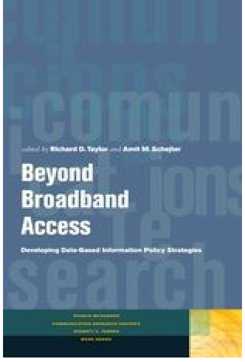

Beyond Broadband Access: Developing Data-Based Information Policy Strategies

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CHAPTER

10 The Determinants of Disconnectedness: Understanding US Broadband Unavailability

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Abstract

This chapter analyzes recent broadband data in the United States to show why the broadband “connectedness” portrayed in the U.S. Federal Communications Commission (FCC) postal code-level data is problematic to a certain extent, suggesting that this problem of “disconnectedness” is a potentially more significant problem than the FCC postal code numbers may suggest. It illustrates a steep decline in “disconnectedness” across the United States over the 2005–2008 period and the persistence of significant pockets of disconnectedness in a number of states. It proposes an approach for systematically modeling the determinants of “disconnectedness” and considers what economic and demographic factors can be identified as important, and statistically significant, in reducing or increasing “disconnectedness”.

Keywords: broadband, United States, broadband connectedness, Federal Communications Commission, postal code, disconnectedness

Subject: Museums, Libraries, and Information Sciences

This chapter reviews recent US broadband data, and briefly discusses why the broadband “connectedness” portrayed in the FCC postal code–level data is in some respects problematic, with the problem of “disconnectedness” addressed in this chapter a potentially more significant problem than the FCC postal code numbers may suggest. This chapter’s preliminary conclusions are that, overall, there was a steep decline in “disconnectedness” across the United States over the 2005–2008 period, but that significant pockets of disconnectedness persist.

Background

Given the increasing emphasis among analysts on the role, actual and potential, of information technology in productivity growth,[1] it is not surprising that policies aimed at accelerating deployment of broadband Internet services sparked considerable discussion in the early years of the new century. One source of concern was international statistics showing US broadband penetration (defined by some measure like percentage of households receiving broadband service) steadily dropping relative to more rapidly rising measures of broadband usage in other countries. In the 2008 presidential election, broadband was back as a policy issue, and a modest national program of investments to improve broadband access in the United States is one element of the stimulus package crafted in response to the current economic downturn.

In some respects the entire discussion seems oddly out of sync. The conventional wisdom was that virtually

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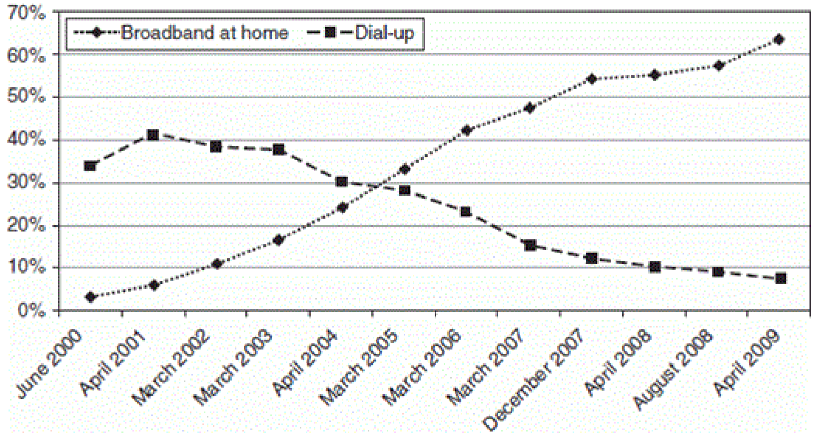
all areas in the United States now have ↳ broadband available. Statistics gathered by the FCC seemed to show that since 2005 (when data collection was improved; more on this below), at least 99 percent of US postal codes, containing in excess of 99 percent of the US population, have at least one broadband service provider serving that area.[2] In its *Fifth Report* on *Advanced Telecommunications*, the FCC noted that:

> Further, as of June 2007, only 0.1 percent of zip codes in the United States reported no high-speed lines, compared to 6.8 percent of zip codes with no reported lines in December 2003. The percent of zip codes reporting four or more providers of high-speed lines also has increased, from 46.3 percent in December 2003 to 88.5 percent in June 2007. While we recognize that the presence of reported lines in a zip code does not necessarily mean service is available throughout a zip code, these figures do provide evidence that broadband deployment is increasing over time.[3]

The *Fifth Report* goes on to say that "most households in the United States have access to both DSL and cable modem services."[4] Furthermore, the data released by the FCC, covering the period ending in June 2008, show high-speed service being provided in every single zip code in the United States![5]

Nonetheless, not all indicators point to pervasive access to broadband in the United States. Survey data gathered by the Pew Internet and American Life Project are the basis for an estimate that 63 percent of US adults lived in homes with access to broadband Internet connections in April 2009, up from 30 percent in March 2005.[6] But at the national level, the rate of increase in home broadband usage seems to have generally slowed after March 2005 (see Figure 10-1). And at least some anecdotal evidence suggests that pockets of the population continue to live in areas without affordable access to broadband,[7] and that the "disconnectedness" of these areas creates a persistent political, economic, and social problems.[8]

Figure 10-1.



Trends in home Internet access: broadband versus dial-up.

Source: Pew Research Center (http://pewresearch.org/pubs/1254/home-broadband-adoption-2009).

But aside from these isolated pockets of disconnectedness, should the apparent ubiquity of broadband service lead us to then conclude that the slowdown in diffusion of broadband Internet services into Americans' homes is not due to lags in deployment by providers? If so, the forces driving slower rates of diffusion in US broadband use lie elsewhere—perhaps reflecting the pricing and quality strategies of those providing the service, a lack of interest on the part of US consumers, or even a failure in providing support for public infrastructure by government, compared with our global competitors.

All may not, however, be quite as it seems. For one thing, the FCC data cited in constructing this argument may not accurately portray the availability of broadband to individual households. One purpose of this

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chapter is to critically evaluate whether this is the case. ↳

The second purpose of this chapter is to examine systematic factors explaining why some areas of the country—the "disconnected"—have significantly fewer options for securing a broadband connection. Given broad agreement that a connection to the Internet at "reasonable" rates of speed is increasingly a necessary social infrastructure required for access to basic information and provision of a variety of services, a better understanding of the characteristics of those areas seemingly "left behind" is increasingly important as we contemplate what policies, if any, are needed to ensure that the remaining pockets of "disconnectedness" are hooked up with the rest of our society.

This chapter examines why the broadband "connectedness" portrayed in the FCC zip code–level data is in some respects problematic, and the problem of "disconnectedness" addressed in this chapter is a potentially more significant problem than the FCC zip code numbers suggest.

Data Hassles

The Federal Communications Commission has been gathering data on US broadband service deployment since 1999. The FCC defines a *high-speed line* (broadband line) to be one with a speed exceeding 200 kilobits per second (Kbps) in at least one direction, while an *advanced services line* is a high-speed line with a 200 Kbps rate in both directions. There are basically two types of information that are gathered. First, providers of at least 250 high-speed connections within a single state were required to provide state-level data on p. 161 numbers of lines in service. Providers of less than 250 lines could voluntarily ↳ provide the FCC the same information, but apparently rarely did so.[9] Since 2005, these small providers have also been required to report to the FCC. The impact on the FCC's statistics has been substantial—the number of reported broadband providers in the United States more than doubled from December 2004 (552) to June 2005 (1,270), effectively rendering data collected after 2005 non-comparable to data from earlier years.[10]

As of 2008, FCC data collection procedures underwent another radical overhaul, with the granularity of publicly available data switched to the census tract, a smaller geographic footprint than is found in the currently available zip code data. There are over twice as many census tracts as zip codes, and the typical census tract contains about 1,700 households, compared with 3,700 for the typical zip code.[11] While this change is to be applauded, for reasons that will become increasingly clear below, it also means that the public statistical record prior to 2008 is going to be difficult to compare to the present, as well as impossible to compare in meaningful ways to the period prior to 2005. Since the evidence I review below suggests that major changes in broadband availability in the United States occurred over the 2005–2008 period, it is necessary to make do with the less useful data collected in the recent past in order to understand the forces that determined the facts on the ground underlying current debates over broadband policy.

Through mid-2008, each broadband service provider was required to identify every zip code in which it supplied at least one high-speed line. Obviously, service providers do not supply information for zip codes in which no high-speed service is offered by any provider, and the FCC must somehow estimate the numbers of zip codes lacking any broadband providers. Unfortunately, the FCC did not publicly report "zero service provider" zip codes in years prior to 2005, and has never precisely documented how it identifies such zip codes, either before or after 2005. FCC staff has sometimes given conflicting explanations of this process to researchers (including the author). Some within the FCC had in the past suggested that the universe of zip codes it uses to determine which zip codes receive no service maps so-called *point* zip codes (zip codes assigned to post offices and large organizations) to the nearest *geo* zip code (zip codes associated with geographically determined mail delivery routes). We now know that this in fact is not the case, based on the revamped FCC data published since 2005.[12] Also, note that data for zip codes where one to three providers have supplied lines are grouped together as a single response in the public version of the FCC zip code data base, "a format that honors requests for nondisclosure of information the reporting entities assert is competitively sensitive."[13]

Beginning in June 2005, the FCC began to list all zip codes, including zero provider zip codes, used in its analysis, and it was clear that the universe of zip codes underlying its statistics included both a subset of p. 162 point zip codes ↳ and a subset of geo zip codes in the universe of postal zip codes. Furthermore, the FCC used the proprietary Dynamap geographic mapping system sold by TANA Inc./GDT Inc. (now TeleAtlas) to map zip codes provided by service providers to a smaller, and it turns out, constantly changing, set of zip codes used in the Dynamap zip code mapping software. For example, forty-one zip codes that existed in 1999 were used in the FCC//Dynamap US map for June 2005 but were dropped six months later, in December 2005. Another twenty 1999 zip codes that were not used by FCC/Dynamap in its June 2005 map of the United States were added to the December 2005 map. The reasons for these rapidly changing Dynamap/GDT zip code geographic definitions are undocumented (in any publicly available documents) and unknown. The most thorough and complete discussion of various zip code geographies available is in Grubesic, who notes that he "made several attempts to gather information on the methodologies used by TeleAtlas to generate zip code boundary files, but, regrettably, they were unwilling to openly share relevant 'proprietary' files."[14]

This confused and problematic situation is illustrated in Table 10-1, which compares a variety of zip code definitional systems to zip codes listed by the FCC in its five listings of high-speed service providers by zip code from June 2005 through June 2007. This table compiles the zip codes listed by the FCC as covering the United States in each of these five periods. These FCC zip codes are contrasted with the 32,038 unique five-digit zip code tabulation areas (ZCTAs) defined as geographic units in the 2000 US population census.[15] I have also constructed a master listing of all zip code numbers for all household income tax returns filed with the IRS for tax years 2004, 2005, and 2006,[16] and compared the intersection of the FCC zips, the ZCTAs, and all zip codes listed on personal income tax returns for these periods.

Table 10-1 Zip Codes Appearing in Various Federal Data Sources, 2005–2007

Data Source/Time Period	Numbers of Zip Codes	Additional Comments
FCC Form 477:		
Jun 05	30087	
Dec 05	30097	
Jun 06	30097	
Dec 06	30097	
Jun 07	30152	
Total 5 digit Census ZCTAs 2000	32038	
Zip codes in FCC data in:		
All 5 periods, 2005–2007	30018	29135 matching ZCTAs 883 not matching ZCTAs
Last 4 periods only	51	11 matching ZCTAs 40 not matching ZCTAs
First 4 periods only	28	15 matching ZCTAs 13 not matching ZCTAs
1st and last periods only	7	6 matching ZCTAs 1 not matching ZCTAs
Last period only	76	26 matching ZCTAs 50 not matching ZCTAs

First period only	34	20 matching ZCTAs 14 not matching ZCTAs
Any period	30214	29213 matching ZCTAs 1001 not matching ZCTAs
Census ZCTAs never in FCC data	2825	
FCC zip codes never matching Census ZCTAs	1001	
Total zips appearing in either Census ZCTA or FCC	33039	
Total zips in either ZCTA or FCC not showing up in IRS SOI 2004–2006	112	104 ZCTAs only
		5 FCC only
		3 ZCTAs and FCC

SOURCE: Author's calculations.

The key findings arising from this comparison are:

- Over the two years from June 2005 through June 2007, the FCC shows 30,214 unique zip codes in use. Roughly 30,000 are in use throughout all 5 periods. The remaining approximately 200 zip codes pop in and out of the FCC high-speed service provider listings. Clearly, the geographic areas covered by the FCC zip codes are morphing over time, sometimes getting absorbed into other zip codes, at other times splitting into more zip codes. Obviously, the population in a disappearing zip code did not really vanish, nor did the population in a recently minted zip code materialize out of thin air. Using these data to track the number of providers of service over time to the population in a particular zip code is therefore problematic, if zips disappear or reappear from one six-month period to the next, or if—as p. 163 implicitly must be the case for this to be happening—zip code ↳ p. 164 ↳ boundaries are constantly being redrawn by the owners of the proprietary data sources the FCC was using to define zip codes.
- Most significantly, there are almost 3,000 more Census ZCTAs than FCC/TeleAtlas/GDT-defined zip codes. There are also another 1,000 FCC zips that do not match up with census ZCTAs. This means that any pre-2005 research (like my own 2005 paper) that attempted to link census socioeconomic data available for ZCTAs to FCC high-speed service provision, using a strategy to identify those ZCTAs without high-speed service by subtracting FCC zips with service from the census universe of all ZCTAs, is fatally flawed. After 2005, the FCC at least identifies what zip codes it thinks have no service available. In this later period, one can only hope that using the intersection of ZCTAs with FCC zips in all available periods for analysis purposes yields a subset of zip codes that are relatively similar and stable in terms of geographic coverage.[17]

Comparing the FCC zips and ZCTAs to zip codes used on IRS personal income tax returns reveals that there are only 112 FCC zips or ZCTAs which are not used on someone's federal tax return over the tax years 2004 to 2006. So both FCC zips and ZCTAs seem to represent "real" zip codes. We do know that the ZCTA methodology involves mapping all real geographic addresses to a subset of actual zip codes (both geo and point codes) in use that approximates geographic areas in which those codes are used (see Table 10-1).[18]

More Measurement Issues

Unfortunately, zip codes cover relatively vast areas, with the typical zip code containing about 3,700 households (this is the ESRI estimate referred to earlier). The fact that one provider offers service to one customer in one portion of a zip code does not mean that the service is available uniformly throughout the zip code. One excellent example is the 78731 zip code in Austin, Texas, where I reside. June 2007 FCC statistics showed fifteen broadband service providers (with physical facilities investments in Texas) offering service within this zip code in June 2007, apparently providing one of the most competitive broadband markets in the United States (by June 2008 that number had declined to thirteen). After a continuing and relatively exhaustive search for alternatives, however, I know that until very recently there was only one local broadband service provider available to homes within this immediate neighborhood—Time Warner Cable.[19] Relatively recently, DSL came to my neighborhood, and by late 2009, I had two choices p. 165 —a 100 percent improvement, but still well short of fifteen ↳ (or thirteen)! This illustrates how the FCC count of high-speed line providers within a zip code may seriously misrepresent competitive options available to individual groups of residents within that zip code.

Another example is the state of Vermont. FCC data have long shown 100 percent of Vermonters living in zip codes with broadband available. Yet a prominent story in the *New York Times* in September 2006 was devoted to the complaints of state residents unable to get broadband service.[20]

When a 2006 GAO study attempted to adjust for some of these same factors in assessing the actual number of competitive entities providing service nationally, the median number of providers serving households within US zip code areas fell from eight to two, and 9 percent of households had no availability at all.[21] In one state, Kentucky, more detailed local estimates of broadband availability to households existed. There, the GAO notes that FCC data showed 96 percent of the Kentucky population living in zip codes with broadband service in December 2004. In contrast, a more geographically disaggregated analysis by ConnectKentucky showed only 77 percent of households with broadband availability.[22] Nonetheless, without a detailed census of service availability at an even lower level of geographic detail, there was no practical alternative to using the FCC data in assessing historical broadband availability through 2008.

Finally, we should note that other data on US broadband use are not entirely comparable with these FCC data, and do not seem entirely consistent. FCC numbers show the universe of residential broadband connections, by type of connection, while the Pew Internet and American Life's surveys of broadband adoption, and GAO/SRI sample-based estimates just described, show the number of households with a broadband connection. Around 2005, according to both Pew and GAO/SRI data, there was a virtual dead heat in numbers, between cable and DSL households.[23] The FCC data, on the other hand, show cable connections significantly exceeding DSL broadband lines.[24]

The FCC data show almost thirty-nine million residential broadband connections in June 2005.[25] By way of contrast, the GAO/SRI survey estimated that about thirty million US households—about 28 percent of the total—had broadband connections in the spring of 2005.[26] Pew estimates are very close to the GAO/SRI survey, showing about 30 percent of adults with broadband at home in March 2005.

Broadband Maps and Disconnectedness

Figure 10-2 contains a recently constructed broadband map for Richland, South Carolina, mapped at the level of individual census blocks (typically about 22 households, nationally, compared with the 1,700 typical households in a census tract and the 3,700 households in a zip code). This is contrasted with a zip code map for the same area (see Figure 10-3). It is clear that blocks ↳

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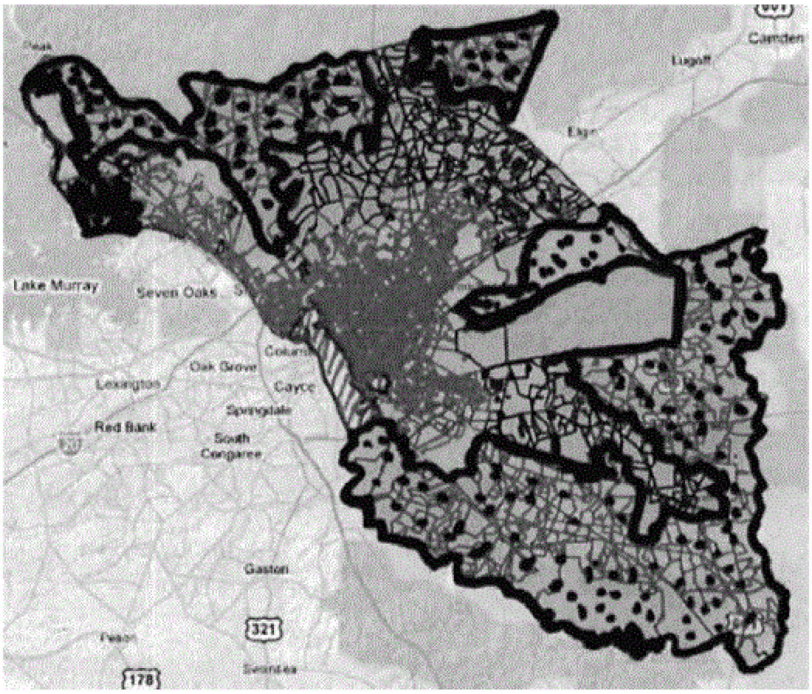
with no broadband service are being combined with blocks with multiple service providers when availability at the zip code level is being measured, illustrating the granularity problem with zip codes. This also illustrates that use of census tracts, with roughly half the households of a zip code, while constituting an improvement over zip codes in assessing availability of service, will still face a significant granularity issue.

Figure 10-2.



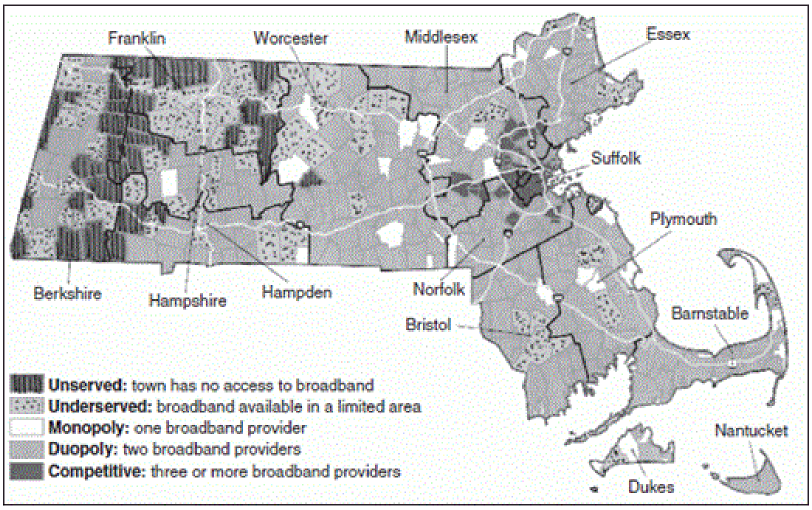
Broadband availability in Richland County, South Carolina. (Stripes = 4 broadband providers; Dots = No broadband providers; Other = 1–2 broadband providers)

Figure 10-3.

Zip codes in Richland County, South Carolina.

Another insight into the broadband mapping issue is provided by a recently constructed map of broadband availability in Massachusetts's towns, in June 2007 (see Figure 10-4). FCC data show no zip codes in Massachusetts in June 2007 had zero providers of broadband Internet services, yet this map shows a significant number of towns in the western part of that state had no access to broadband. Even more towns had broadband only available in a limited area within the township. Again, this illustrates how zip codes aggregate together relatively large areas that are likely to contain significant areas that may not have broadband service.

Figure 10-4.



Broadband availability in Massachusetts's municipalities, June 2007.

Source: MBI (http://www.massbroadband.org/mapping/statewide.html).

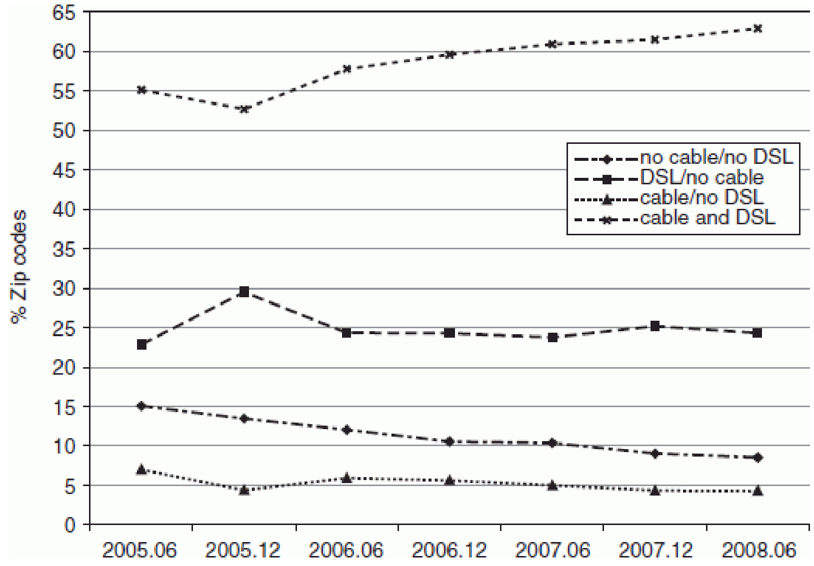
Finally, note that both of the above maps appear to be defined in terms of residential broadband availability to households. The FCC zip code–level provider data, on the other hand, cover provision of broadband to both residential and business customers, and include means of provision other than cable, fiber to the premise, DSL, and Wi-Fi that seem to be included in constructing these residential availability maps. Indeed, if one is willing to pay whatever is necessary to install a satellite dish facing the southern horizon (including possibly building a tower or running a cable to a tower), and purchase services

p. 168 from a national satellite Internet services provider at a relatively high cost, then almost every location in the United States with an unobstructed southern view has access to broadband. Clearly the definition of "broadband availability" driving our national policy debate, however, also has an "affordability" component to it that would be missing with such a definition.

Residential Availability of Broadband

The FCC's reports on availability at the zip code level contain other information that is actually quite helpful in understanding how broadband availability to households in the United States has evolved over time. Table 16 in the FCC's twice-yearly broadband data reports, derived from information on the FCC's Form 477, shows how many zip codes have no ADSL service,[27] no cable service, and neither ADSL nor cable service. By subtraction, one can therefore calculate the shares of US zip codes with cable, but no ADSL; those with ADSL, but no cable; those with neither cable nor ADSL; and those with both cable and ADSL. Figure 10-5 shows the results of these calculations, from June 2005 through June 2008.

Figure 10-5.



Share of US zip codes with and without cable/DSL broadband providers.

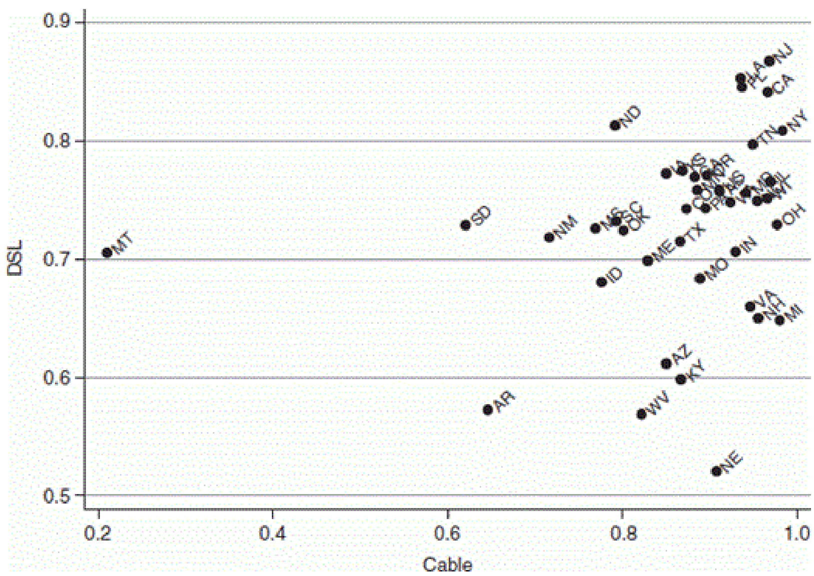
Source: FCC Form-477.

Roughly 63 percent of US zip codes had both cable and ADSL service providers in June 2008. Similarly, about 9 percent of US zip codes had neither cable nor ADSL service being provided anywhere within the zip code in p. 169 2008, down from 15 percent in June 2005. The increase in US zip codes with ↳ both types of service (about 8 percent of total US zip codes) is only a little greater than the decline in US zip codes with neither service (about 6 percent of the total). The share of zip codes with ADSL service only (about 25 percent) and cable service only (about 5 percent) remained roughly constant, quite remarkably, over this three-year period.

This suggests that three quarters of the growth in the number of zip codes with both cable and DSL service came from cable and DSL operators extending their networks into new territories where neither previously provided broadband services. Conversely, cable operators largely do not seem to have entered many zips where incumbent local exchange carriers (ILECs) previously had an effective monopoly on broadband service delivery to residences, nor did ILECs extend their broadband networks into many zip codes where incumbent cable operators effectively were the only providers of household broadband services.

FCC data also give us some insight, geographically, into where these "disconnected" households were located.[28] In 2005, only six states had more than 80 percent of ILEC telephone households with access to DSL available; by contrast, more than two thirds of states had over 80 percent shares of telephone customers offered DSL in 2008 (see Figure 10-6).

Figure 10-6.

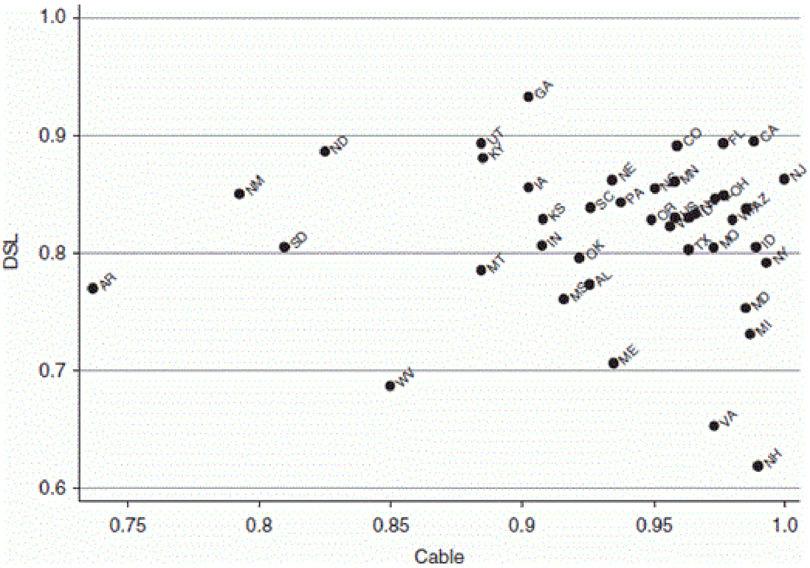


Share of residential end user premises with access to xDSL and cable, June 2005.

Source: FCC, High-Speed Services for Internet Access, various years, Table 14.

There was somewhat less dramatic growth in cable modem service availability. In 2005 a majority of states offered cable broadband to over 90 percent of their customers. In 2008 a majority offered cable broadband to over 95 percent of their customers (see Figure 10-7).

Figure 10-7.



Share of residential end user premises with access to xDSL and cable, June 2008.

Source: FCC, High-Speed Services for Internet Access, various years, Table 14.

By 2008 West Virginia, New Hampshire, and Virginia continued to have less than 70 percent of state telephone customers able to get DSL service, while in Arkansas, Montana, Maine, Michigan, Maryland, New York, Alabama, Mississippi, and Oklahoma less than 80 percent of phone customers could get DSL. In Arkansas, West Virginia, South and North Dakota, and New Mexico less than 85 percent of cable TV customers were also offered broadband; adding to this group the states of Montana, Utah, and Kentucky less than 90 percent of cable customers were offered broadband service by their TV service providers.

Levels of Disconnectedness

The thrust of the above discussion is that substantial numbers of disconnected households, with no wireline or wireless broadband service options, exist in zip codes where FCC statistics show one or more broadband service providers present. It seems reasonable, therefore, to interpret the FCC's zip code data not as an absolute numerical measure of the number of providers available to provide service to households within a

p. 170 given zip code, but rather as an ordinal indicator that is informative of whether or not there is a ↳

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substantial probability that significant numbers of households within a given zip code have any broadband service at all available to them.

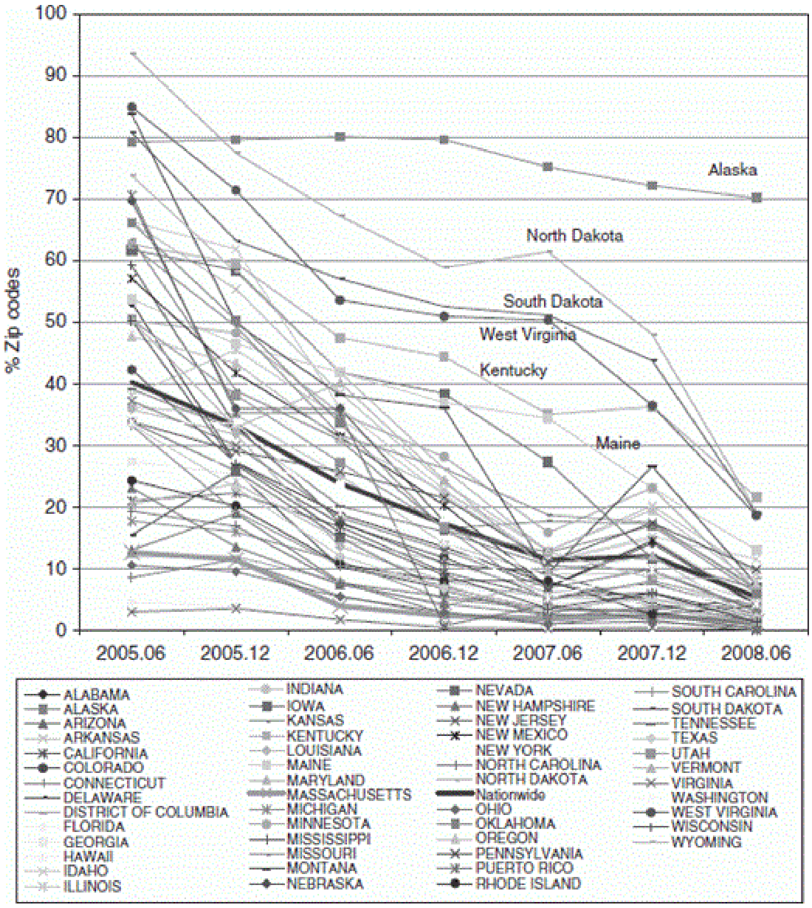
Under this interpretation, zip codes where the FCC data show no broadband lines whatsoever in use are where the *hard-core* (which I shall term *Level-0*) disconnected reside. It is indisputable that someone living in a zip code where no provider is currently providing service of any sort is likely to have an exceedingly difficult time obtaining broadband service. But such Level-0 disconnectedness is now a vanishingly small problem; there were no such zip codes at all in the United States in June 2008.[29]

Measures of hard-core disconnectedness are interesting in one respect, though. If we use only zip codes that showed up in the FCC data in all seven periods from June 2005 through June 2008, hard-core disconnected zips would have been 1.97 percent of all zips in June 2005. But if we had used all June 2005 FCC zip codes in this count (not just the zip codes that showed up in the FCC data in all seven periods), the number of Level-z 0 disconnected zips would have exceeded 2 percent. This suggests that the zip codes that were dropped from the FCC statistics after June 2005 included relatively more "zero service" zip codes, and that nonrandom redefinition of zip codes may further obscure the underlying trends in service provision to sparsely populated (and probably underserved) areas. Those living in under-served areas may have been "redefined into service" when their zips were folded into a more densely populated zip with greater service availability. The extent to which zip code definitional changes accelerated the decline in measured hard-core disconnectedness will remain unclear until a better understanding is available of how and why changes in zip codes and their boundaries were implemented over time.

More realistically, the excerpt from the FCC's Fifth Report quoted above implied that the FCC itself seems to view the share of zip codes with four or more providers as a measure demonstrating that "broadband deployment is increasing over time," and implicitly accepting what seems obvious—that in zip codes with one to three providers, significant numbers of households are likely to not have ready access to broadband. Following the FCC, I therefore define a Level 1 of disconnectedness as characterizing zip codes with at least one, but less than four providers.

Figure 10-8 shows the share of zip codes with Level 1 disconnectedness over time and by state. (The underlying data may be found in Table 10-2 at the end of this chapter.) The period from 2005 to 2008 was one of significant change in broadband connectivity measured by this metric.

Figure 10-8.



Level 1 disconnectedness by state.

Table 10-2 Percent of Zip Codes, Level 1 Disconnectedness (< 4 Providers)

	2005.06	2005.12	2006.06	2006.12	2007.06	2007.12	2008.06
AK	79.10	79.60	80.10	79.60	75.12	72.14	70.15
AL	53.15	27.32	18.87	13.58	7.63	5.14	2.32
AR	66.14	55.32	38.57	23.91	12.91	20.24	9.25
AZ	13.07	19.05	7.94	2.86	1.59	2.86	0.91
CA	21.04	22.33	16.90	9.35	5.42	7.77	2.70
CO	42.31	27.23	17.41	11.83	5.51	6.17	2.40
CT	8.65	11.57	5.60	2.99	1.12	2.60	0.37
DC	15.38	15.38	11.54	7.69	11.54	7.69	7.69
DE	15.52	25.86	10.34	6.90	3.45	3.45	5.17
FL	4.58	3.92	1.53	0.98	0.33	0.65	0.32
GA	27.27	25.40	14.00	7.79	4.47	4.76	2.59
HI	48.89	42.22	24.44	22.22	12.22	14.44	3.33
IA	61.72	58.46	41.87	38.46	27.37	11.67	6.88
ID	66.27	61.85	36.14	22.89	11.24	15.26	11.60
IL	38.22	45.53	34.52	21.85	11.17	14.87	4.72
IN	36.24	35.03	25.15	14.24	9.16	9.30	4.94
KS	63.41	38.92	30.90	16.62	17.78	17.35	7.00
KY	62.59	59.55	47.47	44.52	35.06	36.33	21.49
LA	35.88	31.85	13.59	8.07	5.31	5.10	2.12
MA	12.70	11.49	4.03	7.46	2.02	2.42	1.41
MD	20.47	23.90	14.85	11.37	6.24	7.39	3.93
ME	53.64	46.47	41.85	50.36	34.40	23.10	13.05
MI	17.78	16.04	11.28	5.20	3.53	2.98	1.10
MN	50.29	48.30	35.20	28.19	15.91	23.16	6.55
MO	62.46	49.34	31.68	26.80	18.78	17.56	6.71
MS	59.11	33.16	17.62	10.88	9.33	4.40	1.55
MT	83.70	49.84	38.24	36.05	9.40	26.65	7.52
NC	19.38	16.94	7.72	5.56	3.79	2.98	0.95
ND	93.57	77.42	67.20	58.87	61.39	47.99	19.30
NE	69.66	36.04	36.04	17.67	7.08	14.16	4.07
NH	23.14	13.60	7.46	13.16	2.63	2.63	0.43
NJ	3.08	3.62	1.81	2.72	0.36	0.54	0.18
NM	57.09	41.79	31.43	20.36	7.12	14.59	4.26
NV	33.82	25.90	15.11	7.19	2.74	6.16	1.35
NY	25.96	27.65	23.45	19.31	8.35	7.09	3.39
OH	10.73	9.66	5.62	3.05	1.28	1.58	0.59

OK	66.16	50.34	33.67	16.67	12.73	16.98	6.09
OR	47.69	43.33	31.03	22.56	12.98	19.59	7.61
PA	33.90	29.10	25.83	22.30	11.18	17.48	9.95
PR	70.59	35.29	35.29	0.84	4.20	1.68	0.00
RI	24.32	20.27	10.81	8.11	8.11	2.70	4.05
SC	33.25	19.26	10.55	7.65	2.11	3.96	1.05
SD	80.73	63.20	57.02	52.53	51.13	43.79	18.98
TN	39.04	32.50	20.07	17.91	10.45	9.62	3.15
TX	33.39	23.21	12.09	6.82	3.43	5.27	2.52
UT	50.45	38.18	27.27	16.82	4.95	8.11	4.05
VA	37.20	29.98	18.25	13.15	6.87	9.83	3.20
VT	50.41	32.93	40.24	24.39	9.72	12.15	1.62
WA	33.84	33.65	19.20	14.64	5.31	9.87	4.36
WI	50.28	26.94	15.97	9.17	3.61	6.11	1.53
WV	84.72	71.38	53.58	60.21	50.35	36.51	18.69
WY	73.76	58.16	41.84	26.24	12.77	8.51	8.51
Nationwide	40.25	33.25	23.88	18.12	11.50	12.06	5.48

In June 2005, over 40 percent of zip codes, nationally, had less than four providers. This declined sharply to roughly 12 percent by June 2007, and then was halved to 5.5 percent by the following year, in June 2008. By p. 172 June 2008, only Alaska had over half of its zips in this category (70 percent), while ↳ Kentucky, West Virginia, and the Dakotas were closer to 20 percent. Idaho and Maine continued to have over 10 percent of their zips in this category in 2008.

Table 10-3 examines the share of year 2000 US population residing in Level 1 disconnected zips (excluding Puerto Rico from the list this time), by state. Nationally, the share of the population living in these zips declined from 25 percent in June 2005 to 5 percent in June 2008. The zip codes used in constructing these state-level estimates are defined by the intersection of the year 2000 Census ZCTAs for that state, with the set of zip codes that appeared in the detailed FCC Form 477 tabulations in each and every period from June 2005 to June 2008. The share of the population living in Level 1 disconnected zips decline sharply in most p. 173 states over 2005 to 2008. ↳

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Table 10-3 Percent of Year 2000 Population, Level 1 Disconnected Zips

	2005.06	2005.12	2006.06	2006.12	2007.06	2007.12	2008.06
AK	19.86	18.44	19.95	18.12	14.90	14.08	13.63
AL	22.89	7.69	3.09	2.13	0.84	0.49	0.13
AR	21.06	12.97	6.22	2.28	0.70	1.32	0.35
AZ	1.45	2.64	0.69	0.24	0.26	0.36	0.07
CA	1.30	1.57	0.80	0.23	0.12	0.21	0.02
CO	4.60	2.19	0.73	0.41	0.08	0.11	0.04
CT	1.28	1.65	0.78	0.74	0.05	0.46	0.00
DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DE	1.56	4.61	0.20	0.15	0.09	0.09	0.09
FL	0.50	0.47	0.09	0.04	0.03	0.00	0.00
GA	4.11	4.29	1.43	0.70	0.40	0.33	0.14
HI	7.32	6.59	1.66	1.57	0.61	1.36	0.03
IA	17.65	17.26	8.49	8.12	4.84	1.50	0.63
ID	15.60	13.48	5.36	2.04	1.04	0.61	0.38
IL	4.10	5.94	3.42	1.79	0.67	0.97	0.18
IN	7.02	6.99	4.10	1.76	1.15	0.68	0.23
KS	14.87	6.35	3.79	1.76	1.97	1.58	0.39
KY	18.92	17.02	9.82	8.56	5.88	5.81	2.09
LA	8.12	6.51	1.59	0.73	0.52	0.46	0.15
MA	1.72	1.93	0.19	1.23	0.05	0.03	0.01
MD	1.70	2.32	0.71	0.52	0.29	0.29	0.13
ME	17.53	12.38	10.06	15.39	6.71	3.33	1.28
MI	2.32	2.74	1.42	0.51	0.26	0.20	0.03
MN	9.42	8.87	4.61	3.17	1.44	2.36	0.30
MO	14.16	9.54	3.62	2.81	1.84	1.42	0.29
MS	23.44	8.45	2.80	1.54	1.69	0.43	0.10
MT	27.11	7.43	4.83	4.38	0.68	2.91	0.43
NC	3.83	3.12	0.77	0.51	0.46	0.15	0.01
ND	48.37	28.84	22.78	18.13	20.84	15.33	3.85
NE	26.15	7.37	6.52	2.66	0.62	1.80	0.24
NH	4.74	1.63	0.79	2.21	0.21	0.21	0.00
NJ	0.36	0.46	0.20	0.44	0.12	0.10	0.09
NM	9.17	4.87	2.18	0.91	0.16	0.54	0.07
NV	2.16	1.19	0.56	0.35	0.19	0.12	0.02
NY	2.51	3.18	2.12	1.55	0.49	0.40	0.19
OH	1.56	1.31	0.55	0.19	0.06	0.06	0.02

OK	23.58	11.10	4.79	1.58	1.39	1.49	0.29
OR	7.31	5.62	2.50	1.24	0.58	1.28	0.20
PA	5.09	3.82	3.16	2.35	0.79	1.57	0.61
RI	3.22	1.94	0.24	0.22	0.55	0.10	0.10
SC	8.44	3.41	1.29	1.00	0.24	0.43	0.05
SD	33.08	22.28	16.75	14.46	14.78	11.39	3.46
TN	8.82	6.66	3.32	3.01	1.59	1.13	0.27
TX	4.85	2.44	0.75	0.24	0.07	0.16	0.03
UT	5.79	3.88	1.82	0.83	0.31	0.31	0.16
VA	6.00	3.92	1.82	1.11	0.51	0.64	0.11
VT	15.53	8.56	10.46	5.84	2.09	2.42	0.20
WA	3.57	4.03	1.18	0.81	0.29	0.43	0.15
WI	13.29	5.55	2.19	0.85	0.30	0.59	0.04
WV	38.47	24.25	13.63	17.12	12.67	6.86	2.55
WY	16.71	11.62	6.70	2.63	0.91	0.57	0.70
Nationwide	6.09	4.36	2.16	1.48	0.80	0.75	0.23

But there were significant exceptions. In Alaska, the Dakotas, and West Virginia, the share of the population in Level 1 disconnected zip codes continued to exceed 10 percent. In Kentucky and Maine it exceeded 5 percent. In Vermont, Tennessee, Oklahoma, Kansas, Iowa, and Indiana these Level 1 disconnected zips housed greater than 1 percent of the population.

Interestingly (and coincidentally), the share of the Kentucky population living in Level 1 disconnected zip code areas in June 2005 (19 percent) is quite close to the share of the Kentucky population estimated to be without broadband availability (23 percent) by ConnectKentucky in the spring of 2005. At the national level, about 6 percent of the US population lived in Level 1 disconnected zip code areas in June 2005. This
p. 175 compares with an estimate by the GAO, based on its analysis of the nonpublic raw FCC data, ↳

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that 9 percent of households lacked access to broadband in December 2004. I conclude that the measure of Level 1 disconnectedness defined here seems to be a useful and slightly conservative proxy roughly tracking the prevalence of households without any access to broadband service.

If Level 1 disconnectedness is a reasonable measure of the prevalence of areas with populations not served by broadband service providers, broadband deployment remains a significant problem in selected regions of the United States.

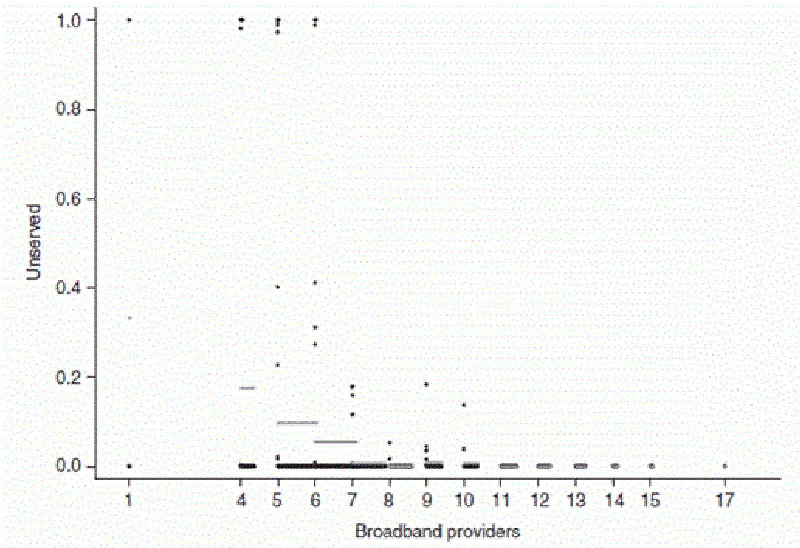
Another Approach to Disconnectedness

The Massachusetts broadband map for June 2007, described earlier, provides a unique opportunity to relate
p. 177 the FCC zip code–level broadband ↳ provider data to an "on the ground" assessment of levels of broadband connectivity available to households in different parts of that state. As discussed earlier, the FCC data cover provision of broadband connections to businesses, not just to households, and include more expensive connections (e.g., T-1 lines, satellite, and optical fiber) that are not frequently included when residential broadband options are being considered.

To look at the relationship between an on-the-ground assessment of household connectivity and numbers of zip code providers as counted in the FCC statistics, I have calculated for each zip code in Massachusetts that appears in the FCC data the share of year 2000 population for that zip code that was living in towns classified by the Massachusetts survey as "unserved" and "underserved."[30]

Figure 10-9 tabulates Massachusetts zip codes by the number of broadband providers in June 2007, and then graphs the number of zip codes falling into different ranges for percentage of the 2000 population in that zip code living in "unserved" towns according to the June 2007 survey. Dark dots correspond to zip codes in different ranges for percent of population living in unserved towns; the lighter bars correspond to the mean of share of

Figure 10-9.



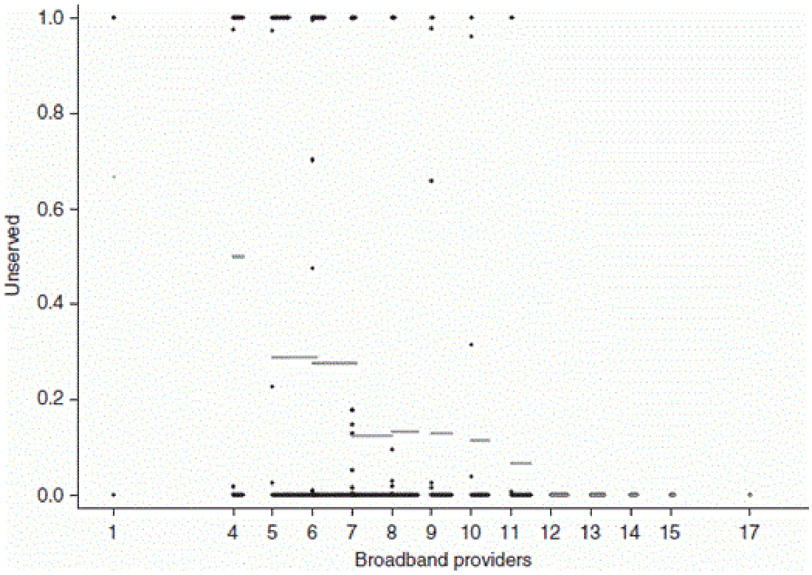
Distribution of Massachusetts zip codes and number of providers by share of 2,000 population living in unserved towns. The horizontal axis represents number of broadband providers per zip code. Dark dots represent zip codes; lighter bars are mean share of population living in unserved towns, across zip codes with given numbers of providers.

p. 178 population living in unserved areas across all those Massachusetts zip codes with a given number of providers. The coding for "1 provider" actually represents one to three providers, reflecting the way the FCC groups this data.

These data suggest that with less than seven broadband providers per zip code, there are multiple instances of zip codes in Massachusetts where the vast majority of households in those zip codes are living in towns classified as unserved. With seven or more providers, on the other hand, the maximum share of the population in a zip code living in unserved townships drops sharply, to under 20 percent. The unweighted average of these unserved population shares across zip codes also drops sharply, to close to zero, as broadband providers rise to the level of seven firms. Thus, assuming that these data from Massachusetts are representative nationally (and understanding that this is a truly limited factual basis for sweeping generalizations), less than seven broadband providers per zip code seems to be the appropriate empirical threshold for asserting that there is some likelihood that large shares of the households within a zip code may be disconnected.

A similar analysis might include the population in "underserved" towns, that is, towns in which some households may have broadband access, but availability is limited within the town. If we calculate the share of a zip code's population living in both unserved and underserved towns, and then relate these shares to the number of providers shown for that zip code in FCC statistics, Figure 10-10 is produced.

Figure 10-10.



Distribution of Massachusetts zip codes and number of providers by share of 2,000 population living in unserved and underserved towns. The horizontal axis represents number of broadband providers per zip code. Dark dots represent zip codes; lighter bars are mean of share of population living in unserved and underserved towns, across zip codes with given numbers of providers.

Alternatively, when defining disconnectedness as occurring when there is a nontrivial probability that a significant portion of some zip code's population is living in towns that are either unserved or underserved, twelve providers seems to be a threshold for disconnectedness. With less than twelve providers, a large share of a zip code's population may be living in towns classified as unserved or underserved, in terms of broadband availability. With twelve or more providers, there is essentially no chance that a significant portion of the zip code's population lacks broadband access. In effect, this level of disconnectedness means that a zip code is not guaranteed to be "really well connected" and thus is qualitatively a bit different from the previous definitions.

I will define zip codes with less than seven providers as Level 2 disconnected, and zip codes with less than twelve providers as Level 3 disconnected (or more accurately, probably best interpreted to mean *not really well connected*, in the sense of virtually everyone having access to broadband). Alternatively, we could interpret one minus the Level 3 disconnected share as the share of the *really well connected*.

Tables 10-4 and 10-5 tabulate the distribution of Level 2 disconnected zips, and year 2000 populations within these zips, across states. Nationally, about p. 179 ↳ 37 percent of zip codes were Level 2 disconnected in June 2008. Alaska was the most disconnected state, with 95 percent of its zips Level 2 disconnected, followed by the Dakotas and West Virginia, with more than 70 percent of zips Level 2 disconnected. Montana, Arkansas, and Wyoming had more than 60 percent of zip codes Level 2 disconnected, while Oklahoma, Maine, and Kentucky still had more than half of their zip codes Level 2 disconnected.

Table 10-4 Percent of Zip Codes, Level 2 Disconnectedness (< 7 Providers)

	2005.06	2005.12	2006.06	2006.12	2007.06	2007.12	2008.06
AK	100.00	96.02	100.00	96.02	95.02	95.02	95.02
AL	83.44	68.38	54.14	49.67	47.93	39.47	30.68
AR	95.29	87.96	82.02	73.30	74.69	74.17	62.13
AZ	42.48	44.13	34.92	28.89	27.94	27.30	16.77
CA	39.72	40.43	37.66	34.28	33.53	34.98	25.09
CO	63.12	57.37	54.02	45.76	41.19	29.74	26.20
CT	39.85	43.28	35.45	50.00	39.03	39.78	32.71
DC	15.38	15.38	15.38	15.38	15.38	15.38	11.54
DE	62.07	58.62	56.90	56.90	50.00	39.66	27.59
FL	23.01	23.86	18.74	11.87	9.00	13.12	6.63
GA	66.09	59.74	49.49	43.58	40.35	37.03	26.91
HI	97.78	91.11	83.33	60.00	52.22	63.33	41.11
IA	90.98	90.55	79.45	79.56	71.76	54.63	44.43
ID	87.15	84.34	76.31	68.27	66.67	59.04	44.40
IL	68.20	69.99	64.29	58.59	56.49	54.05	41.43
IN	71.76	71.51	63.66	54.07	50.29	50.29	38.95
KS	85.57	71.72	70.85	56.85	57.87	55.10	42.57
KY	89.17	85.96	78.79	75.28	70.97	74.33	59.97
LA	70.28	66.03	56.90	48.20	49.47	50.32	27.60
MA	50.81	51.81	49.19	51.61	45.56	32.46	25.00
MD	51.63	54.06	48.96	50.58	46.42	43.88	34.41
ME	93.93	92.46	86.37	90.27	81.08	71.74	56.65
MI	57.11	58.30	53.98	43.25	35.21	34.55	21.39
MN	75.96	77.19	67.84	62.34	57.19	62.22	45.38
MO	79.55	76.65	70.56	65.18	63.86	61.12	46.54
MS	90.63	72.80	61.66	53.89	57.51	49.48	28.50
MT	94.36	91.22	85.27	81.50	80.25	79.31	68.97
NC	72.63	56.37	47.02	41.19	31.53	35.45	17.46
ND	97.32	96.24	95.70	94.35	95.71	91.96	87.40
NE	95.77	81.98	83.22	70.67	65.49	66.19	46.55
NH	73.36	63.60	55.26	67.11	56.58	46.05	19.57
NJ	29.53	26.63	28.80	32.07	20.43	14.83	7.59
NM	81.56	78.93	75.00	66.43	63.35	66.19	47.52
NV	55.15	54.68	49.64	36.69	39.04	42.47	26.35
NY	58.68	57.62	58.31	61.69	50.78	42.31	35.11
OH	58.27	54.48	42.17	34.48	20.93	27.84	16.07

OK	85.88	76.70	73.81	61.56	59.42	62.14	52.62
OR	72.56	67.95	64.36	58.21	52.16	59.03	45.18
PA	63.99	61.66	60.37	57.99	49.19	54.40	46.38
PR	100.00	86.55	89.08	13.45	59.66	31.09	8.40
RI	47.30	45.95	43.24	51.35	41.89	31.08	31.08
SC	78.36	56.46	48.81	42.74	30.34	37.20	22.05
SD	95.81	93.54	91.57	91.01	90.40	86.44	75.07
TN	71.76	64.34	56.88	56.22	44.44	49.42	34.99
TX	62.99	53.24	45.56	33.64	27.99	34.97	26.30
UT	68.18	65.45	60.45	54.09	44.59	47.30	35.59
VA	73.82	64.69	56.52	50.95	47.27	52.49	38.11
VT	86.59	78.05	82.52	71.14	60.73	67.61	32.79
WA	58.51	58.37	50.57	46.20	40.23	41.56	31.50
WI	79.86	72.22	62.78	52.36	48.75	53.61	37.36
WV	97.96	93.19	88.66	94.07	88.24	84.95	79.24
WY	92.91	89.36	86.52	79.43	73.05	57.45	60.28
Nationwide	69.35	64.94	59.39	54.19	49.22	48.63	36.89

Table 10-5 Percent of Year 2000 Population, Level 2 Disconnected Zips

	2005.06	2005.12	2006.06	2006.12	2007.06	2007.12	2008.06
AK	100.00	70.65	100.00	70.65	63.62	63.62	63.62
AL	59.27	35.83	21.16	18.52	17.57	11.66	8.15
AR	78.23	44.55	34.40	23.98	28.85	26.31	15.31
AZ	10.06	10.02	6.41	4.69	5.01	5.43	2.31
CA	6.42	7.47	5.48	4.53	3.89	4.42	1.86
CO	15.69	11.73	8.46	5.48	4.55	2.54	1.52
CT	11.79	12.88	9.01	23.33	15.56	14.02	10.36
DC	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DE	26.14	23.36	30.34	24.48	17.82	8.85	3.11
FL	6.35	6.58	5.00	2.12	1.31	2.17	0.69
GA	26.30	19.68	13.08	9.72	9.81	7.25	5.25
HI	96.13	83.94	70.25	11.89	7.67	15.09	4.65
IA	54.50	52.90	29.48	31.34	24.94	13.34	9.06
ID	41.35	37.92	21.18	15.51	14.98	11.47	6.73
IL	15.23	17.07	13.25	10.71	10.69	8.71	5.03
IN	33.67	29.95	23.18	17.26	17.56	13.21	8.40
KS	37.30	20.42	20.91	12.03	11.23	9.86	6.11
KY	55.38	45.77	32.56	29.42	27.27	28.60	16.69
LA	31.10	24.82	17.13	12.57	14.15	14.10	4.84
MA	20.89	21.47	22.55	24.12	19.55	9.40	5.71
MD	11.09	11.55	10.47	10.53	8.88	8.08	4.95
ME	67.44	61.93	48.86	57.69	45.39	32.89	18.02
MI	17.70	18.96	17.46	10.96	7.89	7.09	3.47
MN	25.09	26.66	18.59	14.94	13.50	15.07	7.93
MO	30.73	25.88	21.28	16.67	16.53	14.94	8.16
MS	70.52	33.47	21.68	17.30	19.00	14.82	5.45
MT	56.26	44.73	30.63	23.28	25.52	22.70	14.51
NC	41.85	20.23	16.06	12.31	8.50	9.58	2.77
ND	67.56	59.77	52.57	46.69	54.42	46.46	34.26
NE	77.99	46.22	38.36	26.68	17.47	18.01	8.38
NH	32.94	24.79	19.56	28.57	23.00	14.77	3.63
NJ	12.03	9.20	10.60	13.29	6.25	4.20	0.92
NM	23.83	20.13	15.90	11.62	10.23	12.40	4.81
NV	14.67	12.48	10.38	5.51	3.29	5.89	1.46
NY	12.89	12.50	14.22	19.08	11.92	7.02	4.71
OH	25.44	19.02	12.36	8.79	4.60	6.15	2.89

OK	54.47	34.80	30.38	16.64	16.57	16.32	11.22
OR	23.59	17.50	15.05	11.38	8.49	13.92	6.01
PA	20.93	19.40	19.14	17.64	12.17	14.68	10.46
RI	12.20	11.51	11.06	17.28	11.21	4.94	5.03
SC	51.81	23.42	19.37	13.02	7.27	10.14	3.99
SD	60.39	49.19	43.83	43.92	44.26	36.80	26.07
TN	34.62	24.06	18.17	17.49	11.30	14.49	8.20
TX	25.19	14.61	12.02	5.71	3.84	5.77	2.95
UT	16.97	12.09	9.39	6.20	4.24	4.34	2.68
VA	26.98	18.01	13.16	10.84	9.79	11.77	5.94
VT	47.23	38.41	44.96	30.93	21.50	29.77	8.09
WA	16.74	15.63	10.15	9.06	5.98	7.05	3.72
WI	41.26	29.36	23.01	15.74	14.72	17.10	8.84
WV	80.86	60.96	48.92	65.24	46.21	41.57	32.73
WY	59.29	42.67	30.34	22.95	17.58	8.20	9.39
Nationwide	24.72	19.16	15.43	12.89	10.29	9.63	5.35

In terms of year 2000 population shares, a very similar picture is produced. Alaska leads, with about 64 percent of its year 2000 population found in Level 2 disconnected zips in June 2008. The Dakotas and West Virginia have more than a quarter of their populations living in Level 2 disconnected zips. Montana, Arkansas, Kentucky, Maine, and Oklahoma have more than 11 percent of their population in Level 2 disconnected zips. If we drew this line at 10 percent or more of the population in such zips, we would add Connecticut and Pennsylvania to our list in June 2008.

Tables 10-6 and 10-7 tabulate the distribution of Level 3 disconnected zips. Nationwide, 77 percent of zips
p. 180 were Level 3 disconnected in June 2008. ↳

p. 181 ↳

The usual suspects (Alaska, the Dakotas, West Virginia, Montana, Arkansas, Kentucky, and Wyoming) had 60 percent or more of their zips Level 3 disconnected in June 2008. If we draw the line at 50 percent, Maine and Oklahoma are added to the list.

Table 10-6 Percent of Zip Codes, Level 3 Disconnectedness (< 12 Providers)

	2005.06	2005.12	2006.06	2006.12	2007.06	2007.12	2008.06
AK	100.00	100.00	100.00	100.00	100.00	100.00	100.00
AL	98.51	95.70	91.23	87.75	93.86	88.23	80.10
AR	100.00	100.00	99.48	98.60	99.65	99.83	97.21
AZ	64.05	64.76	69.21	67.62	67.62	71.43	53.66
CA	64.63	65.72	73.51	80.81	76.46	76.64	59.60
CO	83.03	77.46	80.13	80.36	75.77	70.04	63.10
CT	85.71	82.09	85.07	97.01	96.28	93.68	81.78
DC	50.00	53.85	57.69	50.00	42.31	19.23	15.38
DE	93.10	94.83	100.00	100.00	96.55	81.03	56.90
FL	63.58	55.34	77.78	59.80	58.46	61.28	41.82
GA	83.41	78.64	77.20	77.78	77.67	78.24	69.93
HI	100.00	100.00	100.00	100.00	100.00	100.00	97.78
IA	99.78	99.78	97.91	98.90	97.82	94.33	88.86
ID	97.99	95.58	92.77	92.77	95.98	90.76	86.40
IL	83.74	84.32	87.41	89.47	90.24	87.41	77.67
IN	93.01	90.55	94.19	91.57	93.90	91.86	83.58
KS	97.52	96.06	97.96	95.04	93.88	94.61	87.32
KY	97.89	98.88	98.74	97.05	96.63	96.63	90.87
LA	90.45	86.84	95.97	81.53	86.41	86.20	79.62
MA	84.07	82.26	84.88	89.31	87.70	82.66	73.19
MD	76.51	73.78	78.89	78.65	72.52	73.44	65.13
ME	100.00	100.00	99.27	99.51	100.00	99.02	94.58
MI	81.56	85.18	88.61	87.61	84.88	83.66	72.22
MN	88.10	89.59	87.02	84.44	84.44	86.67	81.99
MO	93.69	94.52	99.19	96.55	96.55	95.23	84.15
MS	99.74	96.63	94.56	84.46	91.45	88.08	76.17
MT	99.37	99.69	97.49	97.49	99.37	97.81	94.98
NC	92.01	82.38	89.97	85.77	83.36	85.52	74.29
ND	100.00	99.73	99.19	98.66	98.93	98.66	98.12
NE	100.00	98.94	99.29	98.23	98.41	98.05	94.51
NH	92.14	89.47	90.79	95.18	96.49	94.74	83.91
NJ	80.98	70.29	86.23	84.96	77.58	67.09	43.76
NM	96.10	95.36	93.93	90.71	91.46	92.17	86.52
NV	90.44	82.01	89.93	91.37	86.30	85.62	64.19
NY	84.95	84.51	91.41	93.54	90.02	83.74	75.80
OH	91.04	87.39	91.23	91.23	87.27	86.77	73.47

OK	99.66	98.13	99.83	98.47	98.30	98.47	89.51
OR	89.74	84.10	88.21	84.62	87.02	87.79	77.66
PA	86.32	85.25	91.64	91.84	88.69	85.09	77.79
PR	100.00	100.00	100.00	98.32	100.00	100.00	99.16
RI	87.84	86.49	95.95	98.65	95.95	91.89	78.38
SC	98.68	91.03	97.36	93.14	89.18	87.34	74.02
SD	100.00	99.72	98.88	98.88	99.15	98.87	96.32
TN	90.03	84.74	88.72	89.39	85.24	88.39	75.62
TX	86.23	82.69	89.28	88.14	82.83	88.04	72.33
UT	83.18	76.36	78.64	75.45	72.07	73.87	68.47
VA	90.64	86.97	90.88	91.71	88.15	85.78	78.34
VT	100.00	99.59	100.00	98.78	98.38	99.19	91.50
WA	82.03	80.04	78.90	78.71	76.09	81.40	68.12
WI	97.92	97.36	98.33	96.81	93.89	91.81	88.33
WV	100.00	99.83	99.83	100.00	100.00	99.83	97.58
WY	100.00	100.00	100.00	97.87	99.29	96.45	96.45
Nationwide	88.52	86.55	90.31	89.40	87.88	86.94	77.34

Table 10-7 Percent of Year 2000 Population, Level 3 Disconnected Zips

	2005.06	2005.12	2006.06	2006.12	2007.06	2007.12	2008.06
AK	100.00	100.00	100.00	100.00	100.00	100.00	100.00
AL	95.85	87.48	75.26	66.18	80.75	68.32	50.59
AR	100.00	100.00	95.36	90.64	96.33	99.98	86.18
AZ	26.84	27.95	36.31	32.64	32.43	39.38	14.27
CA	36.60	38.86	52.83	64.24	54.88	55.91	28.24
CO	47.38	33.89	38.74	38.79	29.26	22.00	15.90
CT	66.82	61.16	68.44	92.85	93.04	86.15	60.32
DC	50.49	52.72	56.65	50.49	37.36	5.59	0.00
DE	81.16	85.16	100.00	100.00	94.01	57.85	21.63
FL	42.63	31.44	62.96	38.27	35.24	39.52	17.32
GA	55.27	46.25	42.20	43.03	43.77	44.39	31.17
HI	100.00	100.00	100.00	100.00	100.00	100.00	96.68
IA	98.67	97.93	84.09	91.82	84.80	69.64	45.61
ID	88.57	77.17	63.62	61.99	78.34	56.47	40.13
IL	40.03	41.74	50.94	60.69	63.16	51.78	27.74
IN	79.86	71.38	81.61	74.38	81.30	75.32	54.83
KS	85.74	79.59	86.41	72.79	72.36	72.71	44.84
KY	92.02	95.04	94.46	85.56	83.40	86.31	60.20
LA	71.46	61.82	87.10	49.39	61.10	58.62	45.38
MA	68.34	68.03	71.55	78.47	74.79	65.21	49.34
MD	42.46	36.45	46.62	44.59	30.33	33.66	20.41
ME	100.00	100.00	95.67	97.05	100.00	92.49	67.97
MI	52.02	61.51	69.36	66.23	60.40	57.82	35.06
MN	51.15	57.33	47.01	39.41	39.70	46.67	34.96
MO	73.02	77.02	95.84	83.83	83.21	79.06	41.23
MS	98.91	89.60	83.02	53.70	71.61	62.37	37.19
MT	90.89	94.99	77.56	76.46	90.89	76.13	58.27
NC	79.00	55.47	73.60	62.95	57.31	62.71	40.76
ND	100.00	92.56	85.18	77.50	79.86	77.50	71.07
NE	100.00	95.00	95.47	90.02	90.15	88.94	70.27
NH	67.78	59.34	62.83	80.63	86.32	76.95	46.94
NJ	65.21	49.44	73.05	69.19	55.74	41.91	19.39
NM	72.96	70.46	60.74	47.25	50.95	54.51	36.15
NV	72.78	47.08	67.54	73.64	60.34	55.62	20.05
NY	49.46	50.18	69.17	75.52	61.92	46.02	31.73
OH	77.22	68.47	78.87	77.41	69.31	68.23	42.94

OK	98.79	91.49	98.90	94.20	92.03	92.86	61.95
OR	66.00	46.25	61.06	48.98	57.92	57.30	30.08
PA	55.58	54.13	71.16	72.72	62.21	52.25	38.07
RI	75.10	76.23	91.00	99.11	91.88	83.95	57.86
SC	96.99	78.39	93.63	82.06	74.53	69.11	43.82
SD	100.00	94.66	83.48	83.48	87.43	83.48	63.64
TN	70.49	58.33	66.12	66.72	58.33	64.16	39.58
TX	65.62	57.23	74.21	71.48	59.61	70.91	37.43
UT	47.27	31.96	37.64	30.32	22.83	25.73	16.14
VA	68.62	55.17	67.11	71.30	59.09	49.67	34.29
VT	100.00	93.56	100.00	87.08	85.06	94.34	60.81
WA	57.57	53.02	50.81	49.22	44.87	56.68	30.01
WI	91.00	90.28	94.24	87.38	75.35	69.03	57.61
WV	100.00	98.56	99.01	100.00	100.00	97.61	80.33
WY	100.00	100.00	100.00	88.52	96.61	79.88	79.88
Nationwide	61.87	57.00	68.05	66.22	61.04	58.62	36.61

In terms of population, 37 percent of the nation's population lived in Level 3 disconnected zips. States which had 60 percent or more of their 2000 population living in such zip codes included the usual list (Alaska, Arkansas, the Dakotas, West Virginia, Kentucky, Wyoming, Oklahoma, and Maine), plus Connecticut, Vermont, Nebraska, and Hawaii.

To put a different spin on it, 63 percent of the year 2000 population lived in zip codes that were really well connected in June 2008. The best connected ↳

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area was the District of Columbia, where no zip codes were Level 3 disconnected in June 2008. Arizona, Colorado, Utah, Florida, and New Jersey all had 80 percent or more of their populations living in areas that were really well connected, while Nevada, Maryland, Delaware, Illinois, and California all had more than 70 percent of their year 2000 populations living in really well-connected zip codes.

Conclusion

The empirical analysis presented in this chapter has identified states where significant pockets of broadband disconnectedness exist. The identities of these states do not depend greatly on the particular definition of disconnectedness adopted. For the most part, the states with the highest levels of ↳

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disconnectedness—Alaska; the Dakotas and West Virginia; Montana, Arkansas, Kentucky, Wyoming, Oklahoma, and Maine—don't seem unreasonable choices. A slightly wider net, and somewhat less conventional ranking, might add Pennsylvania and Connecticut to this list.

Flipping measurement, to look instead at the really well connected, reveals that the District of Columbia leads the list, with the entire population virtually guaranteed broadband service availability. The list of states with pervasive broadband connections (more than 70 percent of the 2000 population living in zip codes with twelve or more providers in June 2008) would include not only New Jersey, Florida, California, Maryland, Delaware, and Illinois, but also, perhaps slightly more surprisingly, Arizona, Colorado, Utah, and Nevada. ↳

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Finally, it is important to remember that we may be missing a significant quality-of-service issue when we frame a broadband discussion of broadband policy using the 2005 vintage FCC definition of broadband speed. It has been argued that this so-called low-quality definition of broadband (i.e., > 200 kbps) is glossing over a new and rapidly developing issue.[31] Even if there is relatively wide availability of low-grade broadband, there may be substantially greater unevenness in access to high-quality, high data rate services that could come to define a new digital divide. This may be even truer for advanced broadband services that will define new levels of functionality in the near future.

The FCC data seem to indicate that, on the one hand, availability of some (at least low) level of broadband services seems to be a rapidly diminishing p. 188 ↳ issue for most of the US population. On the other hand, the number of providers, the degree of competition (and presumably, impacts on pricing), the quality of available service, and not the mere presence or absence of any availability at all, are likely to be the real up-and-coming issues in national policy on broadband Internet services.

Notes

1. Influential studies suggesting links between IT deployment and aggregate productivity growth include S. Oliner and D. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives* 14 (2000), 3-22; D. Jorgenson, "Information Technology and the U.S. Economy," *American Economic Review* 91 (2001), 1-32; U.S. President, Council of Economic Advisors, "The Making of the New Economy," in Economic Report of the President (2001), 25–38. A more skeptical view can be found in R. Gordon, "Does the 'New Economy' Measure Up to the Great Inventions of the Past?" *Journal of Economic Perspectives* 14 (2000): 49–74.
2. Federal Communications Commission, Industry Analysis and Technology Division, Wireline Competition Bureau, *High-Speed Services for Internet Access: Status as of December 31, 2005*, July 2006, 4.
3. Federal Communications Commission, *Fifth Report, Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996*, FCC 08–88, June 2008, 18–19.
4. Federal Communications Commission (2008), 34.
5. Federal Communications Commission, Industry Analysis and Technology Division, Wireline Competition Bureau, *High-Speed Services for Internet Access: Status as of June 30, 2008*, July 2009 , Table 15.
6. John B. Horrigan, *Home Broadband Adoption 2006*, Pew Internet and American Life Project, May 2006; John B. Horrigan, *Home Broadband Adoption 2009*, Pew Internet and American Life Project, June 2009.
7. Seventeen percent of dial-up Internet users in Pew's April 2008 survey said that broadband service was unavailable where they live (Horrigan 2009).
8. Ken Belson, "Rural Areas Left in Slow Lane of High-Speed Data Highway," *New York Times*, September 28, 2006, A1.
9. Such voluntarily reported lines accounted for less than .05 percent of high-speed lines in recent submissions. Federal Communications Commission, Industry Analysis and Technology Division, Wireline Competition Bureau, *High-Speed Services for Internet Access: Status as of December 31, 2003*, June 2004, 2.
10. Federal Communications Commission, Industry Analysis and Technology Division, Wireline Competition Bureau, *High-Speed Services for Internet Access: Status as of June 30, 2006*, December 2006, Table 7. I thank Scott Wallsten for first bringing this point to my attention.
11. My source for the "typical" numbers here is an ESRI PowerPoint presentation.
12. This has the practical effect of making most if not all prior research using this (pre-June 2005) data, which typically assumed that "geographic" zip codes not disclosed in the FCC list of zip codes with broadband service constitute the "no service" zip codes, deeply flawed. Examples of research making this erroneous assumption include J. E. Prieger, "The Supply Side of the Digital Divide: Is There Equal Availability in the Broadband Internet Access Market?" *Economic Inquiry* 41 (2003); K. Flamm, "The Role of Economics, Demographics, and State Policy in Broadband Availability," presented at the PURC/London Business School Conference on "The Future of Broadband: Wired and Wireless, 2005," University of Florida, Gainesville, 2005. My initial, incorrect, and sometimes conflicting misunderstandings of FCC procedures were derived from a teleconference with FCC staff in January 2005, and a follow-up discussion in September 2006.
13. Federal Communications Commission (July 2009), 4n8.
14. Tony H. Grubesic, "Zip Codes and Spatial Analysis: Problems and Prospects," *Socio-Economic Planning Sciences* 42 (2008): 136–137.

15. ZCTA-based Census data are approximations corresponding to actual zip codes. Their construction is explained at http://www.census.gov/geo/ZCTA/zcta_brch_prnt.pdf, and http://www.census.gov/geo/ZCTA/zcta.html. I have discarded "artificial" ZCTAs (unclassified areas, or areas consisting of bodies of water), which do not have a corresponding "real" zip code in the analysis that follows. The census data correspond to the estimates in the Census SF-3 (long form) database, and were taken from the "Gazeteer" ZCTA file available at http://www.census.gov/geo/www/gazetteer/places2k.html, and from the version of the Census SF-3 database as extracted and made accessible at the University of Missouri's Missouri Census Data Center through http://mcdc2.missouri.edu/cgi-bin/uexplore?/pub/data/sf32000x. I have omitted 1,152 additional alphanumeric "HH" and "XX" codes defined by the US census to cover primarily water and unpopulated areas from this count.
16. These are available in various annual revisions of IRS Publication 3496, downloadable from the IRS website.
17. There is also a possible matching issue with the population and income data that the FCC has used in its six-month reports on broadband availability. The FCC in its public reports on high-speed service combines these provider numbers by zip code with 2000 census population estimates by zip code, to construct an estimate of the percentage of the year 2000 US population living in US zip codes with at least one service provider. The 2000 population estimates (and ancillary year 2000 data on zip code area and median household income by zip) apparently come from yet another proprietary data source, Mapinfo's Demographic Power Pack, Current Year Update (2000). It is unclear that there is any necessary relationship between Mapinfo's 2000 zip code boundaries—even if the zip code numbers were to match up perfectly, which is most unlikely, given the constant morphing of the FCC zip codes in use—and the current TeleAtlas/GDT definitions. There is no discussion of this issue in any FCC publication that I have been able to locate.
18. A final point to make is that as part of a program intended to encourage the development of e-filing, the IRS publishes information on precise numbers of approved e-Filing service vendors, and operating e-filing companies, by zip code. This information on number of vendors by zip code is either not deemed sensitive or business confidential by the IRS, or the objective of encouraging entry and growth in e-filing of tax returns was thought to outweigh any such concerns. The FCC, by way of contrast, has refused to reveal analogous data (number of vendors by zip code) for high-speed service providers on grounds of business information sensitivity (one to three providers have always been lumped into a single bin). Clearly, there does not seem to be some immutable principle obstructing disclosure in one case, but not the other, and the objective of encouraging broadband deployment would seem to be at least as worthy as—indeed, complementary to—the goal of encouraging e-filing.
19. Until recently, my neighborhood was beyond the three-mile range for a DSL connection from a DSL-capable central office telephone switch, and DSL-based service was unavailable. The hilly neighborhood I live in also may lack the clear, unobstructed view of the southern horizon needed for higher cost satellite service. The broadband service I purchased is actually an Earthlink-branded service (my ISP appears to be Mindspring.com when my IP is identified on the Internet). Earthlink has agreements with Time Warner to market this service in a number of US markets. FCC instructions on its Form 477 website seemed to require Time Warner, and not Earthlink, to report my broadband connection: "An ISP that obtains a broadband connection or service from an unaffiliated entity, which it incorporates into its own high-speed Internet-access service, is exempt from reporting broadband connections in Part I of Form 477. Instead, the obligation to report the broadband connection rests with the underlying facilities-based provider." See http://www.fcc.gov/broadband/broadband_data_faq.html, question 10.
20. Belson.
21. Government Accountability Office, "Broadband Deployment is Extensive Throughout the United States, but It Is Difficult to Assess the Extent of Deployment Gaps in Rural Areas," May 2006, 18. Adjustments the GAO (which had access to the proprietary data in the FCC database) made included removing satellite-only service providers, business-only service providers, DSL-based service providers to residences more than 2.5 miles from a central office, and not double-counting cable service operators serving disjoint groups of households in a zip code.
22. Ibid., 17.
23. The Pew data actually use survey weights to estimate the number of adults in households with broadband connections, so it would also seem possible that the number of adults in households might vary systematically between areas primarily served by cable and areas primarily served by DSL, perhaps explaining a small part of the discrepancy.
24. Possible explanations include respondent error in the Pew and GAO/SRI surveys (people thinking that their telephone line connections are broadband when they are not), sample bias (homes without a conventional landline telephone, who are therefore excluded from many telephone-based sampling frames, would be more likely to use cable for a broadband connection), and the (unlikely?) possibility that a significant number of residences may have multiple broadband connections.
25. FCC (July 2006), Table 3.
26. Government Accountability Office, 10.
27. Note that cable providers provide broadband services to office premises passed by their cable infrastructure in many instances.
28. This analysis is based on Table 14 in FCC's Form 477 reports, for June 2005 and June 2008. The numbers shown are the share of households where ILECs offered telephone service where xDSL (including both symmetric and asymmetric variants) was also offered, and the share of households with cable TV service that also had access to cable modem service.
29. Having no zero provider zip codes, once it occurs, is not necessarily a permanent state. I note that Kentucky went from having over 3 percent of its zip codes with no providers in December 2006, to no zip codes with zero providers in June 2007, to over 3 percent of its zip codes once again with zero providers in December 2007!
30. To undertake this task, I made use of the Missouri Census Data Center's MABLE/Geocorr2K geographic correspondence engine, available at http://mcdc2.missouri.edu/websas/geocorr2k.html.

31. See for example, K. Flamm, A. Friedlander, J. B. Horrigan, and W. Lehr, “Measuring Broadband: Improving Communications Policymaking through Better Data Collection,” 2007, http://www.pewinternet.org/PPF/r/227/report_display.asp.