**DRAFT Broadband Study**

**Prepared for Ann Arbor Township November 2018**

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**1 Executive Summary** Ann Arbor Charter Township (Township) leadership has determined that its residents and businesses require access to modern, high-speed broadband services, and that this need will likely continue to grow. While several providers offer broadband service in the area, the Township has come to understand anecdotally that there may be gaps in broadband availability in certain areas. The Township seeks to quantify these gaps and to evaluate steps it can take to address them.

The Township engaged CTC Technology & Energy (CTC) to develop strategic guidance on these issues. This report represents the outcome of the engagement and is based on research, fieldwork, and analysis conducted by CTC during the spring and summer of 2018.

**1.1 Methodology and Objectives** This report examines broadband availability gaps throughout the Township, identifies potential steps to address the gaps, and examines the Township’s potential costs if it were to deploy broadband infrastructure to support private service delivery.

Over the course of the engagement, CTC performed the following tasks:

• Consulted extensively with Township staff and incorporated feedback into our analysis;

• Held discussions with local providers and other potential partners identified by the Township;

• Analyzed serviceability data provided by Comcast;

• Conducted a statistically valid market research survey to quantify residents’ perceptions of available services in the Township (Section 2);

• Researched the region’s available broadband services and costs (Section 3);

• Conducted onsite and desk surveys of Township infrastructure, and developed a candidate fiber-to-the-premises (FTTP) network design and cost estimates (Section 4);

• Examined potential alternatives to traditional partnership approaches (Section 5).

**1.2 Township Residents Are Highly Connected** As part of the Township’s effort to evaluate its broadband needs, CTC worked with the Township to conduct a survey of residents in 2018. We mailed 1,742 survey packets to residential

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households in July 2018 with a goal of receiving at least 320 valid responses. A total of 378 useable questionnaires were received by the cutoff date.1

The mailing list was developed by first identifying the targeted market area and the households that fall within this region. We used a mapping tool to draw boundaries around the main portion of the Township, while excluding the island neighborhoods within the City of Ann Arbor (with the exception of the Wines neighborhood).

The main portion of the Township that was part of the survey sample includes the areas north of the Huron River and Highway 14, and east of Highway 23, plus the Wines Neighborhood south of the river. The sample was then selected from this mapped region.

The overall survey methodology and range of findings is included in Section 2. Key findings include:

• Internet usage is high across all demographic groups in the Township.

• Township residents are highly connected, with **98 percent of respondents having some form of internet connection**. Specifically, 92 percent of residents have home internet service and 83 percent have a cell/mobile telephone with internet. (We note that the national trendline for home internet service is much lower. While the proportion of adults in the United States with high-speed broadband service at home increased steadily between 2000 and 2016, adoption rates have decreased over the past few years. At the beginning of 2018, adoption had declined to about 65 percent, down from its peak of 73 percent in 2016.)

1 At least 10 responses were received after analysis had begun and are not included in these results.

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**Figure 1: Communications Services Purchased**

• **Three-fourths of households have a cable modem internet connection**, while much smaller shares have digital subscriber line (DSL), satellite, cellular/mobile (only), fiber, and other connections. We note that, nationwide, the number of people who exclusively access the internet via smartphones grew from 12 percent in 2016 to 20 percent in 2018.2 In contrast, the Township’s survey shows that only 2 percent of residents use only smartphones to access the internet.

2 Matt Kapko, “Smartphone-only internet users grow from 12% in 2016 to 20% this year,” *FierceWireless*, last modified October 3, 2018, https://www.fiercewireless.com/wireless/smartphone-only-internet-users-grow-from- 12-2016-to-20-year, accessed October 5, 2018.

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**Figure 2: Primary Home Internet Service**

• **Reliability of the internet connection ranks as the most important aspect**, followed by connection speed and price. Residents are moderately satisfied with the speed and reliability of their internet service (and less satisfied with the price); **the extremely high importance placed on these factors may signal some willingness to switch providers if needs are not being met**.

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**Figure 3: Importance of Communication Service Aspects**

• Respondents indicated a willingness to switch to a very high-speed internet connection, especially at monthly prices lower than $50 per month or for one-time hookup fees at or below $100. **Willingness to switch drops sharply at higher price points.**

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**Figure 4: Willingness to Switch Providers at Various Price Levels**

• More than one-half of respondents purchase cable television service, one-third receive television through the internet, 12 percent have satellite/Dish TV, and 10 percent have antenna (over-the-air) service. **Television services are only moderately important to respondents, with local news programming ranking as the most important features.**

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**Figure 5: Importance of Communication Services**

• **One-half of respondents indicated that the Township should install a state-of-the-art network**, including 27 percent who indicated that the Township should offer services directly.

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**Figure 6: Role of the Township**

Figure 7 shows a map of the survey response locations throughout and around the Township.

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**Figure 7: Map of Residential Market Research Survey Responses**

Figure 8 shows a map of the survey responses both by location and by the type of service that the respondents indicated they have. Note that “type of service” also includes those respondents who indicated “other” in their response or that do not have home internet service.

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**Figure 8: Map of Residential Market Research Survey Responses by Service Type**

Figure 9, below, shows an overlay of the map of survey results by type of service indicated and the Comcast serviceable and non-serviceable addresses.

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**Figure 9: Internet Services Reported Versus Comcast Serviceable Addresses**

**1.3 Comcast Serves Nearly 80 Percent of the Township** As part of our research into the local broadband market (Section 2), we asked Comcast to provide data about the areas in the Township it currently considers serviceable.3 After completing its analysis of addresses we provided, Comcast reported that it considers approximately 79 percent of the addresses in the Township serviceable, meaning that no construction is necessary to begin providing service to those residents and businesses.4 The map in Figure 10 shows the Township

3 Comcast provided a required format for addresses. CTC modified the list of Township addresses we had purchased from InfoUSA to match this format, and Comcast indicated whether each address was considered serviceable. 4 Residents at serviceable addresses can request to have a Comcast technician install equipment, or they can self- install equipment that Comcast ships to them.

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broken down by land-use with yellow circles indicating those areas Comcast considers serviceable and black circles illustrating non-serviceable areas.

**This high degree of cable service availability (coupled with the market research findings we outline in Section 2) suggests there are only select gaps in service availability throughout the Township.** More specifically, our analysis indicates that gaps are most prominent in areas such as gated communities and other locations where household density and demand density are not particularly high. And it is our understanding that, in many of these cases, residents have the option of paying a one-time fee to Comcast to build the infrastructure necessary to serve them.

A key purpose of developing the map in this way was to be responsive to Comcast’s request to show that a significant portion of the areas it considers non-serviceable comprise land-use areas that are unlikely to become developed residential areas, such as cemeteries. Because of the proprietary nature of the Comcast address data, we were unable to develop a map that shows exact address points of all serviceable and non-serviceable addresses.

**Figure 10: Comcast Serviceable Areas in Ann Arbor Township**

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**1.4 Ubiquitous Fiber Outside Plant Deployment Would Cost $7.6 Million** To support the Township’s consideration of options for addressing its broadband goals, we developed a candidate design and cost estimate for a fiber-to-the-premises (FTTP) network that would be capable of serving every resident and business in the community.

**Our analysis indicates that deploying fiber outside plant (OSP) to support an FTTP network throughout the Township will total $7.6 million.** However, additional expenses, such as drop cables (fiber infrastructure to connect individual passings to the network),5 and core and user- end electronics (customer premises equipment, or CPE) will need to be deployed to provide services to Township homes and businesses. The total of these expenses would depend on the Township’s operating model and the number of subscribers on the network (the take-rate, or the percentage of customers in the Township that subscribe to service).

For further discussion of our cost estimate, including our estimation methodology, conceptual design, and key assumptions, please see Section 4.

**1.4.1 A “Dark” Fiber-to-the-Premises Network Would Cost $8.6 Million If the Township were to deploy a ubiquitous dark FTTP network, it will cost approximately $8.6 million**, inclusive of OSP construction labor, materials, engineering, permitting, lateral fiber, and drop materials. This estimate assumes a 35 percent take-rate. This estimate does not include any electronics or subscriber equipment.

**Table 1: Estimated Dark FTTP Cost with Drops (Assuming a 35 Percent Take-Rate)**

**Cost Component Total Estimated Cost**

OSP $7.6 million FTTP Service Drop and Lateral Installations 1.0 million **Total Estimated Cost:** $8.6 million

This estimate assumes that the Township constructs and owns the FTTP infrastructure up to a demarcation point (a network interface device) at each residence and business, and leases the dark fiber backbone, distribution, and drop fiber to a private partner. The private partner would be responsible for all network electronics and CPE—as well as network sales, marketing, and operations.

For more discussion in a dark FTTP network, please see Section 4.

5 A “passing” refers to a potential customer address, such as an individual home or business.

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**1.4.2 A “Lit” Fiber-to-the-Premises Network Would Cost Roughly $9.2 Million Assuming a take-rate (i.e., the percentage of residents and businesses that subscribe to the service) of 35 percent, the full FTTP network deployment will cost roughly $9.2 million**, or $4,900 per passing, inclusive of OSP construction labor, materials, engineering, permitting, network electronics, drop installation, CPE, and testing.

**Table 2: Estimated Lit FTTP Cost**

**Cost Component Total Estimated Cost** OSP $7.6 million Central Network Electronics 0.3 million FTTP Service Drop and Lateral

Installations 1.0 million CPE 0.3 million **Total Estimated Cost:** $9.2 million

For more discussion of a lit FTTP network, please see Section 4.4.

**1.5 Demand Density Is Key to Serving the Township’s 1,560 Passings** Density, or the number of “passings” along a given fiber route, is a key element of projecting the cost to deploy an FTTP network. (A passing refers to a location that is passed by a fiber network— in other words, a potential customer.) Generally, the higher the number of passings on a given route, the less expensive it is to serve each one. When passings are close together, each one requires less fiber, resulting in reduced costs. Put another way, the cost to deploy a fiber segment that is a quarter-mile long will be more easily recovered if that quarter-mile run passes 50 potential customer than if there are only five passings along the route.

Our candidate network design and cost estimate assumed that there are approximately 1,560 passings in the Township.6 Most of these are considered high density, likely in neighborhoods where houses are relatively close together and delivering service would be relatively easy because of the proximity of buildings to one another. We considered about 500 of the passings in the Township to be low density; these likely represent homes in gated communities.

Geographic density has historically been one of the most critical factors for evaluating the potential return on investment (ROI) of an FTTP deployment. Many providers use internal metrics based heavily on density to determine whether they will build in a given area. Rural and other low-density infrastructure deployments tend to be particularly expensive, and this is a critical

6 There are approximately 1,050 high-density passings and approximately 500 low-density passings. Although these do not add up to 1,560, this is the number that was used in our cost estimation due to rounding.

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reason that many rural Americans are still not well-served with broadband. Simply put, it is extremely expensive to deploy infrastructure in areas where passings are far apart.

Another important concept is demand density, which is often a key driver for the potential success or failure of any FTTP endeavor. Even in areas where passings may be close together, there is still an important hurdle for providers: Convincing potential customers to cancel their existing service and purchase something new. A challenge new market entrants face is customer inertia, or the tendency of people to retain the service they have because it is “good enough,” and the prospect of making a change is more daunting than simply sticking with what they know.

Demand density is the number of potential customers a provider may be able to obtain in an area, based on the actual demand for service. Market research, both in the Township (see Section 2) and in other localities we have surveyed throughout the United States often indicates that consumers are very price sensitive and are only willing to switch at fairly low price points. Respondents to the Township’s survey indicated a willingness to switch to a very high-speed internet connection at monthly prices lower than $50 per month. This willingness dropped sharply at higher price points.

**1.6 Regional and State Broadband Initiatives Do Not Provide Funding** Through an executive order, the State of Michigan’s Governor created the Michigan Consortium of Advanced Networks, or MCAN. While CTC’s engagement with the Township was ongoing, MCAN released a report outlining its findings following an investigation of the state of broadband in Michigan, per direction from the Governor’s office. 7 The resulting Michigan Broadband Roadmap describes goals related to ensuring that broadband is made available statewide, and outlines some steps that stakeholders (e.g., regional and local governments) may be able to take to bolster broadband availability. Although this report details the broadband gaps statewide, it does not appear that any state funding has been allocated at this time.

Similarly, the Washtenaw County Board of Commissioners Broadband Equity Sub-Committee provided Township leaders with a report outlining findings about lack of broadband availability in Washtenaw County. Like the state report, the sub-committee identified a range of reasons access to broadband is important and indicated that Washtenaw County is not well-served today. The sub-committee’s recommendations include more closely studying the lack of access to broadband in Washtenaw County, and developing a stated goal. However, like the state’s report,

7 “Gov. Rick Snyder unveils plan to provide broadband access to every corner of Michigan,” *Michigan.gov*, last updated August 15, 2018, https://www.michigan.gov/snyder/0,4668,7-277-80388\_80397-475272--,00.html, accessed September 1, 2018.

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the Washtenaw County report does not indicate that the County will allocate funds to support broadband deployment.

**1.7 Local Entities May Be Willing to Support Township’s Efforts** Following guidance from Township staff, CTC held discussions with several local stakeholders— AT&T, Comcast, the Michigan Broadband Cooperative, and Toyota—about their willingness to work with the Township to bolster local broadband availability. These discussions included private providers like. The entities represented a range of potential users of a Township network, as well as those that may otherwise have a stake in a publicly owned local fiber network.

All the parties we spoke with on behalf of the Township indicated a willingness to work with the Township to bolster broadband availability. (We note, however, that while the local AT&T representative indicated the company would be willing to work with the Township, there were no additional conversations between AT&T and CTC, despite CTC’s follow-up efforts.) Given this, it will be prudent for the Township to determine its goals and path forward, and then engage the private sector as appropriate.

**1.8 Lower-Cost Alternatives to Constructing a Fiber Network May Help The**

**Township Meet Its Broadband Goals** As the Township considers the feasibility of constructing an FTTP network capable of delivering ultra-high-speed 1 gigabit per second (Gbps) service, we note that our analysis and experience throughout the United States, including in the Township, indicates that while interest in Gigabit service exists, consumer demand is very price sensitive and depends on age, education, and income. The market research findings in Section 2 also illustrate this phenomenon.

Indeed, while the need for fast, reliable broadband service at home will likely continue to grow, it appears that consumers in the Township and nationwide care less about the medium over which their high-speed service is delivered and more about the service being reliable and affordable.

The Township may elect to develop dark FTTP infrastructure and pursue a public–private partnership for service delivery. But given the high price tag for network construction, it may be prudent for the Township to also consider alternative ways to support increased broadband availability.

**1.8.1 Encourage and Incentivize Local Incumbent Providers** Given Comcast’s willingness to disclose proprietary information about its network and services to the Township, it may be possible to work closely with Comcast to help bolster service availability to currently underserved areas. Comcast indicated that it has not historically leased

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publicly owned infrastructure, but the Township may be able to offer other incentives to bolster Comcast’s efforts to expand its network to encompass more of the Township. For example, while the Township likely does not want to directly subsidize a private entity, it may be possible to offer drop cable reimbursement to citizens or to fund other similar programs.

Additionally, the Township may find a willingness on the part of other local providers to participate in some type of program in which the Township covers a portion of high-cost drop cable installation, while the provider and the resident or business user pays for the rest.8 Because there is not sufficient ROI for deploying to areas where density or demand density is not particularly high, the Township may need to get creative in how it addresses service gaps in these areas.

**1.8.2 Engage Regional Wireless Internet Service Providers** There are potential options for engaging WISPs in the region that may not currently provide service directly in the Township. Often, WISPs may elect not to deliver service to a given area because of barriers to market entry like access to assets such as mounting locations and backhaul sufficient to provide high-speed service. Although fixed wireless speeds cannot compete with FTTP speeds, this may be a viable alternative for providing service to locations that currently have few options and may be limited only to satellite or DSL service. Some examples of WISPs in the region are:

• Webster Broadband Coop

• AirAdvantage

• FreedomNet

• Rural Reach

• Great Lakes High Speed

• EZWisp

Depending on a variety of factors, these WISPs may be willing to work with the Township to close gaps in hard-to-reach areas, like gated communities and areas where geographic density is low. Some of these areas may not be ideal for wireless service because of heavy tree coverage, but if the Township determines that a full-scale FTTP deployment is infeasible, it may be worth approaching WISPs in the region for further discussions.

8 This approach may be most applicable to Comcast, given its footprint in the Township. CTC did not approach this directly with Comcast in our discussions. We encourage the Township to hold follow-up conversations with Comcast.

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**1.8.3 Evaluate “Internet in a Box” Options** Common barriers to fixed wireless deployment in areas with low density include accessing dependable and robust backhaul, aggregating sufficient demand, and obtaining mounting assets and power for antennas. It is unlikely that larger regional providers will make an investment in low-density areas, or areas where there is low demand density. Even for an innovative provider, the costs make it difficult to achieve even a break-even cash flow, much less to obtain an ROI.

Recently, some communities in other parts of the country have addressed these issues by leveraging their specific circumstances and collective strength to deploy smaller neighborhood networks. This approach may be particularly attractive for certain areas of the Township, like gated communities and “neighborhoods” comprising homes spread far apart and set back from the road, where providers’ infrastructure would typically be placed in the public right-of-way (PROW).

In an “internet in a box” deployment, a group of potential customers (e.g., a homeowner or neighborhood association, community group, etc.) would form a broadband entity that can coordinate with a backhaul provider, the owner(s) of potential mounting assets, and an energy provider to obtain affordable connectivity, attachments, and power. From there, using wireless assets purchased from a specialized equipment vendor, such as California-based Mimosa Networks, the community can develop and deploy a network to support its users’ needs. We note that Mimosa is not just an equipment vendor—it also provides user-friendly interfaces and front-end management tools to administer and manage the network.9

The Township may be able to facilitate access to backhaul and mounting assets to enable groups in low-density areas, such as neighborhood associations in some of its gated communities, to facilitate an “internet in a box” deployment. Especially given the Township’s proximity to the City of Ann Arbor, backhaul may be more easily obtainable than in more rural areas. If the Township can effectively package this concept, it can offer “internet in a box” to grassroot associations throughout the Township that are not, or will not soon be, served by one of the traditional providers.

9 CTC has no relationship with Mimosa, or with any vendor.

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**2 Market Research Shows Almost All Residents Have Broadband Access** As part of its efforts to evaluate and improve the area’s internet access and quality, the Township conducted a survey of residents in 2018. The results indicate that the Township has a highly educated population and diverse economy for its approximately 4,500 residents.

Key findings include:

• **Township residents are highly connected, with 98 percent of respondents having some form of internet connection**. Specifically, **92 percent of residents have home internet** service and **83 percent have a smartphone with internet**. Internet usage is high across all demographic groups.

• Three-fourths of households have a cable modem internet connection, while much smaller shares have DSL, satellite, cellular/mobile (only), fiber, and other connections.

• The most frequent use of home internet is for general information/searching, followed by streaming movies, videos, or TV. About 64 percent of residents occasionally use the internet to access government information or services. Six in 10 use the internet for educational purposes.

• Residents rank the reliability of their internet connections as the most important aspect of their service, followed by connection speed. Residents are moderately satisfied with the speed and reliability of their internet service, but the extremely high importance placed on these factors may signal some willingness to switch providers if needs are not being met.

• Respondents indicated a willingness to switch to a very high-speed internet connection, especially at monthly prices lower than $50 per month or for one-time hookup fees at or below $100. Willingness to switch drops sharply at higher price points.

• Nearly two-thirds of respondents’ employers allow telework, and 43 percent of responding households have a member who already teleworks. Seven in 10 household members who can telework and with fast home internet connections do telework.

• More than one-half of respondents purchase cable television service, one-third receive television through the internet, 12 percent have satellite/Dish TV, and 10 percent have antenna (over-the-air) service. Television services are only moderately important to respondents, with local news programming ranking as the most important features.

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• One-half of respondents indicated that the Township should install a state-of-the-art network, including 27 percent who indicated that the Township should offer services directly.

The sections below document the survey process, discuss methodologies, present results, and provide key findings that will help the Township assess the current state and ongoing needs of its residents regarding high-speed communications services.

**2.1 Survey Process** As part of an effort to evaluate and improve high-speed communications services in the area, the Township conducted a mail survey of residents. The survey captured information about residents’ current communications services, satisfaction with those services, desire for improved services, willingness to pay for faster internet speeds, and opinions regarding the Township’s role in the availability of internet service. A copy of the survey instrument is included in Appendix B

CTC and its partner market research firm, Clearspring Research, coordinated and managed the survey project, including development of the questionnaire, sample selection, mailing and data entry coordination, and survey data analysis.

**2.1.1 Coordination and Responsibilities** In the project planning phase, the Township and CTC project teams discussed the primary survey objectives, the timing of the survey and data needs, and options for the survey process. The project scope, timeline, and responsibilities were developed based on those discussions.

CTC developed the draft survey instrument based on the project objectives and provided it to Township staff for review and comment. Township staff provided revisions and approved the final questionnaire and specified geographies to be included in survey sampling. CTC used a mapping service to identify households within the specified boundaries to receive the survey packet. CTC coordinated all printing, mailing, and data entry efforts, and provided regular updates regarding survey responses. CTC also performed all data coding and cleaning, statistical analyses, response summaries, and reporting of results.

**2.1.2 Survey Mailing and Response** A total of 1,742 survey packets were mailed first-class to residential households in July 2018 with a goal of receiving at least 320 valid responses. Recipients were provided with a postage-paid business reply mail envelope in which to return the completed questionnaire.

The mailing list was curated by first identifying the targeted market area and the households that fall within this region. A mapping tool was used to draw boundaries around the main portion of the Township, while excluding the island neighborhoods within the City of Ann Arbor (with the

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exception of the Wines neighborhood). The main portion of the Township that was part of the survey sample includes the areas north of the Huron River and Highway 14, and East of Highway 23, plus the Wines neighborhood south of the river. The sample was then selected from this mapped region.

A total of 378 useable questionnaires were received by the date of analysis,10 providing a gross response rate of 22 percent.11 The margin of error for aggregate results at the 95 percent confidence level for 378 responses is ±4.5 percent, within the initial sample design criteria. That is, for questions with valid responses from all survey respondents, one would be 95 percent confident (19 times in 20) that the survey responses lie within ±4.5 percent of the target population as a whole.

**2.1.3 Data Analysis** The survey responses were entered into SPSS software and the entries were coded and labeled.12 SPSS databases were formatted, cleaned, and verified prior to the data analysis. Address information was merged with the survey results using the unique survey identifiers printed on each survey. The survey data was evaluated using techniques in SPSS including frequency tables, cross-tabulations, and means functions. Statistically significant differences between subgroups of response categories are highlighted and discussed where relevant.

The survey responses were weighted based on the age of the respondent. Since older persons are more likely to respond to surveys than younger persons, the age-weighting corrects for the potential bias based on the age of the respondent. In this manner, the results more closely reflect the opinions of the Township’s adult population in the defined geographic area. Note that the age distribution of the market area’s adult population is estimated using Census data for Ann Arbor Charter Township as a whole.

Table 1 and Figure 11 summarize the weighting used for survey analysis.

10 At least 10 responses were received after analysis had begun and are not included in these results. 11 143 surveys were undeliverable, mostly vacant residences. The “net” response rate is 378/(1,742-143) = 23.6%. 12 Statistical Package for the Social Sciences ( http://www-01.ibm.com/software/analytics/spss/)

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**Table 3: Age Weighting**

**Age Cohort Census Population**

**(Adult) Survey Responses \*\* Weight** 18-44\* 1,379 69 2.12 45-54 846 59 1.52 55-64 465 86 0.57 65+ 795 156 0.54 Total 3,485 370 The Census data used represents individuals in the entire Ann Arbor Charter Township area as a proxy for the selected Township areas included in the survey. \*The 18-34 and 35-44 age cohorts were grouped together due to small numbers in the sample. \*\*Not all respondents provided their age.

**Figure 11: Age of Respondents and Adult Population**

The following sections summarize the survey findings.

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**2.2 Survey Results** The results presented in this report are based on analysis of information provided by 378 respondents from an estimated 1,742 residences in selected areas of Ann Arbor Charter Township. Results are representative of the set of households with a confidence interval of ±4.5 percent at the aggregate level.

Unless otherwise indicated, the percentages reported are based on the “valid” responses from those who provided a definite answer and do not reflect individuals who said “don’t know” or otherwise did not supply an answer because the question did not apply to them. Key statistically significant results (p ≤ 0.05) are noted where appropriate.

**2.2.1 Home Internet Connection and Use** Respondents were asked about their home internet connection types and providers, use of the internet for various activities, and satisfaction and importance of features related to internet service. This information provides valuable insight into residents’ need for various internet and related communications services.

***2.2.1.1 Communications Services*** Respondents provided information about the communication services currently purchased for their household. As illustrated in Figure 12, 92 percent of respondents purchase home internet service, and 83 percent purchase cellular/mobile telephone service with internet. (In total, 98 percent have some internet access—either a fixed home connection or via smartphone.) Six in 10 respondents purchase cable or satellite television service. Additionally, 40 percent have fixed (landline) telephone service, and 11 percent have cellular/mobile service without internet.

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**Figure 12: Communication Services Purchased**

Use of communication services is correlated with the age of the respondent. In particular, use of internet services is higher for those under age 45. Purchase of fixed (landline) telephone service or cable/satellite television is higher among those ages 65+, as shown in Figure 13.

The use of some communication services is also correlated with household income. In particular, respondents who earn $200,000 or more per year are most likely to purchase cellular/mobile telephone service with internet or cable/satellite television (see Figure 14).

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**Figure 13: Services Purchased by Age of Respondent**

**Figure 14: Services Purchased by Household Income**

Total internet access by demographics is provided in Table 4. Total internet access does not vary significantly by demographic characteristics, as saturation is very high in the market area among

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all groups. However, older respondents are less likely than younger respondents to have both home internet and a smartphone.

**Table 4: Internet Access by Key Demographics**

**No Internet Service**

26 **Home Internet Connection Only**

**Total Smartphone**

**Both Home/**

**Internet Only**

**Smartphone**

**Access**

***Weighted Count* TOTAL 2% 14% 6% 77% 98%** 378 **Gender** Female Male 1% 16% 8% 75% **99%** *144* 2% 13% 5% 80% **98%** *225*

**Age group**

< 45 years 0% 13% 1% 86% **100%** *146* 45 to 54 years 2% 8% 8% 81% **98%** *90* 55 to 64 years 6% 14% 7% 73% **94%** *49* 65 years or more 2% 21% 12% 65% **98%** *84*

**Highest level of education**

Less than graduate 3% 18% 8% 71% **97%** *101* Graduate degree 1% 12% 6% 81% **99%** *269*

**Approximate 2017 household income**

Less than $100,000 2% 22% 9% 67% **98%** *78* $100,000 to $149,999 3% 17% 6% 74% **97%** *64* $150,000 to $199,999 0% 11% 10% 78% **100%** *51* $200,000 or more 0% 9% 4% 86% **100%** *115*

**Children in Household**

No Children in HH 3% 16% 7% 74% **97%** *236* Children in HH 0% 11% 5% 84% **100%** *138*

**Total Household Size (Adults + Children)**

One HH member 6% 23% 9% 61% **94%** *52* Two HH members 3% 14% 7% 76% **97%** *139* Three HH members 0% 9% 2% 90% **100%** *62* Four+ HH members 0% 14% 6% 80% **100%** *120*

**Number of years lived at current residence**

Less than 1 year 7% 20% 0% 74% **93%** *32* 1 to 2 years 0% 11% 6% 83% **100%** *63* 3 to 4 years 0% 15% 0% 85% **100%** *51* 5 or more years 3% 15% 8% 75% **97%** *229*

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***2.2.1.2 Importance of Communication Services*** Respondents were asked to indicate the importance of various communications services to their household, using a scale where 1 is “Not at All Important” and 5 is “Extremely Important.” The mean importance of various service aspects is illustrated in Figure 15, while detailed responses are illustrated in Figure 16. Cellular/mobile phone and internet services are extremely important to respondents, while basic cable television service, premium cable television service, and fixed (land-line) telephone service are significantly less important.

**Figure 15: Importance of Communication Services (Mean Ratings)**

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**Figure 16: Importance of Communication Services**

Specifically, 84 percent said cellular/mobile phone service is extremely important. Three-fourths of respondents said high-speed internet or internet connections of any speed are extremely important, while less than one-fifth indicated that television services are extremely important. More than one-half of respondents said that fixed telephone service is not at all important as illustrated in Figure 16.

Figure 17 illustrates the importance of communications services by the age of the respondent. The importance of cable television and landline telephone services is higher for ages 65 and older, while the importance of high-speed internet is somewhat lower. Specifically, 86 percent of those under age 45 said that high-speed internet is extremely important, compared with 68 percent of those ages 45 to 54 years, 69 percent of those ages 55 to 64 years, and 65 percent of those ages 65 years or older.

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**Figure 17: Importance of Communication Service Aspects by Age of Respondent**

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***2.2.1.3 Personal Computing Devices*** Respondents were asked to indicate the number of personal computing devices they have in the home. As might be expected, almost all (100 percent) respondents with internet access (either home connection or smartphone) have at least one personal computing device.

**Figure 18: Number of Personal Computing Devices**

Three-fourths of respondents have five or more personal computing devices. Another 16 percent have three or four devices, and 7 percent have one or two devices (see Figure 18).

Saturation of personal computing devices is high among households with multiple members, with nearly three-fourths of two-member households having five or more devices. More than nine in 10 households with four or more residents have at least five personal computing devices (see Figure 19).

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**Figure 19: Number of Personal Computing Devices in Home by Household Size**

The number of computing devices in the home is also correlated with household income. About nine in 10 of those earning $200,000 or more per year have at least five computing devices, compared with six in 10 of those earning less than $100,000 (see Figure 20).

**Figure 20: Number of Personal Computing Devices in Home by Household Income**

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***2.2.1.4 Internet Services Purchased*** Respondents were asked about their purchase of internet services for their home, as well as the cost and speed of services purchased.

**Figure 21: Primary Home Internet Service**

As shown in Figure 21, a majority of homes (99 percent) reported having home internet service, consistent with 98 percent reporting internet access via a home connection or via a smartphone in Question 1. Three-fourths of households have a cable modem, while other connection types represent much smaller shares of the Ann Arbor Charter Township market area.

The saturation of cable modem internet connections tends to increase as household income increases. Nearly two-thirds of those earning under $100,000 per year have a cable modem connection, compared with 86 percent of those earning $200,000 or more per year (see Figure 22).

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**Figure 22: Primary Home Internet Service by Household Income**

As illustrated in Figure 23, more than one-third of respondents pay more than $80 per month for home internet. More than one-half of subscribers pay $41 to $80 per month. The estimated monthly average cost for internet service is $73. Monthly cost does not vary significantly between cable modem and all other internet services (keeping in mind that counts for individual services, besides cable internet, are too small to evaluate separately in a statistically significant manner).

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**Figure 23: Monthly Price for Internet Service**

Most Internet subscribers described their internet speed as “medium” (38 percent) or “fast” (47 percent), while only 8 percent said it was “very fast.” Only 7 percent of subscribers described their connection as “slow” (5 percent) or “very slow” (2 percent), as illustrated in Figure 24. Cable modem subscribers rated their connection faster than did subscribers of other services.

**Figure 24: Internet Speed (Respondent Opinion)**

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***2.2.1.5 Internet Service Aspects*** Respondents were also asked about the importance of, and their satisfaction with, a number of internet service aspects. The importance and satisfaction levels are compared in the following tables and graphs.

2.2.1.5.1 Importance Respondents were asked to rate their levels of importance and satisfaction with various internet service aspects. Respondents rated connection reliability as the most important aspect, followed by connection speed, as shown in Figure 25. The ability to bundle with television service is relatively unimportant compared with other service aspects.

**Figure 25: Importance of Internet Service Aspects**

2.2.1.5.2 Satisfaction Overall, respondents are only moderately satisfied with aspects of their internet service, as shown in Table 5. Respondents rated the reliability and speed of their connection as the aspects with which they are most satisfied. The lowest satisfaction aspect is for the price of service, which is typical in satisfaction surveys, followed by overall customer service.

Specifically, six in 10 respondents are very or extremely satisfied with the reliability and speed of their internet connection, but four in 10 are not at all satisfied to moderately satisfied. Nearly one-half of subscribers are not at all satisfied or only slightly satisfied with price of services.

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**Table 5: Satisfaction with Service Aspects**

2.2.1.5.3 Performance Comparing respondents’ stated importance and satisfaction with service aspects allows an evaluation of how well internet service providers are meeting the needs of customers (see Figure 26). Aspects that have higher stated importance than satisfaction can be considered areas in need of improvement. Aspects that have higher satisfaction than importance are areas where the market is meeting or exceeding customers’ needs. However, it should be cautioned that the extremely high level of importance placed on some aspects (such as reliability) may make it nearly impossible to attain satisfaction levels equal to importance levels.

**Figure 26: Importance of and Satisfaction with Internet Service Aspects**

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The difference between importance and satisfaction of home internet aspects is also presented in the gap analysis table (see Figure 27). The largest gap between importance and performance is for price, followed by reliability, overall customer service, and speed of connection.

**Figure 27: Internet Service Aspect Gap Analysis**

**Mean Satisfaction**

37 **Mean Importance**

**GAP < = >**

**Customer Expectations** Price of Services 2.6 4.3 -1.7 **Not Met** Reliability of Connection 3.6 4.9 -1.4 **Not Met** Overall Customer Service 2.8 4.1 -1.3 **Not Met** Speed of Connection 3.6 4.6 -1.0 **Not Met** Ability to Bundle with TV service 3.1 2.5 0.6 **Exceeded**

The importance scores and performance scores were plotted to help visually determine areas in which internet service providers are doing well and areas that might need improvement. Figure 28 compares the importance and satisfaction in a “quadrant” analysis. Those aspects for which importance is higher than satisfaction are above the equilibrium line and are defined as “underperformers.” As is typical, the cost of internet service is well off the line, as satisfaction with costs is typically low. Reliability, customer service, and connection speed are other under- performing service areas. The mediocre satisfaction levels could indicate a willingness to switch internet service providers if these needs are not being met.

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**Figure 28: Internet Service Aspect “Quadrant” Analysis**

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***2.2.1.6 Willingness to Switch Internet Service*** Respondents were asked if they would be willing to switch to high-speed internet service (defined as 1 Gbps) for various price levels. The mean willingness to switch across this array of questions is illustrated in Figure 29, while detailed responses are illustrated in Figure 30.

**Figure 29: Willingness to Switch to High-Speed Internet at Price Levels (Mean Ratings)**

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**Figure 30: Willingness to Switch to High-Speed Internet at Various Price Levels**

As depicted in Figure 29 and in Figure 30, respondents’ willingness to switch to high-speed internet service (1 Gbps) is very high at $50 per month, but it drops considerably as the price increases. At a price of approximately $90 per month, the mean rating falls to 3.1 (moderately willing). From another perspective, 88 percent are very or extremely willing to switch to high- speed internet for $50 per month, dropping to 7 percent at $150 per month.

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**Figure 31: Willingness to Switch to High-Speed Internet by Price and Respondent Age**

**Figure 32: Willingness to Switch to High-Speed Internet by Price and Household Income**

The willingness to switch to very fast internet service is correlated with some demographic characteristics of the respondents, including respondent age and household income, as depicted in Figure 31 and Figure 32. Specifically, those over age 65 would be less likely than younger respondents to switch to a high-speed connection at various price points. (Similarly, those with

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children in the household, who are younger on average, would be more willing to switch providers.) Additionally, the likelihood of switching providers tends to increase as household income increases.

***2.2.1.7 Internet Uses and Importance*** Respondents were asked about their use of the internet for various activities, as illustrated in Figure 33. Among those items listed, the internet is most frequently used for general information/searching (88 percent) and watching movies, videos, or TV (71 percent). Although nearly two-thirds of respondents occasionally use the internet to access government information or services, just 18 percent use the internet frequently for this purpose. Use of the internet for playing online games or running a home business is less frequent than the other activities included in this question.

**Figure 33: Frequency of Home Internet Activities**

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The use of the internet for some activities varies by age, as illustrated in Figure 34. Younger respondents are much more likely to use the internet for many applications, especially listening to music, watching videos or movies, playing online games, and connecting to a work computer. Internet subscribers ages 45+ are somewhat more likely to ever use the internet for accessing government information.

**Figure 34: Home Internet Activity by Age of Respondent (Percent Ever Using)**

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Similarly, respondents with children under age 18 in the household are more likely to use the internet for various activities, particularly for listening to music, playing online games, connecting to a work computer, and accessing educational resources (see Figure 35).

**Figure 35: Home Internet Activity by Children in Household (Percent Ever Using)**

***2.2.1.8 Willingness to Pay Hook-Up Fee for High-Speed Network*** Respondents were asked if they would be willing to pay an upfront hook-up fee to connect to 1 Gbps internet service for either no savings per month or for $20 savings per month. Almost all respondents would be extremely willing to switch to the network for no hook-up fee (for $0

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savings and for $20 savings), as would be expected.

Additionally, respondents would be more willing to pay the fee for some savings on their monthly communications bill. They are very willing to pay a $100 hook-up fee, particularly for $20 per month savings, and moderately willing to pay a $250 hook-up fee. Willingness to pay a hook-up fee falls sharply at higher price points, as shown in Figure 36.

**Figure 36: Average Willingness to Pay Upfront Hook-Up Fee for High-Speed Internet**

Almost all respondents are very or extremely willing to pay no fee to connect to a high-speed network. Most respondents would pay a $100 hook-up fee for a $20 savings per month (87 percent) or no savings (78 percent). Approximately 64 percent would be very or extremely willing to pay a $250 hook-up fee for a $20 per month savings, but this falls to 43 percent if there were no monthly savings on their bill, as illustrated in Figure 37.

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**Figure 37: Willingness to Pay Upfront Hook-Up Fee for High-Speed Internet**

For most price points, the willingness to pay an upfront hook-up fee, for either no monthly savings or for a $20 per month savings, is higher for those earning $200,000 or more per year (see Figure 38 and Figure 39).

**Figure 38: Willingness to Pay Upfront Hook-Up Fee by Household Income**

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**Figure 39: Willingness to Pay Upfront Hook-Up Fee for $20/Month Savings by Income**

Additionally, the willingness to pay an upfront hook-up fee is correlated with household size, as shown in Figure 40 and Figure 41. Specifically, households with one resident would be less likely to pay an upfront hook-up fee, either for no savings or for $20 per month savings.

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**Figure 40: Willingness to Pay Upfront Hook-Up Fee by Household Size**

**Figure 41: Willingness to Pay Upfront Hook-Up Fee for $20/Month Savings by Household Size**

**2.2.2 Television and Telephone Service** Respondents were asked to indicate what television and telephone services are used, as well as cost of services and the importance of various features.

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***2.2.2.1 Television Service*** Respondents were asked to evaluate the importance of television programming features. Overall, television programming features are only moderately important to respondents. The most important aspects are local programming and news programming, while the least important is children’s programming, as illustrated in Figure 42 and Figure 43.

**Figure 42: Importance of Television Programming Features**

**Figure 43: Mean Importance of Television Programming Features**

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However, those with children in the household placed more importance on children’s programming than did those without children in the home (3.1 mean vs. 1.6 mean). Additionally, respondents younger than age 45, who are more likely to have children in the home, placed more importance on children’s programming than did older respondents. The importance placed on most types of programming, particularly news programming, is higher for those ages 65+, compared with younger respondents (see Figure 44).

**Figure 44: Importance of Television Programming Aspects by Children in Household**

The importance placed on most programming (particularly children’s programming, sports programing, movie network channels, and specialty channels) is higher for those earning $150,000 or more per year, compared with those with a lower household income. This segment is also more likely than others to have children in the household.

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**Figure 45: Importance of Television Programming Aspects by Household Income**

More than one-half of respondents purchase cable television service, one-third receive television service through the internet, 12 percent have satellite/Dish TV, and 10 percent have antenna (over-the-air) service. Nine percent do not watch television (see Figure 46).

**Figure 46: Types of Television Service in Home**

The use of cable television services and internet television services are correlated with respondent age. Respondents under age 45 are more likely than older respondents to use internet television services, while those over age 65 are much more likely than younger respondents to have cable TV service (see Figure 47).

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**Figure 47: Types of Television Service in Home by Age of Respondent**

The estimated average monthly price for cable or satellite television service is $82, with more than one-half of respondents paying over $80 per month, as illustrated in Figure 48. The estimated average monthly price is slightly higher for satellite/Dish services vs. cable services ($93 vs. $83), but this is based on a relatively small number of respondents who subscribe to satellite television.

**Figure 48: Monthly Price of Cable or Satellite TV Service**

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***2.2.2.2 Telephone Service*** Respondents were asked about their home and mobile telephone services. As illustrated in Figure 49, 87 percent of respondents have a cellular/mobile telephone. Nearly one-fourth of respondents have a landline from a traditional telephone provider, and 22 percent have a landline from a cable provider. Another 17 percent of respondents have internet-based phone service.

**The saturation of landline telephone service increases as the age group of householder increases, although cellular/mobile is the leading service across all age cohorts (see**

Figure 50). Landline use from a traditional provider increases from 9 percent of those ages 18 to 44, to 42 percent of those ages 65 and older. Internet-based telephone service is somewhat higher among the 18 to 44-year-old cohort.

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**Figure 49: Home Telephone Service(s)**

**Figure 50: Home Telephone Service(s) by Age of Respondent**

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**2.2.3 Internet Use for Jobs/Careers** Nearly two-thirds of respondents indicated that a member of their family is allowed by their employer to telework, most of whom said their internet connection enables telework. Just 5 percent said their internet connection was not fast enough to allow telework (see Figure 51).

**Figure 51: Employer Allows Telework**

As shown in Figure 52, 43 percent of respondents indicated that someone in their family already teleworks from home, and another 15 percent would like to telework.

**Figure 52: Household Member Teleworking**

Seven in 10 household members who are allowed to telework and who have a fast-enough home internet connection do indeed telework from home. Seven in 10 of those who are allowed to telework but who have a slow connection would like to telework, although this is based on a relatively small number of respondents (see Figure 53). This indicates that a substantial additional

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share may telework if feasible, allowed by their employer, and if their connection were fast enough to enable telework.

**Figure 53: Teleworking Status by Ability to Telework**

Those under age 65 and those earning $100,000 or more per year are more likely to have a household member who telecommutes, as shown in Figure 54 and Figure 55 respectively.

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**Figure 54: Current Telecommuting and Interest by Age of Respondent**

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**Figure 55: Current Telecommuting and Interest by Household Income**

More than one-fourth of respondents either have a home-based business or are planning to start one within the next three years, as illustrated in Figure 56. Of those who operate or are planning to start a home-based business, 52 percent indicated that a high-speed internet connection is (or would be) extremely important to this business and 27 percent said it would be very important (Figure 57).

**Figure 56: Own or Plan to Start a Home-Based Business**

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**Figure 57: Importance of High-Speed Internet to Existing or Potential Home-Based Business**

Saturation of home-based businesses is lower for those with graduate degrees, compared with those without a graduate degree (Figure 58). This is possibly due to greater employment in education or by a local university among those with a graduate degree.

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**Figure 58: Own or Plan to Start a Home-Based Business by Education**

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**2.2.4 Internet Use for Education** Respondents were asked if they or a household member use an internet connection for educational purposes, such as completing assignments, research, or study related to coursework or formal education. Overall, 59 percent reported using the internet for educational reasons, as shown in Figure 59.

**Figure 59: Use of Internet for Educational Purposes**

Respondents less than age 54 are more likely than older respondents to have a household member who uses the internet for educational purposes (see Figure 60); they are also more likely to have children age 18 and under in the household. Approximately 80 percent of those with children in the household use the internet for educational purposes, compared with 46 percent of those without children in the home.

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**Figure 60: Use of Internet for Educational Purposes by Age of Respondent**

Nearly two-thirds of those with a graduate degree use their internet connection for educational purposes, compared to 44 percent of respondents with a lower level of education (Figure 61).

**Figure 61: Use of Internet for Educational Purposes by Education Level**

Respondents use the internet across a range of education levels. Among those who use the internet for educational purposes, 31 percent use it for primary education, 21 percent use it for secondary education, and 20 percent use it for early childhood education. Additionally, 32 percent use the internet for graduate level education, and 32 percent use it for continuing/adult education (see Figure 62).

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**Figure 62: Education Level for Which Internet Connection Is Used**

Use of the internet for educational purposes is related to presence of children in the household, as might be expected, particularly for early childhood, primary, and secondary education needs. Those without children in the home are more likely to use the internet for graduate or continuing education (see Figure 63).

**Figure 63: Education Level for Which Internet Connection Is Used by Children in Household**

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Among those who use the internet for educational purposes, 51 percent said that a high-speed internet connection is extremely important, and 31 percent said it is very important for their education needs (see Figure 64).

**Figure 64: Importance for High-Speed Internet for Education Needs**

**2.2.5 Respondent Opinions** Respondents were asked their opinions about the Township’s role in providing or promoting broadband communications services within the area. The most favorable opinions were for the Township to help ensure that all residents, students, and teachers have access to competitively priced broadband services. A majority of respondents strongly agreed with these statements. Overall, there is moderate agreement that the Township should build a publicly financed network. Figure 65 illustrates the mean ratings, while Figure 66 provides detailed responses to each portion of the question.

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**Figure 65: Opinions About the Role(s) for Ann Arbor Charter Township (Mean Ratings)**

**Figure 66: Opinions About the Role(s) for Ann Arbor Charter Township**

As illustrated in Figure 67, respondents under age 45 were more likely than older respondents to agree that the Township should help ensure that all residents, students, and teachers have access to competitively priced broadband services.

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**Figure 67: Opinions About the Role(s) for Ann Arbor Charter Township by Respondent Age**

Respondents were also asked their opinion of the current broadband market. One-half of respondents strongly agreed that high-speed internet is an essential service (and seven in 10 agreed or strongly agreed). One-half of respondents agreed or strongly agreed that availability is a factor in deciding where to live and that the market currently provides high-speed internet at prices they can afford; one-half of respondents were either neutral or did not agree, suggesting a need for affordable broadband internet among a sizeable segment of respondents.

Detailed responses to statements about broadband availability are illustrated in Figure 68. The average agreement with broadband availability statements are shown in Figure 69.

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**Figure 68: Opinions About the Broadband Internet Market**

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**Figure 69: Opinions About the Broadband Internet Market (Mean Ratings)**

As illustrated in Figure 70, agreement with availability of affordable high-speed internet tends to increase as household income increases. Specifically, approximately two-thirds of respondents earning $200,000 or more per year agreed or strongly agreed that the market currently offers affordable high-speed internet, compared with 37 percent of those earning under $100,000 per year (see Figure 71).

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**Figure 70: Opinions About Broadband Internet by Household Income**

**Figure 71: Agreement That Market Offers Affordable High-Speed Internet by Income**

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Respondents were asked what should be the ***main*** role of the Township with respect to broadband internet access. One-half of respondents indicated that the Township should install a state-of-the art network and either offer services to the public (27 percent) or lease the network to private companies that would in turn provide services to the public (22 percent). Another 24 percent said the Township should encourage a private firm to build a high-speed network, and 22 percent were unsure. Only 4 percent said the Township should play no role, as illustrated in Figure 72.

**Figure 72: MAIN Role of the Township with Respect to Broadband Access**

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**Figure 73: MAIN Role of the Township with Respect to Broadband Access by Income**

As illustrated in Figure 73, those earning under $100,000 per year were more likely than those with a higher household income to say the Township should install a state-of-the-art network and offer services to the public. Also, the likelihood of saying the Township should encourage a private firm to build a high-speed network increases as household income increases.

These responses indicate a relatively clear signal about residents’ desire to have a state-of-the- art communications network and for the Township to play *some* role in its installation. It should be noted that this question did not specifically ask about how that network should be financed or funded. Questions regarding consumers’ willingness to pay monthly fees or hook-up costs for access to that network were presented previously.

**2.2.6 Respondent Information** Basic demographic information was gathered from survey respondents and is summarized in this section. Several comparisons of respondent demographic information and other survey questions were provided above.

As indicated previously in Figure 11 regarding age-weighting, disproportionate shares of survey respondents were in the older age cohorts relative to the Township’s adult population as a whole. Approximately 42 percent of survey respondents are ages 65 an older, compared with only 23 percent of the population. Conversely, only 19 percent of survey respondents are under age 45, compared with 40 percent of the population (see Figure 74). The weighted survey results

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