Digital Divide: County Broadband Access in Tennessee

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Introduction

Digital divide is defined as the gap between underserved communities that have poor or limited internet access and the communities that have relatively better access to broadband internet (25 megabits per second download/3 megabits per second upload speeds). While the Federal Communications Commission (FCC) claims that broadband internet is not available to 24.7 million people in the United States, data from Microsoft indicates that 162.8 million people (almost half of the population of the United States) do not use internet at broadband speeds (Hegle and Wilding, 2019). Broadband internet is still out of reach for many communities in Tennessee, with only 53.4 percent of residents adopting broadband in 2019 (FCC, 2019). With the shift to digital technology and widespread applications, access to broadband internet has become critical for economic development, specifically for education, work force, health care and recreation.

Impacts of the digital divide have been broadly highlighted during the COVID-19 pandemic. Where possible, employees have shifted to working at home. Similarly, K-12 schools, colleges and universities are offering classes online, and many residents are increasingly choosing online methods to order retail goods and services. Additionally, people need broadband internet to access up-to-date health care, prescriptions and health services information about COVID-19 from news and media outlets, as well as the state and federal government.

The purpose of this publication is to inform Extension agents, local government leaders and economic development professionals about the digital divide, the relative measures of socioeconomic status and broadband infrastructure across Tennessee. This publication is to be used in conjunction with the county digital divide index profiles available at https://utextensionced.tennessee.edu/digital-divide-index/.

Digital Divide Index Data and Methods

The digital divide index score, which ranges from 0 to 100, is comprised of an infrastructure score and a socioeconomic score. Lower scores indicate a lower divide or relatively better internet access, better adoption and better socioeconomic conditions. Higher scores indicate poor or limited internet access, relatively low adoption and relatively low socioeconomic conditions. In collaboration with Purdue University's Center for Regional Development, county digital divide profiles were developed.

The data source for all the infrastructure score variables is the Federal Communications Commission Form 477. The variables and the weights used to calculate the infrastructure score are shown in Table 1.

Table 1. Infrastructure Variables Description and Weights

Variable Name	Description	Weight
Infrastructure		1.0
NBBND	Percent population with no access to fixed broadband	0.3
NIA	Percent households with no internet access	0.3
NCD	Percent households with no computing device	0.3
DNS	Median advertised fixed download speed	0.05
UPS	Median advertised fixed upload speed	0.05

Source: Gallardo, 2020.

The infrastructure score/adoption score is calculated based on the following equation:

$$INFA = NBBND*0.3 + NIA*0.3 + NCD*0.3 - DNS*0.05 - UPS*0.05 \quad (1)$$

The source of the data for all the socioeconomic variables is the U.S. Census Bureau's five-year American Community Survey. The variables and weights used to calculate the socioeconomic score are shown in Table 2.

Table 2. Socioeconomic Variables Description and Weights

Variable Name	Description	Weight
Socioeconomic		1.0
AGE65	Percent of population aged 65 and older	0.25
POV	Percent of population aged 25 and older with less than high school	0.25
LTHS	Individuals in poverty	0.25
DIS	Percent of population with a disability	0.25

Source: Gallardo, 2020.

The socioeconomic score (SE) is calculated based on the following equation:

$$SE = AGE65*0.25 + POV*0.25 + LTHS*0.25 + DIS*0.25 \quad (2)$$

The infrastructure (INFA) score and the socioeconomic (SE) score are combined to calculate the Digital Divide Index (DDI).

Comparison of the infrastructure and socioeconomic scores allows for an interpretation of the results. If the infrastructure score is much higher than the socioeconomic score, the county should focus efforts on improving the broadband infrastructure, but if the socioeconomic score is much higher, the county should focus efforts on improving the digital literacy skills of residents to take advantage of the technology. If a county has high scores for both the infrastructure and socioeconomic scores, the county should focus on improving broadband infrastructure and digital literacy skills.

2018 Tennessee Digital Divide Index

The Digital Divide Index for Tennessee counties ranged from 10.15 to 58.65. The spatial extent of the digital divide in Tennessee is shown in Figure 1. Counties in major metropolitan areas and surrounding counties typically have a digital divide index score below 20, owing mainly to robust broadband infrastructure, relatively younger and more educated population and lower poverty levels. On the other hand, many rural counties have a digital divide index score above 30, such as counties associated with the Tri-Cities area, upper Cumberland region and western Tennessee.

A complete list of the digital divide index, infrastructure scores, socioeconomic scores and the associated rankings for all the 95 counties in Tennessee are presented in Appendix A. Digital Divide Index county profiles including the infrastructure score and socioeconomic data were developed to provide a better insight of the broadband access issues at the local level.

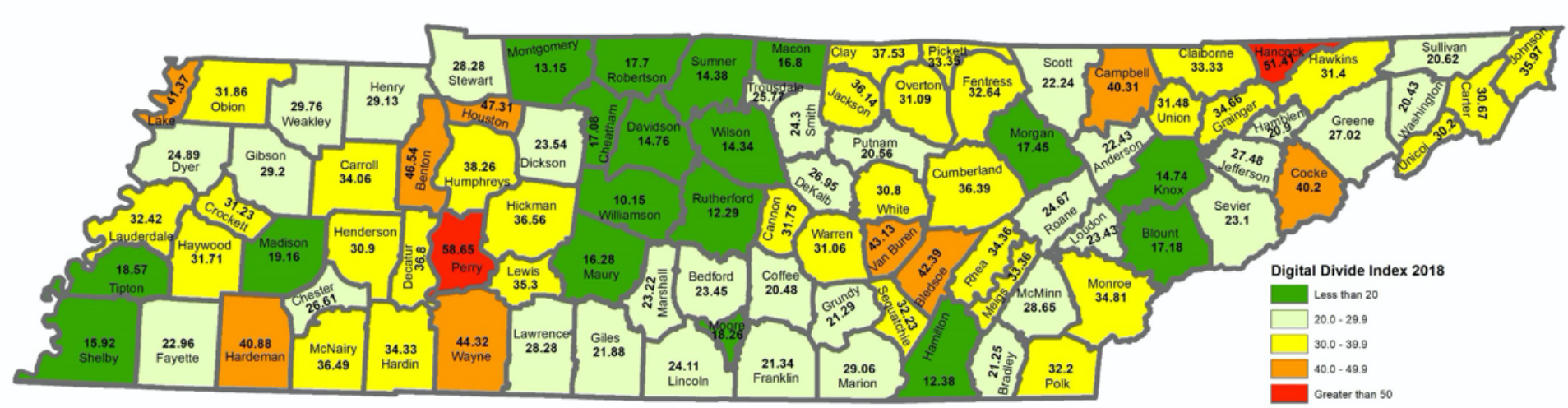

Figure 1. 2018 Digital Divide Index Across Tennessee.
Data Source: Gallardo, 2020

The 10 counties with the lowest digital divide index score are presented in Table 3. These counties are concentrated in the metropolitan counties adjoining Nashville, Chattanooga, Knoxville and Memphis. These counties have robust broadband infrastructure as indicated by the infrastructure score. The low socioeconomic score indicates that the population is relatively young, highly educated and have low poverty levels.

Table 3. Top 10 Counties With the Lowest Digital Divide Index Score (Highest Digital Divide Index Rank)

County	OMB Metropolitan Status	Digital Divide Index	Infrastructure Score	Socioeconomic Score	Digital Divide Index Rank
Williamson	Metropolitan	10.15	21.74	5.63	1
Rutherford	Metropolitan	12.29	17.71	17.45	2
Hamilton	Metropolitan	12.38	8.52	33.73	3
Montgomery	Metropolitan	13.15	16.43	21.59	4
Wilson	Metropolitan	14.34	16.91	23.41	5
Sumner	Metropolitan	14.38	14.81	27.17	6
Davidson	Metropolitan	14.67	15.25	27.06	7
Knox	Metropolitan	14.74	14.04	29.34	8
Shelby	Metropolitan	15.92	13.12	33.56	9
Maury	Metropolitan	16.28	15.30	30.56	10

The 10 counties with the highest digital divide index score are presented in Table 4. The counties are identified as noncore counties (counties that are neither metropolitan nor micropolitan) and are predominantly in rural regions of Tennessee. These higher digital divide scores indicate relatively limited internet infrastructure. The high socioeconomic score indicates that the population has a higher proportion of senior citizens, relatively lower educational attainment and higher poverty levels.

Table 4. Counties With Highest Digital Divide Index Score (Lowest Digital Divide Index Rank)

County	OMB Metropolitan Status	Digital Divide Index	Infrastructure Score	Socioeconomic Score	Digital Divide Index Rank
Perry	Noncore	58.65	45.32	72.51	95
Hancock	Noncore	51.41	33.82	76.48	94
Houston	Noncore	47.31	36.28	63.04	93
Benton	Noncore	46.54	29.60	73.00	92
Wayne	Noncore	44.32	35.18	58.30	91
Van Buren	Noncore	43.13	28.52	67.31	90
Bledsoe	Noncore	42.39	25.97	70.11	89
Lake	Noncore	41.37	25.51	68.64	88
Hardeman	Noncore	40.88	31.82	56.50	87
Campbell	Metropolitan	40.31	23.71	69.43	86

Broadband Challenges in Rural Tennessee

Broadband access is relatively low in rural communities in Tennessee because of:

- Barriers to broadband expansion: Tennessee is among 22 states in the U.S. that have barriers in developing municipally owned broadband networks (Orms, 2013). Tennessee state laws (Code Annotated, Section 7-52-602) allow only municipalities with electric systems to provide broadband within their service areas.
- Lower rural population density: According to the U.S. Census Bureau, Tennessee's population density in 2018 was 161.3 people living per square mile. The population density of metropolitan counties was 252.3 people per square mile, while that of micropolitan counties was 89.5 people per square mile and that of noncore counties was 44.9 people per square mile. It requires many more miles of fiber-optic cable to connect households in micropolitan and noncore counties (rural) as compared to urban areas where the population and household density is much higher. Many internet service providers (ISPs) have concerns that providing broadband access to rural households may not guarantee a return on investment.
- Right-of-way or easements: Seeking right-of-way and easement permissions to lay fiber-optic cable from local governmental authorities is a slow process, and ISPs need faster approvals to keep up with growing demand (Owen et al., 2017).
- Topography: Presence of hills, valleys and tree coverage act as an impediment to internet signal strength. It also adds to the cost of laying cable and maintaining broadband equipment.
- Adoption and use: In rural Tennessee, broadband adoption and use are relatively low when compared to urban areas, mainly due to lack of a reliable signal and affordable subscription plans (Tennessee Broadband Internet, 2018).

Summary and Conclusions

The digital divide index highlights the disparity in broadband access across Tennessee. While the urban areas have good broadband infrastructure, many rural communities have limited infrastructure or poor access that face significant barriers. The digital divide index captures broadband access and socioeconomic conditions at the county level. There may be communities within a county that could have better or poorer access that is not representative of the digital divide index.

Reducing the barriers on municipal electric cooperatives to provide broadband within their network by encouraging public-private partnerships will likely improve broadband infrastructure. In order to reduce the digital divide, local leaders and economic development should focus on improving the broadband infrastructure, as well as improving the digital literacy skills of the population.

Rural communities in Tennessee can benefit from broadband solutions that contribute to community development through improving educational program access, creating employment and telework opportunities and providing better health care through telehealth and other programs to support the residents.

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Appendix A. Digital Divide Index Score Breakdown and Rankings

County	OMB Metropolitan Status	Digital Divide Index	Infrastructure Score	Socioeconomic Score	Digital Divide Index Rank	Infrastructure Score Rank	Socioeconomic Score Rank
Williamson	Metropolitan	10.15	21.74	5.63	1	71	1
Rutherford	Metropolitan	12.29	17.71	17.45	2	42	2
Hamilton	Metropolitan	12.38	8.52	33.73	3	6	12
Montgomery	Metropolitan	13.15	16.43	21.59	4	35	3
Wilson	Metropolitan	14.34	16.91	23.41	5	37	4
Sumner	Metropolitan	14.38	14.81	27.17	6	24	6
Davidson	Metropolitan	14.67	15.25	27.06	7	28	5
Knox	Metropolitan	14.74	14.04	29.34	8	19	7
Shelby	Metropolitan	15.92	13.12	33.56	9	9	11
Maury	Metropolitan	16.28	15.30	30.56	10	29	8
Macon	Metropolitan	16.8	3.50	52.34	11	3	47
Cheatham	Metropolitan	17.08	15.33	32.29	12	31	10
Blount	Metropolitan	17.18	13.50	35.71	13	12	14
Morgan	Metropolitan	17.45	1.06	58.07	14	1	61
Robertson	Metropolitan	17.7	17.02	30.70	15	38	9
Moore	Micropolitan	18.26	13.68	37.80	16	13	15
Tipton	Metropolitan	18.57	15.89	34.63	17	34	13
Madison	Metropolitan	19.16	13.94	39.36	18	18	16
Washington	Metropolitan	20.43	13.91	42.26	19	17	24
Coffee	Micropolitan	20.48	14.15	41.94	20	21	22
Putnam	Micropolitan	20.56	14.04	42.29	21	20	25
Sullivan	Metropolitan	20.62	8.24	52.57	22	4	50
Hamblen	Metropolitan	20.9	8.30	53.11	23	5	52
Bradley	Metropolitan	21.25	13.21	45.31	24	10	27
Franklin	Micropolitan	21.34	12.67	46.43	25	7	31
Giles	Noncore	21.88	13.79	45.68	26	15	29
Scott	Noncore	22.24	3.21	64.98	27	2	82

County	OMB Metropolitan Status	Digital Divide Index	Infrastructure Score	Socioeconomic Score	Digital Divide Index Rank	Infrastructure Score Rank	Socioeconomic Score Rank
Anderson	Metropolitan	22.43	13.48	47.44	28	11	33
Fayette	Metropolitan	22.96	17.19	42.15	29	39	23
Sevier	Micropolitan	23.1	14.98	46.33	30	27	30
Marshall	Micropolitan	23.22	18.66	40.15	31	49	19
Loudon	Metropolitan	23.43	14.85	47.28	32	26	32
Bedford	Micropolitan	23.45	17.42	42.84	33	40	26
Dickson	Metropolitan	23.54	18.67	40.85	34	50	20
Lincoln	Noncore	24.11	13.85	50.55	35	16	40
Smith	Metropolitan	24.3	19.08	41.83	36	57	21
Roane	Metropolitan	24.67	14.83	50.08	37	25	38
Dyer	Micropolitan	24.89	14.71	50.78	38	22	41
Trousdale	Metropolitan	25.77	18.86	45.49	39	54	28
Chester	Metropolitan	26.61	23.03	40.07	40	76	17
Dekalb	Noncore	26.95	18.07	49.49	41	43	37
Greene	Micropolitan	27.02	12.81	58.87	42	8	68
Jefferson	Metropolitan	27.48	18.98	49.10	43	56	36
Stewart	Noncore	28.28	18.61	51.51	45	48	45
Lawrence	Micropolitan	28.28	18.90	51.02	44	55	43
McMinn	Micropolitan	28.65	18.82	51.99	46	53	46
Marion	Metropolitan	29.06	16.49	56.95	47	36	60
Henry	Micropolitan	29.13	15.86	58.23	48	33	65
Gibson	Noncore	29.2	21.48	48.55	49	70	35
Weakley	Micropolitan	29.76	21.12	50.43	50	63	39
Unicoi	Metropolitan	30.2	13.71	64.38	51	14	80
Carter	Metropolitan	30.67	15.30	62.63	52	30	77
White	Noncore	30.8	20.40	54.01	53	60	56
Henderson	Noncore	30.9	21.39	52.51	54	68	49
Warren	Micropolitan	31.06	17.63	59.42	55	41	70
Overton	Micropolitan	31.09	22.44	51.07	56	74	44

County	OMB Metropolitan Status	Digital Divide Index	Infrastructure Score	Socioeconomic Score	Digital Divide Index Rank	Infrastructure Score Rank	Socioeconomic Score Rank
Crockett	Metropolitan	31.23	21.09	53.77	57	62	55
Hawkins	Metropolitan	31.4	18.79	58.17	58	52	64
Union	Metropolitan	31.48	18.38	59.05	59	45	69
Haywood	Noncore	31.71	23.31	50.96	60	77	42
Cannon	Metropolitan	31.75	25.09	47.93	61	81	34
Obion	Micropolitan	31.86	18.58	59.57	62	46	71
Polk	Metropolitan	32.2	22.92	52.72	63	75	51
Sequatchie	Metropolitan	32.23	20.55	56.94	64	61	59
Lauderdale	Noncore	32.42	18.58	60.79	65	47	75
Fentress	Noncore	32.64	15.55	66.60	66	32	84
Claiborne	Noncore	33.33	18.76	62.50	67	51	76
Pickett	Noncore	33.35	14.80	69.50	68	23	91
Meigs	Noncore	33.36	24.61	52.34	69	80	48
Carroll	Noncore	34.06	21.36	59.59	70	65	72
Hardin	Noncore	34.33	22.15	58.81	71	73	67
Rhea	Micropolitan	34.36	21.46	60.11	72	69	74
Grainger	Metropolitan	34.66	20.31	62.78	73	59	78
Monroe	Noncore	34.81	22.05	60.07	74	72	73
Lewis	Noncore	35.3	26.28	53.76	75	86	54
Johnson	Noncore	35.97	18.23	69.32	76	44	89
Jackson	Micropolitan	36.14	20.19	66.27	77	58	83
Cumberland	Micropolitan	36.39	21.38	64.76	78	67	81
McNairy	Noncore	36.49	25.30	58.13	79	82	63
Hickman	Metropolitan	36.56	28.18	53.23	80	87	53
Decatur	Noncore	36.8	25.72	58.09	81	84	62
Clay	Noncore	37.53	21.27	67.50	82	64	86
Humphreys	Noncore	38.26	29.51	54.72	83	89	57
Grundy	Noncore	40.09	21.29	73.15	84	66	18
Cocke	Micropolitan	40.2	23.70	69.21	85	78	88

County	OMB Metropolitan Status	Digital Divide Index	Infrastructure Score	Socioeconomic Score	Digital Divide Index Rank	Infrastructure Score Rank	Socioeconomic Score Rank
Campbell	Metropolitan	40.31	23.71	69.43	86	79	90
Hardeman	Noncore	40.88	31.82	56.50	87	91	58
Lake	Noncore	41.37	25.51	68.64	88	83	87
Bledsoe	Noncore	42.39	25.97	70.11	89	85	92
Van Buren	Noncore	43.13	28.52	67.31	90	88	85
Wayne	Noncore	44.32	35.18	58.30	91	93	66
Benton	Noncore	46.54	29.60	73.00	92	90	94
Houston	Noncore	47.31	36.28	63.04	93	94	79
Hancock	Noncore	51.41	33.82	76.48	94	92	95
Perry	Noncore	58.65	45.32	72.51	95	95	93

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