



Contents lists available at ScienceDirect

Telecommunications Policy

URL: www.elsevierbusinessandmanagement.com/locate/telpol

Efficiency in broadband service provision: A spatial analysis

Tony H. Grubescic

Department of Geography, Indiana University, Bloomington, IN 47405, USA

ARTICLE INFO

Keywords:

Broadband
Spatial analysis
Data envelopment analysis
United States
Regional development
Competition

ABSTRACT

With the 2008 Federal Communications Commission (FCC) order amending both the definition of broadband and its data collection practices, the problems associated with data integrity and ZIP code aggregations in the United States will soon be forgotten. However, between 1999 and 2007, FCC Form 477 data remain the only viable, nationwide database of broadband provision in the United States. While broadband data from 1999–2004 and 2005–2007 are not directly comparable due to a modification in collection procedure, there is an absence of objective empirical analysis for the latter time period. Interestingly, although the FCC made the 2005–2007 data publicly available on the Internet, password protected files largely prevented analysts from accessing, manipulating and analyzing these data. The purpose of this paper is three-fold. First, the process utilized for liberating these data from their protected format and integrating them into a geographic information system (GIS) is outlined. Second, the spatial distribution of broadband provision in the United States for 2005–2007 is explored. A mathematical programming approach is also utilized for comparing the relative efficiencies of ZIP code areas in acquiring broadband service given their demand-side socio-economic and demographic determinants. Finally, implications for public policy, particularly those associated with developing local and regional benchmarks for broadband provision, competition and access, are addressed.

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1. Introduction

In June 2008, the Federal Communications Commission (FCC) released a Report and Order and Further Notice of Proposed Rulemaking (*Form 477 Order*) that modified several important elements of the Form 477 data collection program for broadband (FCC, 2008). First, providers are required to document and report broadband speed data (upload and download) for customers and categorize them into one of three tiers, ranging from 200 kbps to 10 mbps. Second, the *Form 477 Order* requires that mobile wireless broadband providers report the number of subscribers whose data plans permit access to the Internet. Third, and perhaps most importantly, Form 477 is modified to require that broadband providers report the number of broadband connections at the Census tract level.

These changes represent a marked departure from existing broadband data collection efforts by the FCC. Between 1999 and 2007, there were two basic versions of the broadband provision data available for public use. Between 1999 and 2004, the FCC required that all facilities-based providers with at least 250 high-speed lines in a single state file a Form 477 report.¹ However, beginning in June 2005, the FCC modified its reporting requirements, mandating that all providers with

E-mail address: tgrubesi@indiana.edu

¹ High-speed lines are those that have a minimum of 200 kbps in at least one direction. Advanced services lines must have 200 kbps in both directions.

at least one high-speed line in a state file a Form 477 report. As noted by Kolko (2007), while the 2005–2007 data are more complete, comparing them to 1999–2004 data is impossible.

One of the major caveats associated with all of the Form 477 data was the use of ZIP codes as the reporting units. As noted by Grubestic (2006, 2008), Flamm and Chaudhuri (2007) and many others (GAO, 2006; Flamm, Friedlander, Horrigan, & Lehr, 2007), ZIP codes are highly dynamic and fail to provide an empirically sound unit for reporting broadband provision. As a result, the change in policy mandating that providers document broadband connections at the Census tract level is a welcome one.

While the problems associated with broadband data collected and reported at the ZIP code level will soon be forgotten, the FCC Form 477 data remain the only viable, nationwide database of broadband provision in the United States between 2005 and 2007. Interestingly, although the FCC made the 2005–2007 data publically available on the Internet, their format differed from the 1999–2004 data. Instead of making broadband provider counts available in a user-friendly, Microsoft Excel worksheet (.xls), the FCC released the 2005–2007 data in a password protected Adobe Acrobat (.pdf) document. This format effectively prevented analysts from accessing, manipulating and analyzing these data. In several email exchanges with officials at the FCC, their response to requests for obtaining these data in an alternative format or the existing format without encryption was, “we have not prepared an .xls or other easily sortable/searchable version of the recent files... [and] there’s no intention to revisit the decision to allocate available staff time to producing only one version of the list” (Burton, 2007).

It is not surprising, therefore, that there is not a single published researched article dealing with the 2005–2007 data. This would require an analyst to manually enter over 32,000 records (one for each ZIP code in the United States) for each reporting period using the password protected FCC documents.

With these limitations in mind, the purpose of this paper is three-fold. First, it develops and outlines an easily repeatable and automated process for liberating these data from their protected format and integrating them into a geographic information system (GIS). Second, the spatial distribution of broadband provision in the United States for 2005–2007 is explored and a mathematical programming approach is utilized for comparing the relative efficiencies of ZIP code areas in acquiring broadband service given their demand-side socio-economic and demographic determinants. Finally, implications for public policy, particularly those associated with developing local and regional benchmarks for broadband provision, competition and access, are addressed.

2. Liberating “Public” FCC Form 477 data

As noted in the introduction, while the FCC certainly made the 2005–2007 Form 477 data available to the general public via the Local Telephone Competition and Broadband Reporting page (<http://www.fcc.gov/wcb/iatd/comp.html>), the data were provided in a “protected” Adobe Acrobat document. Protected files can limit functionality and user access in several ways. For example, password protection in Adobe Acrobat can include locking the print function for a document (i.e. disable printing), encrypting the document contents (i.e. preventing search engines from accessing metadata) and disabling the copying of text, content or images, etc. It is the latter that proved to be a major problem for utilizing these data. The FCC password protected each of the reports, beginning in June 2005, disabling the copy command in the Acrobat documents. As a result, if analysts wanted to use these data, they were forced to manually enter each record in a database instead of copying and pasting this information into a more user friendly format. For obvious reasons, this severely limits one’s ability to make use of these data, let alone integrate them into a GIS or statistical analysis package for investigation.

While this type of low-level encryption and protection of data is annoying and counterproductive to analysts working on issues of broadband and public policy, there are options for automating the extraction process of these data. Using a combination of relatively low-cost software applications, these data were extracted from the protected Acrobat documents and integrated into a geographic information system for analysis.

2.1. Unlocking and extracting the FCC data

The first step in liberating the Form 477 data for analysis was to unlock the password protected Adobe Acrobat files, essentially removing the function that disabled copying and editing these data/documents. This was accomplished with the “Atomic PDF Password Recovery” program (Atomic PDF, 2008). Retailing for \$25, it uses a simple graphical interface for guiding users through the process of releasing restrictions from any .pdf document. Once released, analysts can copy, edit and manipulate the FCC data freely. For example, if one was interested in provider counts for a particular state or subset of ZIP codes, these data are now easily pasted into a more user friendly format, such as Microsoft Excel or Access. However, if one is interested in provider counts for the entire United States, the process of copying and pasting 756 pages of data for each FCC.pdf document remains daunting. This is particularly true when one considers that the copying and pasting process between .pdf and .xls often generates strange formatting and needless column headers throughout the document.

To expedite the data transfer process, a second software package, “Able2Extract” by Investintech, is utilized Able2Extract (Version 6.0) (2008). A 30 day subscription to the professional version (unlimited use) is less than \$35. Using proprietary conversion algorithms and optical character recognition technology, Able2Extract largely automates the conversion process between .pdf and many other software packages and platforms, including Microsoft Word, Excel,

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