July 2013

New collection titled: **Urban Rate Survey Data Collection**

Supporting Statement

Part B: Statistical Methodology:

B.1. The respondent universe is providers of fixed voice or fixed broadband services in urban Census tracts of the 50 United States, the District of Columbia, and Puerto Rico. We estimate the respondent universe as 903 urban providers of fixed voice services and 970 providers of fixed broadband services in 57,601 urban Census tracts. Providers will be categorized as major or minor service providers based on their estimated subscribership; this categorization will be performed separately for voice and broadband services.

The survey will collect a sample of urban rates for voice services and a separate sample of urban rates for broadband services. For each service, the sample will be selected as follows:

An urban Census tract will be selected randomly according to a probability proportional to its household population W_i. For purposes of our calculations, the number of major providers in the selected Census tract is N_1 and the number of minor providers in the selected Census tract is N_2. If $N_2 = 0$, then the probability for a major service provider to be selected is $1/N_1$. Otherwise, the group of N_2 minor providers is treated as a single major provider in the sample selection process; consequently, the probability for a major service provider to be selected is $1/(N_1+1)$ and the probability of a minor service provider to be selected is $1/[N_2 (N_1+1)]$.

Using this methodology, a sample of 500 Census tract/provider pairs will be selected to provide urban rates for each service type (i.e. fixed voice and fixed broadband). The selection process will be performed with replacement. Once the sample is selected, the survey will be organized by provider so that each provider surveyed is given a list of Census tracts for which the appropriate urban service rate is to be provided.

We anticipate the response rate will be high because compliance by those providers selected for the survey is mandatory. We will contact directly any provider that is sent a survey notification that does not complete the online survey form within 30 days. Because compliance is mandatory, failure to comply may lead to enforcement action, including forfeiture penalties, pursuant to the Communications Act of 1934, as amended, and other applicable law.

B.2. The survey will provide a sample of urban rates for voice services and a separate sample of urban rates for broadband services. For each of the two types of service, the sample will be selected as follows:

An urban Census tract will be selected randomly according to a probability proportional to its household population W_i. For purposes of our calculations, the number of major providers in the selected Census tract is N_1 and the number of minor providers in the selected Census tract is N_2. If $N_2 = 0$, then the probability for a major service provider to be selected is $1/N_1$. Otherwise, the group of N_2 minor providers is treated as a single major provider in the sample selection process; consequently, the probability for a major service provider to be selected is $1/(N_1+1)$ and the probability of a minor service provider to be selected is $1/[N_2 (N_1+1)]$.

Through this process, a sample of 500 Census tract/provider pairs will be selected to provide urban rates for that service. The selection process will be performed with replacement. Once the sample is selected, the survey will be organized by provider so that each provider surveyed is given a list of Census tracts for which the appropriate urban service rate is to be provided.

The goal of the survey is to estimate the mean and standard deviation of the distribution of offered urban rates for a given service. These estimates will then be used to estimate upper and lower limits for carrier rates; for example, the mean plus twice the standard deviation is a possible upper limit based on the approximate 97.5 percentile of a normal distribution.

The estimate of the mean is

$$\hat{\bar{R}} = \frac{\sum_{j=1}^{n} K_j Y_j}{\sum_{j=1}^{n} K_j}$$

where Y_j is the rate and K_j is the provider count for the Census tract of the *jth* sampling unit. The provider count is N_1 in Census tracts with no minor service providers and N_1+1 otherwise.

Similarly, the estimate of the standard deviation is

$$\hat{\sigma}_R = \sqrt{\frac{\sum_{j=1}^{n} K_j \left(Y_j - \hat{\bar{R}}\right)^2}{\sum_{j=1}^{n} K_j}}$$

This estimate is based on the following assumptions:

- Major service providers offer service to all households in the Census tract.
- Minor service providers offer service to a fraction of the households in the Census tract, inversely proportional to the number of competitors (other minor service providers) in the Census tract.
- The Census tracts in the sample are selected based on probability proportional to the number of households in each tract. Within a Census tract, the service providers in the sample are selected based on probability inversely proportional to the number of service providers of comparable type in the Census tract. The group of minor service providers within a Census tract is treated as a single major service provider; this process reduces the burden on smaller service providers as they are less likely to be in the sample. Estimates are calculated taking into account the probabilities of sampling unit selection.
- The universe of rates consists of all offers of specific services being surveyed. The total number of rates in the universe is $N_R = \sum_{i=1}^{U} W_i K_i$ where U is the total number of urban Census tracts.

The sample process was designed to eliminate the necessity of listing all providers in each urban Census tract. Instead, only the service providers in sampled Census tracts must be identified.

B.3. We anticipate the response rate will be high because compliance by those providers selected for the survey is mandatory. We will contact directly any provider that is sent a survey notification that does not complete the online survey form within 30 days. Because compliance with the rules is mandatory, failure to comply may lead to enforcement action, including forfeiture penalties, pursuant to the Communications Act of 1934, as amended, and other applicable law. Based on the sampling methodology described above and an anticipated high rate of compliance, the information collected should be both sufficiently accurate and reliable for the purpose of determine the rate floor and rate comparability.

B.4. Several analyses were performed to guide the selection of sample size.

A preliminary simulation experiment was designed to gauge the possible degree of bias in the estimators and the precision of the estimators for different sample sizes for the broadband portion of the survey. A distribution of offered broadband rates was generated randomly across 50 virtual service providers in 44,791 Census tracts. The Census tracts used were those in which 99% or more of the population in the tract were in urban Census blocks. In the distribution, the average number of virtual service providers per Census tract ranged from 1 to 19 with 6.8 on average. The simulation assumed all service providers were major service providers. The distribution had an average offered rate of $44.28 and a standard deviation of $5.66.

A set of 1000 samples of 200 rates using the methodology described above was generated using population for weights of Census tracts. The average of the means determined using the estimators described above was $44.30 and the average of the standard deviations was $5.64; the small difference between these values and the actual average and standard deviation indicates that bias is small. The standard deviations of the estimated mean and standard deviation were $0.43 and $0.32, respectively.

The above procedure was repeated using sample sizes of 500 and 1000 rates. The average mean was $44.28 for both and the average standard deviation was $5.66 for both; so, virtually no bias was found. The standard deviations of the estimated means were reduced to $0.27 and $0.19, respectively. The standard deviations of the estimated standard deviations were reduced to $0.21 and $0.15, respectively.

Because one goal of the survey is to establish for broadband a reasonable comparability benchmark based on the estimated mean and standard deviation, it is useful to examine the precision of such a benchmark. The standard deviation for a 95th percentile estimate[1] was $0.67, $0.42 and $0.30 for sample sizes 200, 500, and 1000, respectively. The rate floor would have the same precision.

The simulation indicates substantial improvement in precision between sample sizes of 200 and 500. While the precision also improved further for a sample size of 1000, we believe such small improvement in precision does not justify doubling the number of providers surveyed . For this reason, a sample size of 500 was selected.

[1] Mean + 1.645 x Standard Deviation

Another analysis was based on broadband prices from the 2011 Current Population Survey (CPS).[2] The mean and standard deviation of monthly broadband prices for households with DSL, Cable, or Fiber broadband service were $40.85 and $15.80, respectively. Assuming that offered monthly prices follow a normal distribution with these parameters, sample sizes of 500 and 1000 would produce margins of error at a 95% level of confidence for the following estimates:

Sample Size	Mean	Standard Deviation	Mean ± 1 SD	Mean ± 2 SD
500	$1.38	$0.98	$1.70	$2.41
1000	$0.97	$0.69	$1.20	$1.70

Thus, for example, an estimated upper limit (mean plus 2 standard deviations of the price distribution) would be $72.45 ± $2.41 based on a sample of 500 prices and $72.45 ± $1.70 based on a sample of 1000 prices. We consider the analysis based on the CPS data a worst case for the following reasons:

- CPS data include rural households as well as urban households.
- CPS data are for prices paid by subscribers while the survey is intended to capture advertised prices. Prices paid would tend to be more variable as they include variable elements such as discounts and promotions.
- With respect to price, responses by household owners are less reliable than responses from service providers.
- The CPS data provided no information on the grade of service. Information gathered in the survey will be used to provide some constraints on service grades to make the prices more comparable.

All of the above elements lead to greater variability in the CPS data than in the data collected in the proposed survey. Consequently, we anticipate that the margins of error for estimates of the survey will lie somewhere between those from the simulation based on the 2005 data and those based on the 2011 CPS data.

A similar analysis was performed for voice services based on flat-rate prices.[3] The weighted mean and standard deviation of monthly prices were $25.81 and $5.75 respectively. Assuming that monthly prices follow a normal distribution with these parameters, sample sizes of 500 and 1000 would produce margins of error at a 95% level of confidence for the following estimates:

Sample Size	Mean	Standard Deviation	Mean ± 1 SD	Mean ± 2 SD
500	$0.51	$0.36	$0.62	$0.88
1000	$0.36	$0.25	$0.44	$0.62

[2] Parameters in generating the distribution were based on FCC staff calculations using data on standalone, fixed broadband prices reported by households in the Census Bureau's Current Population Survey July 2011 Supplement.

[3] *Reference Book of Rates, Price Indices, and Household Expenditures for Telephone Service*, FCC, 2008.

Thus, for example, an estimated upper limit (mean plus 2 standard deviations of the price distribution) would be $37.31 ± $0.88 based on a sample of 500 prices and $37.31 ± $0.62 based on a sample of 1000 prices. An estimated lower limit (mean minus 2 standard deviations of the price distribution) would be $14.31 ± $0.88 based on a sample of 500 prices and $14.31 ± $0.62 based on a sample of 1000 prices.

B.5. The individuals within the agency who consulted on the statistical aspects of the design are:

Jay Bennett, Mathematical Statistician, 202-418-2761

Jay Schwarz, Industry Economist, 202-418-0948

Rodger Woock, Supervisory Industry Economist and Division Chief, 202-418-1560

The survey data will be collected and analyzed by these same individuals and other Industry Analysis & Technology Division of the Wireline Competition Bureau staff. We do not anticipate seeking assistance from outside the agency unit.