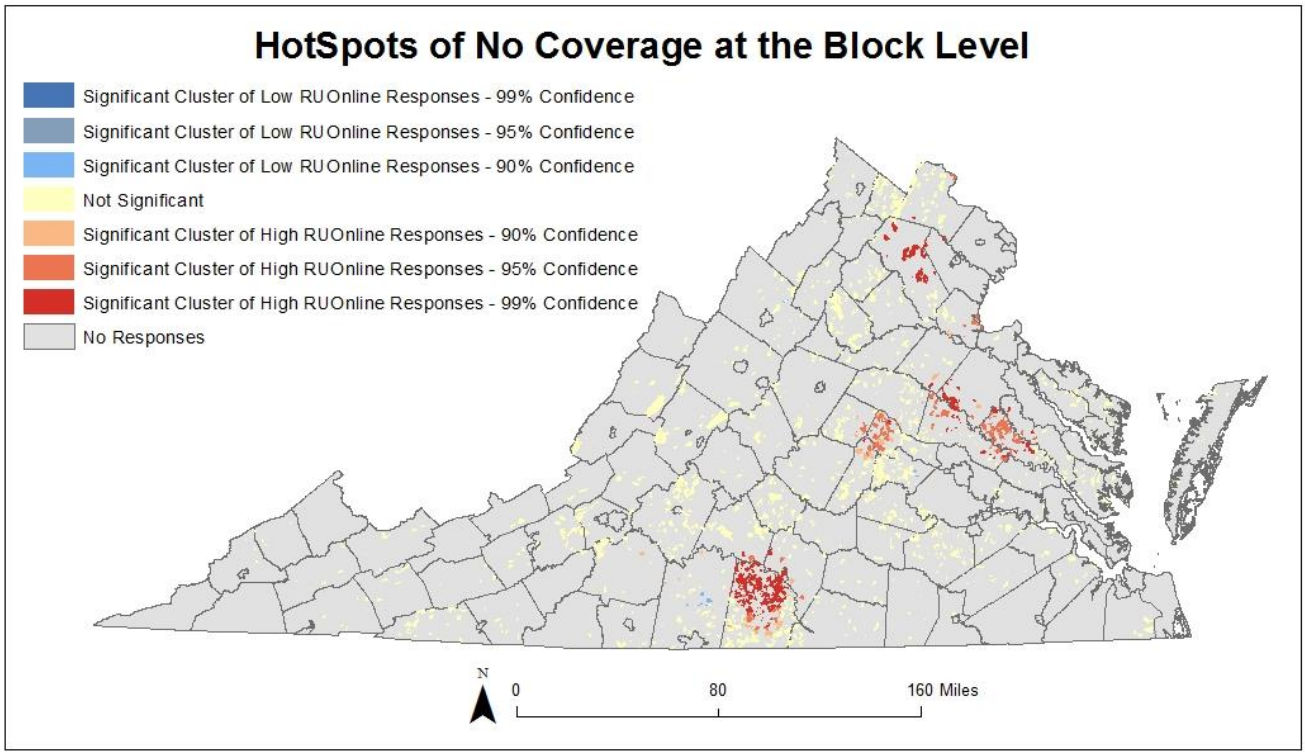

Figure 22: Hotspots of no coverage at census block level

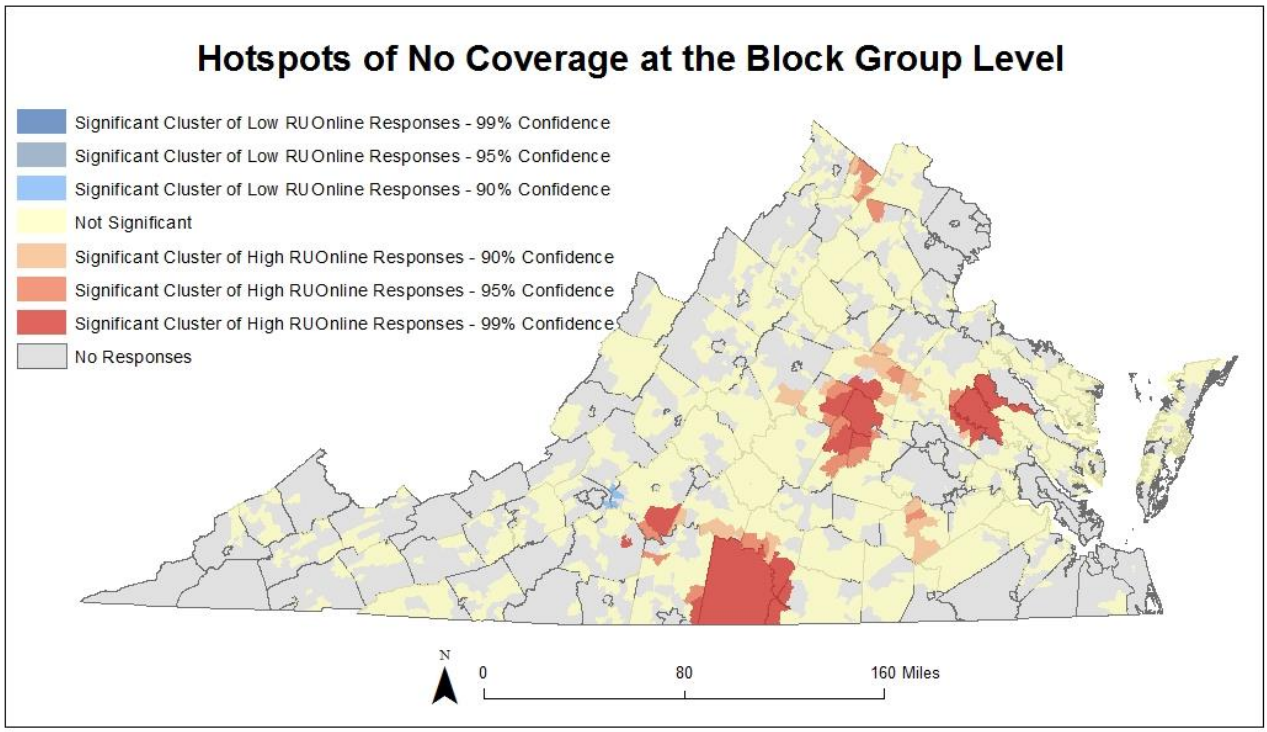

Figure 23: Hotspots of no coverage at census block group level

Referencing the initial number of responses by location it is no surprise that localities with higher response rates were the ones flagged as having the most "no coverage" hot zones. Please remember that just because a hotspot is not shown does not mean that coverage exists at that location. A lack of a no-coverage hotspot simply means there were not enough "no coverage" responses in a particular region to be statistically significant at that particular census area level.

The Getis-Ord function helped highlight areas where RUOnlineVA data can be used with more confidence to make decisions about broadband planning. Although the responses were analyzed for hotspots (aggregated down to block level) it is important to note that the calculation does not take jurisdictional boundaries into account, thereby giving a better idea of where no-coverage clusters may exist. This allows high response rates within one block to affect the statistical significance of high response rates of a nearby block, even if the nearby block is in a separate jurisdiction. In this manner, the Getis-Ord evaluation of the data highlights areas that may not be apparent when viewing by jurisdiction alone.

After hotspots were identified, a list of vertical assets within a 7km border of each hotspot was pulled from the Vertical Assets Inventory Tool (VAIT). The VAIT aggregates data about structures that can or do hold antenna and collects the data from a number of sources, including the Virginia Municipal League, planning district commissions, individual cities and counties, and the FCC. A table counting the number of assets identified near or in a hotspot has been aggregated by city/county and is available in Appendix C, along with the percent area the city/county is covered by a hotspot. Based on this analysis there is no direct correlation between a lack of assets and unserved areas. In fact some of the localities with large hotspot areas appear to have a large number of vertical assets.

SURVEY RESPONSE ANALYSIS TO CONNECT AMERICA FUND AREAS

CONNECT AMERICA FUND AREAS ACCEPTED BY CENTURYLINK

In 2011 the FCC took a portion of the Universal Service Fund ($1.8B), a fund that has been used to subsidize the deployment of landline telephone in high-cost rural areas, to be spent annually to expand broadband access in areas served by price cap carriers. This funding is known as Connect America Fund (CAF). CAF Phase I funding – more than $438 million – went to price cap carriers to expand broadband access. In 2015, nearly $1.8B was made available for CAF Phase II incumbent wireline providers. Those providers accepted $1.5B of CAF II funding to be used over six years to expand broadband in rural areas. In Virginia, CenturyLink accepted the funds (over $15.7m annually over 6 years) and Verizon did not. The FCC identified 49,979 locations within the CenturyLink eligible census blocks for Virginia. However, CenturyLink has advised that the funding is not enough to upgrade every location in all eligible census blocks.

The RUOnlineVA responses were evaluated against the census blocks that are eligible for the funding that CenturyLink accepted to determine if there is potential for meeting a portion of this broadband demand with potential CenturyLink upgrades and found 9.35% (1,205) of survey responses indicating broadband need (responding no access or need improved services) fall within eligible census blocks. There are no available details on CenturyLink's upgrade plans for the next six years using this funding; however, it was important to view the RUOnlineVa demand against these eligible areas. A table providing a complete list of the localities, total CAF II funding provided to CenturyLink and potential affected locations (homes/businesses) that are eligible for these upgrades is available in Appendix C.

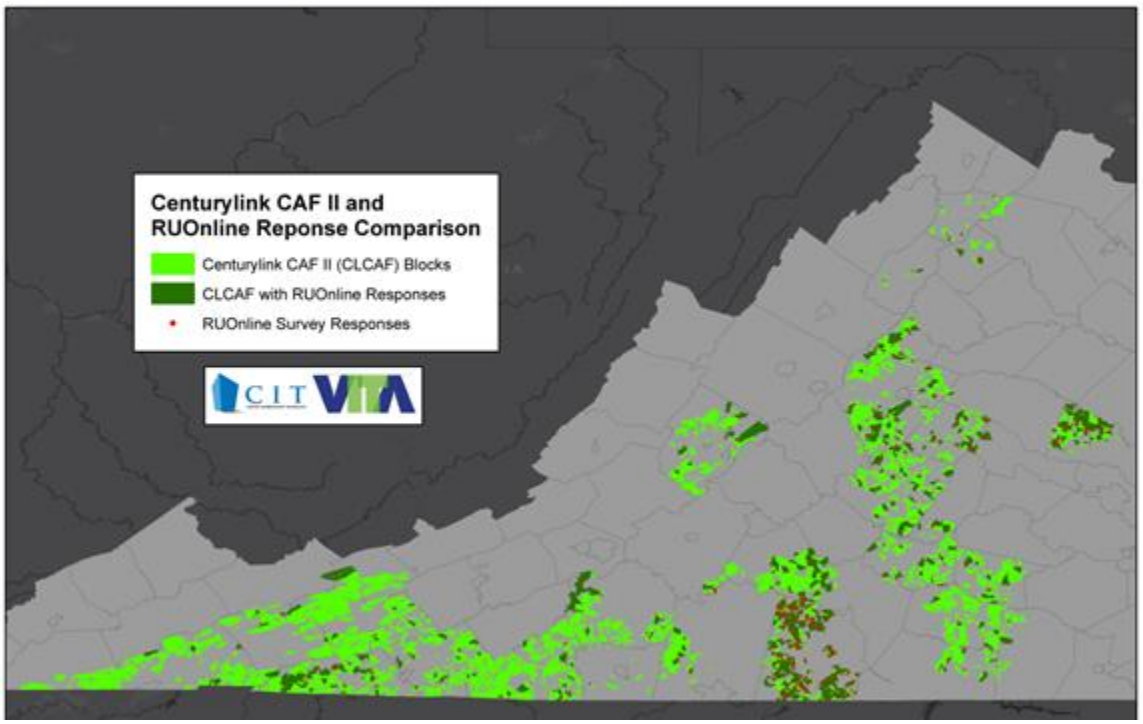

Figure 24: Eligible census blocks with RUOnlineVA responses

CONNECT AMERICA FUND PRELIMINARY ELIGIBLE AREAS FOR UPCOMING REVERSE AUCTION

In some states the CAF Phase II money was not accepted by the incumbent providers to upgrade infrastructure. In Virginia, Verizon turned down over $174.7M ($29M annually for the six year period). At the end of May 2016, the FCC approved a reverse auction to make almost $2B available over the next decade to rural broadband providers to expand services of at least 10Mbps/1Mbps in targeted areas where broadband does not exist. In mid-august the FCC released the preliminary eligible census blocks for this additional funding which will be awarded based on a reverse auction. The auction will be conducted as a competitive bid process allowing cable, landline telecommunications and fixed wireless providers to bid for support to deploy broadband and voice services in high-cost unserved areas. This will be the first opportunity for competitive providers to go after a portion of the Connect America Funding to expand broadband in those high-cost areas. The FCC has cautioned that these areas are preliminary and no one should assume that support will be available for all areas. The FCC has committed to providing the final eligible areas at least three months prior to the auction.

Based on this preliminary data it appears there may be potential for Internet service providers in the Commonwealth to obtain approximately $338.7M over the 10 year period. These areas are preliminary and currently being challenged by existing broadband providers, as such, they are subject to change prior to the actual auction which has yet to be scheduled.

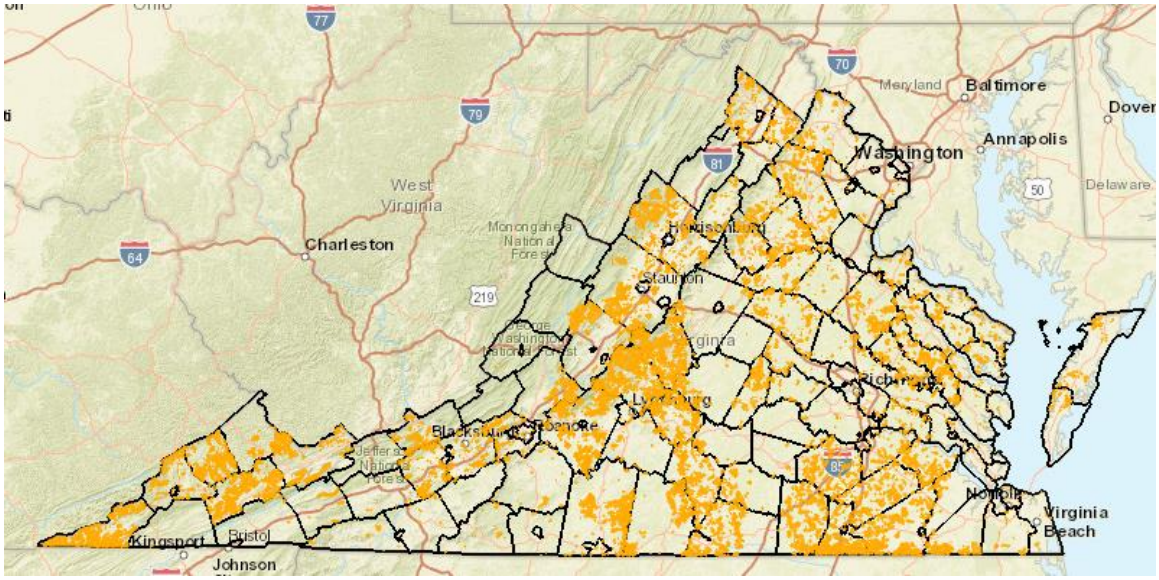

Figure 25: FCC Preliminary Eligible Areas for CAF II Auction

INCUMBENTS RESPONSE TO REPORTED BROADBAND DEMAND

One of the intended purposes of the RUOnlineVa data was to provide service providers and localities insight into areas of reported unmet demand. Areas of unmet demand represent potential new customers for service providers and new connections for citizens and their localities. Service providers need to know there is demand for their services before they invest in expansion. Localities need to know if there are sufficient broadband services available to accommodate their citizens and economic development efforts. Citizens need to know where broadband exists so they can make smart choices about where they want to live and work. Adding new customers and creating new connections is a win-win scenario and equates to expanding broadband services across the Commonwealth.

A preliminary examination of data for which unmet demand was noted within currently reported service areas has generated some positive collaboration with several service providers. Comcast, Shentel and CenturyLink have all worked with the CIT Broadband team to address inquiries about the lack of service reported within claimed coverage areas. The addresses along with maps from several locations around the state where clusters of RUOnlineVa data indicated unmet demand within or close to claimed coverage areas were sent to the respective service providers to find out what it would take to get service to those addresses. In all cases the providers were highly responsive, one expressing "we are always looking for opportunities to edge out." One inquiry resulted in the identification of a forgotten backhaul that could play a role in connecting new customers.

Providing Internet services to new locations typically involves a lot of time, engineering, cost and more increasingly creative planning. Service provider construction costs are not usually part of the profit equation and vary depending on numerous factors including terrain, distance, and geography. Take rate – how many households will commit to the service for some period of time, is generally what determines the need for customer contribution. The economics of extending infrastructure to areas of low population density, addresses with long setbacks (long driveways) or long distances from the incumbents current infrastructure, generally necessitates some amount of customer contribution. A few examples follow:

- One provider documented that it took over a year of planning to be able to make the economics work to provide a rural neighborhood of 24 homes with new services. The construction costs for the underground facilities was close to $100,000, residents were required to contribute upfront costs of $500.00 per household plus whatever services the homeowner wanted as well as committing to a three year contract. These provisions made the build possible from an economic standpoint.
- A homeowner with a school-aged child with no Internet and a 600 foot driveway complained she could not get broadband. After the incumbent provider assessed the location, identified a few other potential customers along the way, determined they could extend their infrastructure to provide services if each household would contribute $500 up front and $90 per month for 3 years.
- Another example documents a potential build to extend infrastructure nine miles to serve a rural subdivision of almost 100 households. The provider would need customer contribution of approximately $1000 per household to make those economics work.

Much of the cost of bringing Internet services to new housing developments and homes built with long setbacks can attribute to the lack of consideration or preparation for broadband infrastructure by real estate developers. The same considerations a developer uses for provisioning electrical or water services to a new neighborhood or home should be given to broadband services as well. The addition of conduit in roads and to home sites would make providing broadband services to new locations much less costly. This strategy is the basis of the "Dig Once" policy agenda.

These examples are intended to show that the cost of connecting new customers is sometimes prohibitive to both customers and providers.

Additionally, CIT made inquiries about reported unmet demand clusters on behalf of two localities that it is actively working with. Those inquires resulted in over two thousand (2020) addresses that the incumbent assessed for serviceability. Of those, 64% were serviceable – meaning those addresses are currently capable of receiving service, 36% were not serviceable.

The discrepancy between citizens reported unmet demand and an incumbent's stated serviceability stems from the way an individual answered the question "Does this address currently subscribe to internet service?" In

some cases a respondent may not have realized service was available, or is unhappy with the service they have, or simply want other options. Whatever the reason for their response, the unmet demand exists. However, not all unmet demand means service is not available.

The addresses that were identified as not serviceable were in most cases due to long setbacks, where houses are far off the main road. From previous examples though, in some cases with customer contribution, service can be provided.

For most of these inquiry areas, the providers deployed engineers to assess the potential for connecting new customers. On the ground work to verify serviceability is very tedious and time consuming. The fact that providers were willing to send out engineers demonstrates a sincere desire to provide services whenever possible. While not all assessments resulted in the potential to connect new customers, some in fact will. Nevertheless, even when there is the ability to connect a new location, the cost to connect that customer may be unacceptable to the citizen.

The interactions with the incumbent service providers regarding the possibility of expanding services into areas of unmet demand have been highly effective. That some inquires may result in new services and/or new customers provide evidence that demand data is a valuable asset to both service providers and any locality working on expansion plans.

However, the key to this particular exercise was that CIT leveraged its relationships with providers to make these service inquiries. It is hoped that any locality could do the same with similar results.

Significant expansion of broadband to those in areas of need will require state level policy changes to ease the economics for providers as well as home and business owners. A combination of funding mechanisms could ultimately equate to faster expansion of broadband services across the Commonwealth.

RESPONSIVE LOCALITIES AND CURRENT BROADBAND INITIATIVES

Fortunately most of the 14 most responsive localities are currently engaged in a broadband initiative and almost half of those are actively involved with CIT. Many of these most likely had very responsive citizens due to their active broadband efforts. CIT Broadband works with local governments to facilitate assessment of current broadband access, identification of needs leading to adoption of prioritized broadband goals and specification of the local government's desired role in expanding broadband ultimately leading to the formation of public-private partnerships to meet those goals. The process diagram below in Figure 20 represents the process CIT follows for this work with local governments.

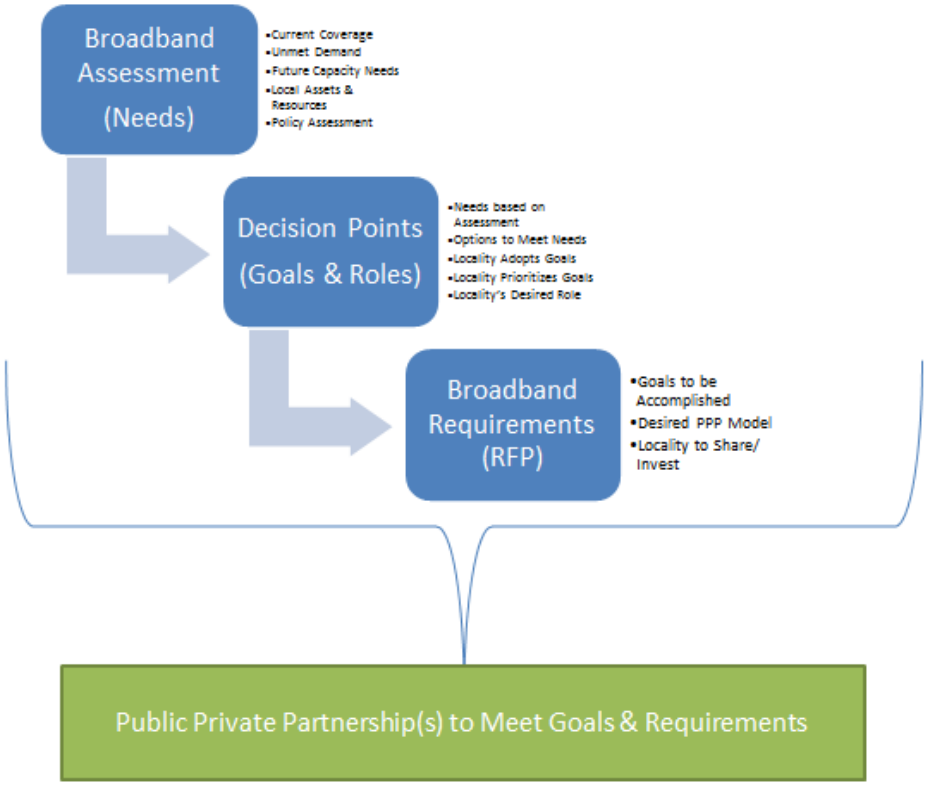

Figure 26: CIT Process when working with local governments and regions

Table 5: list of known initiatives for each locality

County	Broadband Initiative Information
Halifax County	**CIT** began working with the County in February 2016. **ASSESSMENT** completed in August. Board at **DECISION POINTS**
Clarke County	**CIT** has provided information, maps and data and presented to the Board of Supervisors in June. The Board advised they would be back in touch once CIT completed the RUOnlineVa campaign.
Bedford County	**CIT** has worked on/off with Bedford for several years providing information, guidance and maps. CIT presented to their Broadband Committee in August 2016. **ASSESSMENT** completed in September and will deliver in October.
King William County	**CIT** and **CGIT** began working with the County in late 2015 and completed a county-wide wireless propagation study in early June 2016. The study evaluated existing vertical assets and made recommendations for a few additional locations to support a fixed

County	Broadband Initiative Information
	wireless deployment to serve the citizens.
Loudoun County	**CIT** has worked provided the County information, maps and advice for the last few years. CIT advocated for over 6 months on behalf of a tower company to facilitate approval from federal agencies to construct a tower in Western Loudoun on property adjacent to the Appalachian Trail.
Powhatan County	**CIT** began working with the County in October 2015 **ASSESSMENT** completed in February. **REQUIREMENTS & RFP** completed in April. Powhatan signed a contract with a private provider in August 2016.
Hanover County	
Louisa County	Design Nine via DHCD Planning Grant
Goochland County	**CIT** met with County Broadband Committee in August 2016. **ASSESSMENT** completed in early September, will deliver in October.
Dinwiddie County	**CIT** provided the County an RFP template in late 2014. The County issued the RFP in 2015 and signed a contract with a Internet service provider in 2016.
Fauquier County	Hired Design Nine to develop a plan in summer of 2016.
Amelia County	**CIT** began working with the County in February 2016. **ASSESSMENT** completed in early August. **DECISION POINTS** completed in late August. **REQUIREMENTS** and **RFP** delivered to County in early September.
Fluvanna County	
Albemarle County	**CIT** participated in the County's Broadband Task Force in 2014 and offered to provide an Assessment in spring of 2015. However, at that time DHCD announced additional planning grant funds and the County leveraged those funds to hire Design Nine to develop a plan.

APPENDICES

APPENDIX A – DATA CLEANSING AND VALIDATION DETAILS

Detailed notes of the RAW data analysis can be found in Appendix **B.** Geocodable (locatable) address statistics for the RAW data are listed below. These percentages do not account for non-address submissions or duplicates that may exist in the RAW data:

Table 1: Total Counts and Percentage of Geocodable RAW Data from RUOnlineVA Survey

Type	Count	Percent
Total Submissions	15031	100%
VGIN Auto-Geocoded	13131	87.36%
Google Auto-Geocoded	11149	74.17%
Only VGIN Auto-Geocoded	2903	19.31%
Only Google Auto-Geocoded	921	6.13%
VGIN + Google Geocoded	**14052**	**93.49%**

RUONLINEVA DATA CLEANING PROCEDURE FROM RAW TO FINAL DATA

After the RAW data was evaluated, CGIT and VGIN proceeded to clean the data to obtain a higher percentage of Geocodable addresses. The goals and methods of the data cleaning procedures were:

1. Remove duplicate submissions:
    a. Identified entries that had identical lat/lng combinations to remove duplicates. They may not be duplicates (sometimes, address points for apartments/skyscrapers may be "stacked" in the geocoder).
    b. Identified entries that have identical values for address, city, state, and zip (using case-insensitive comparison) to remove duplicates.
    c. In both cases the most recent submission was retained in the final cleaned data set.
2. Remove submissions that contain "non-addresses": reviewed the address, city, state, and zip fields of all submissions and removed submissions that do not match USPS postal standards for street address. PO Boxes do not count as a valid street address. (http://pe.usps.gov/text/pub28/28c2_012.htm)
3. Remove submissions not in Virginia:
    a. Removed entries that did not have a value of 'VA' in the state field
    b. Removed entries that had zip codes that could not be matched to VA zip codes
    c. Removed entries that had zip codes indicating they were a test/not real address
    d. Fixed zip codes with obvious typos based on other submitted information

A snapshot of the final results of the cleaned data is below:

Table 2: *Total Counts and Percentage of Geocodable Cleaned Data from RUOnlineVA Survey*

Type	**Count**	**Percent**
Total Submissions	13106	100%
VGIN Auto-Geocoded	11230	85.7%
Google Auto-Geocoded	9928	75.8%
Only VGIN Auto-Geocoded	2532	19.3%
Only Google Auto-Geocoded	1230	9.4%
VGIN, CIT, CGIT Manual Correction	430	3.3%
VGIN + Google Geocoded	**12891**	**98.4%**

The overall submission count was reduced from 15031 to 13106 when accounting for duplicates, non-addresses, and addresses that were not within Virginia. When including the addresses that had obvious mistakes that were corrected the overall percentage geocoded rose from 93.49% to 98.4%.

APPENDIX B – RAW DATA ANALYSIS

The following points of discussion are to be used as a primer to better understand the methods of data collection and how the collected addresses were geocoded to determine lat/long of the submission. Referenced field names below refer to the RAW data (Attachment X) collected during the entirety of the campaign (May 23, 2016 @ 1936 hrs UTZ to August 16, 2016 @ 1317 hrs UTZ).

- The "Name" and "Email" fields will always be blank since they were not collected for this survey
- The "Visited On" field is populated when the survey is completed and stored in the database
- The Address, City, and Zip fields are provided by users submitting the form. They may not be actual address and may not be formatted in a regular manner.
- The State field defaulted to 'VA' for this survey.
- Lat and Lng are populated by the results of the VGIN Composite Geocoder. If they are blank, then the address could not be geocoded accurately enough for mapping purposes
    - Geocoded addresses are accepted if they meet the following requirements:
        - Are from the address point or road centerline geocoders
            - Attribute 'Loc_name' is 'AP' or 'RCL'
        - Are a street address
            - Attribute 'Addr_type' is 'StreetAddress'
        - Have a match score above 80%
            - Attribute 'Score' is greater than 80

    - Geocoded addresses may return multiple valid candidates. The order of preference is as follows:
        - Address Points
            - Highest Score
        - Road Centerlines
            - Highest Score
    - If no valid matches are found, the location field will be null
- City/County Name and City/County FIPS were derived by checking to see which polygon geocoded addresses were in. The City/County boundaries used for this were the Virginia Administrative Boundary Dataset (reference link: http://vgin.maps.arcgis.com/home/item.html?id=c148ecd214404ddb95e0e9991531a7f3) from VGIN
- PDC Name was derived by using the VA_PDC_boundaries (reference link: http://vgin.maps.arcgis.com/home/item.html?id=ce2f89e8385f4e38bbe0ca22db79053b) dataset from VGIN
- CD Name was derived by using the Virginia 113th Congressional Districts (reference link: http://vgin.maps.arcgis.com/home/item.html?id=dc20260d27654c64bfa0c2979a317597) from VGIN
- Questions and answers for the survey were provided by CIT and revised as noted below per their direction
    - Survey responses for the question "If you do currently have Internet service at this address, what TYPE of service is it?" changed on May 26, 2016 at 12:53 PM per direction from CIT. Filtering results from before 12:55 PM on that date should remove responders that used the old version of the survey. This affects the first 3,000+ survey responses (no more than 3,134).
        - Changes requested:
        - From: "Fiber (the fastest and most future proof service)
        - To: "Fiber (Most often associated with gigabit speed. Typically only available in densely populated areas.)
        - From: "Satellite – you purchase Internet Service from a SatelliteTV provider"
        - To: "Satellite – you purchase Internet Service from a Satellite service provider"
- The RAW dataset has no other quality control (removal of duplicates, removal of clearly non-address submissions, etc)
- Excel cannot read the date/time format provided in the download by default, so timezone will have to be removed before using that field in analysis (find and replace "+00:00" with an empty string)
- Times recorded are in UTZ format
- Excel will not display values in the Address field properly by default if it contains multiple lines. This can be solved by auto-adjusting the vertical and horizontal height of these rows and columns
- Some submissions were added via a third-party helpdesk. There is no way to distinguish which submissions are from phone and which are from the website.
- The fully post-processed RAW results file squashes together VGIN- and Google-geocoded results; defaulting to VGIN when available. When the Google-geocoder is used, the fields City/County Name, City/County FIPS, PDC Name, and CD Name are all populated based on the Google-geocoded values.
    - Google-geocoded values are accepted when:
        - It is not a "partial match"
        - It has a location type of "ROOFTOP" or "RANGE_INTERPOLATED"
    - Google-geocoded values are sorted by the following order of preference:
        - Rooftop matches over range interpolated matches

APPENDIX C – CAF II CENTURYLINK ACCEPTED FUNDING

It is important to remember that CenturyLink is not bound to upgrading all eligible locations.

CenturyLink CAF II Funding by County		
County Name	**Eligible Locations**	**Total Funding Support**
Halifax, VA	4,289	$ 1,443,003
Grayson, VA	3,392	$ 1,244,708
Patrick, VA	3,923	$ 1,199,020
Carroll, VA	3,338	$ 1,072,529
Albemarle, VA	2,912	$ 906,264
Franklin, VA	3,064	$ 812,006
Washington, VA	2,385	$ 753,222
Rockbridge, VA	2,435	$ 734,030
Wythe, VA	2,092	$ 728,699
Lunenburg, VA	1,841	$ 718,725
Buckingham, VA	2,263	$ 669,917
Campbell, VA	2,191	$ 657,768
Nottoway, VA	1,967	$ 585,658
Bland, VA	1,047	$ 461,438
Fluvanna, VA	1,458	$ 426,550
Smyth, VA	947	$ 386,982
Prince Edward, VA	1,480	$ 363,536
Pittsylvania, VA	1,245	$ 322,498
Scott, VA	1,036	$ 287,901
Greene, VA	764	$ 273,736
Hanover, VA	1,141	$ 262,567
Mecklenburg, VA	761	$ 209,038
Warren, VA	593	$ 178,776
Henry, VA	615	$ 178,047
Charlotte, VA	466	$ 154,162
Rappahannock, VA	420	$ 130,509
Brunswick, VA	408	$ 111,795
Cumberland, VA	351	$ 106,332
Page, VA	338	$ 72,796
Tazewell, VA	167	$ 65,854
Floyd, VA	78	$ 37,168
Bedford, VA	114	$ 29,231
Nelson, VA	91	$ 26,800
Louisa, VA	111	$ 21,318
Appomattox, VA	40	$ 20,971

CenturyLink CAF II Funding by County		
County Name	**Eligible Locations**	**Total Funding Support**
Madison, VA	25	$ 13,582
Fauquier, VA	54	$ 10,454
Lexington City, VA	22	$ 10,144
Goochland, VA	51	$ 9,424
Buena Vista City, VA	17	$ 8,961
Pulaski, VA	14	$ 7,642
Amelia, VA	3	$ 2,395
Martinsville City, VA	16	$ 2,182
Bristol City, VA	5	$ 1,824
Galax City, VA	3	$ 1,282
Orange, VA	4	$ 1,043
Charlottesville City, VA	2	$ 582

APPENDIX D – VERTICAL ASSETS IDENTIFIED NEAR HOTSPOTS

Jurisdiction Name	Number of Assets	% Area Covered by Hotspot
Halifax County	81	28.94%
King William County	33	27.80%
Goochland County	34	20.92%
Hanover County	196	10.33%
Fauquier County	98	8.70%
Cumberland County	6	7.51%
Caroline County	86	5.63%
Stafford County	171	5.18%
Fluvanna County	18	3.54%
Charlotte County	12	3.01%
King and Queen County	16	2.51%
Spotsylvania County	113	1.85%
Prince William County	72	1.60%
Campbell County	107	1.04%
Loudoun County	26	0.94%

Jurisdiction Name	Number of Assets	% Area Covered by Hotspot
Pittsylvania County	18	0.35%
Franklin County	20	0.35%
Powhatan County	0	0.10%
Louisa County	21	0.09%
New Kent County	6	0.03%
Essex County	6	0.00%
Fredericksburg City	41	0.00%
King George County	13	0.00%
Warren County	10	0.00%
Culpeper County	4	0.00%
Clarke County	3	0.00%
Fairfax County	3	0.00%
Buckingham County	2	0.00%
Mecklenburg County	1	0.00%
Accomack County	0	0.00%
Albemarle County	0	0.00%
Alexandria City	0	0.00%
Alleghany County	0	0.00%
Amelia County	0	0.00%
Amherst County	0	0.00%
Appomattox County	0	0.00%
Arlington County	0	0.00%
Augusta County	0	0.00%
Bath County	0	0.00%
Bedford County	0	0.00%
Bland County	0	0.00%
Botetourt County	0	0.00%
Bristol City	0	0.00%
Brunswick County	0	0.00%
Buchanan County	0	0.00%
Buena Vista City	0	0.00%
Carroll County	0	0.00%
Charles City County	0	0.00%
Charlottesville City	0	0.00%
Chesapeake City	0	0.00%
Chesterfield County	0	0.00%
Colonial Heights City	0	0.00%
Covington City	0	0.00%

Jurisdiction Name	Number of Assets	% Area Covered by Hotspot
Craig County	0	0.00%
Danville City	0	0.00%
Dickenson County	0	0.00%
Dinwiddie County	0	0.00%
Emporia City	0	0.00%
Fairfax City	0	0.00%
Falls Church City	0	0.00%
Floyd County	0	0.00%
Franklin City	0	0.00%
Frederick County	0	0.00%
Galax City	0	0.00%
Giles County	0	0.00%
Gloucester County	0	0.00%
Grayson County	0	0.00%
Greene County	0	0.00%
Greensville County	0	0.00%
Hampton City	0	0.00%
Harrisonburg City	0	0.00%
Henrico County	0	0.00%
Henry County	0	0.00%
Highland County	0	0.00%
Hopewell City	0	0.00%
Isle of Wight County	0	0.00%
James City County	0	0.00%
Lancaster County	0	0.00%
Lee County	0	0.00%
Lexington City	0	0.00%
Lunenburg County	0	0.00%
Lynchburg City	0	0.00%
Madison County	0	0.00%
Manassas City	0	0.00%
Manassas Park City	0	0.00%
Martinsville City	0	0.00%
Mathews County	0	0.00%
Middlesex County	0	0.00%
Montgomery County	0	0.00%
Nelson County	0	0.00%

Jurisdiction Name	Number of Assets	% Area Covered by Hotspot
Newport News City	0	0.00%
Norfolk City	0	0.00%
Northampton County	0	0.00%
Northumberland County	0	0.00%
Norton City	0	0.00%
Nottoway County	0	0.00%
Orange County	0	0.00%
Page County	0	0.00%
Patrick County	0	0.00%
Petersburg City	0	0.00%
Poquoson City	0	0.00%
Portsmouth City	0	0.00%
Prince Edward County	0	0.00%
Prince George County	0	0.00%
Pulaski County	0	0.00%
Radford City	0	0.00%
Rappahannock County	0	0.00%
Richmond City	0	0.00%
Richmond County	0	0.00%
Roanoke City	0	0.00%
Roanoke County	0	0.00%
Rockbridge County	0	0.00%
Rockingham County	0	0.00%
Russell County	0	0.00%
Salem City	0	0.00%
Scott County	0	0.00%
Shenandoah County	0	0.00%
Smyth County	0	0.00%
Southampton County	0	0.00%
Staunton City	0	0.00%
Suffolk City	0	0.00%
Surry County	0	0.00%
Sussex County	0	0.00%
Tazewell County	0	0.00%
Virginia Beach City	0	0.00%
Washington County	0	0.00%
Waynesboro City	0	0.00%
Westmoreland County	0	0.00%

Jurisdiction Name	Number of Assets	% Area Covered by Hotspot
Williamsburg City	0	0.00%
Winchester City	0	0.00%
Wise County	0	0.00%
Wythe County	0	0.00%
York County	0	0.00%