

## SUPPORTING STATEMENT

**Part B: Statistical Methodology:**

B.1. The specifics of the survey design described here (e.g., strata definitions, sample sizes) were based on data collected in the 2015 Urban Rate Survey. It is a specific example of the general template for designs of future Urban Rate Surveys. 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 846 urban providers of fixed voice services and 1,158 providers of fixed broadband services in 58,000 urban census tracts. Each (service provider, census tract) pair will be assigned an offer weight reflecting the number of households offered service by the provider in the census tract. This weight will be calculated as

$$\text{Provider Presence Ratio} \times (\text{households in the census tract})$$

where

$$\text{Provider Presence Ratio} = 1/(1 + 10^{-Y}),$$

$$Y = 1.75315 + 0.96111 \text{ Log}_{10}(X/(1-X)), \text{ and}$$

$$X = \text{residential subscribers for provider in the tract} / \text{households in the tract.}^1$$

The survey will collect a sample of urban rates for voice services and a separate sample of urban rates for broadband services. In both cases, the sampling unit will be a (service provider, census tract) pair.

For the voice survey, the sampling units will be divided into two strata depending on whether the service provider is an incumbent local exchange carrier (ILEC) or Non-ILEC. A sample of 255 ILEC and 245 Non-ILEC sampling units will be selected randomly from their respective strata; the selection will be weighted proportionately by the offer weight and will be performed with replacement.

For the broadband survey, the sampling units will be divided into 24 strata. Past Urban Rate Surveys demonstrated that for many of the service providers (particularly the large national service providers), the rates offered for broadband services did not vary across census tracts. Stratification will allow us to reduce the number of survey responses requested in such cases while still capturing the offered rates in accordance with their estimated effect on the reasonable comparability benchmark. The following 22

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<sup>1</sup> We used a regression model to estimate the proportion of the census tract's households to which a service provider offers service. The regression was developed from data relating broadband provider presence to broadband provider subscription. Linear regression was used to regress  $\text{Log}_{10}(p/(1-p))$  on  $\text{Log}_{10}(s/(1-s))$ , where  $p$  is the fraction of housing units covered by the broadband provider in the census tract and  $s$  is the provider's broadband subscriber fraction of households in the tract. This assumes that the relationship of voice provider presence to voice subscribership is similar to that of broadband provider presence to broadband subscribership.

strata will sample the number of sampling units shown from the service providers indicated in parentheses for a total of 500 sampling units:

- AT&T (AT&T Services, Inc.) - 16
- COMCAST (COMCAST CABLE COMMUNICATIONS, INC.) - 50
- Verizon New York Inc. (Verizon New York Inc.) - 1
- Verizon Pennsylvania LLC (Verizon Pennsylvania LLC) - 1
- Verizon New Jersey Inc. (Verizon New Jersey Inc.) - 1
- Verizon California Inc. (Verizon California Inc.) - 1
- Verizon New England Inc. (Verizon New England Inc.) - 1
- Verizon Virginia LLC (Verizon Virginia LLC) - 1
- Verizon Maryland LLC (Verizon Maryland LLC) - 1
- Verizon Florida LLC (Verizon Florida LLC) - 1
- Verizon Delaware LLC (Verizon Delaware LLC) - 1
- GTE Southwest Incorporated dba Verizon Southwest (GTE Southwest Incorporated dba Verizon Southwest) - 1
- Verizon Washington, DC Inc. (Verizon Washington, DC Inc.) - 1
- Time Warner (Time Warner Cable Inc.) - 52
- CenturyLink (CenturyLink, Inc., CenturyLink Communications, LLC) - 6
- Cox (Cox Communications) - 6
- Charter (Charter Communications, Inc.) - 5
- Frontier (Frontier Communications Corporation) - 13
- CSC Holdings (CSC Holdings LLC) - 5
- Bright House (Bright House Networks, LLC) - 5
- Windstream (service providers identifying Windstream as their holding company) - 5
- WideOpenWest (Knology and WideOpenWest) - 5

The remaining sampling units will be divided into two strata based on the offer weight of the sampling unit:

- Major (Remaining sampling units with offer weight greater than or equal to 500) - 272

- Minor (Remaining sampling units with offer weight less than 500) - 49

The sample sizes for each stratum are a reflection of the offer weights in the stratum and the estimated variability of offered rates from the previous Urban Rate Survey. Sampling units will be selected randomly from each stratum, unweighted and without replacement.

Once each 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 collect a sample of urban rates for voice services and a separate sample of urban rates for broadband services. In both cases, the sampling unit will be a (service provider, census tract) pair.

For the voice survey, the sampling units will be divided into two strata depending on whether the service provider is an incumbent local exchange carrier (ILEC) or Non-ILEC. A sample of 255 ILEC and 245 Non-ILEC sampling units will be selected randomly from their respective strata; the selection will be weighted proportionately by the offer weight and will be performed with replacement.

For the broadband survey, the sampling units will be divided into 24 strata. Past Urban Rate Surveys demonstrated that for many of the service providers (particularly the large national service providers), the rates offered for broadband services did not vary across census tracts. Stratification will allow us to reduce the number of survey responses requested in such cases while still capturing the offered rates in accordance with their estimated effect on the reasonable comparability benchmark. The following 22 strata will sample the number of sampling units shown from the service providers indicated in parentheses for a total of 500 sampling units:

- AT&T (AT&T Services, Inc.) - 16
- COMCAST (COMCAST CABLE COMMUNICATIONS, INC.) - 50
- Verizon New York Inc. (Verizon New York Inc.) - 1
- Verizon Pennsylvania LLC (Verizon Pennsylvania LLC) - 1
- Verizon New Jersey Inc. (Verizon New Jersey Inc.) - 1
- Verizon California Inc. (Verizon California Inc.) - 1
- Verizon New England Inc. (Verizon New England Inc.) - 1
- Verizon Virginia LLC (Verizon Virginia LLC) - 1
- Verizon Maryland LLC (Verizon Maryland LLC) - 1

- Verizon Florida LLC (Verizon Florida LLC) - 1
- Verizon Delaware LLC (Verizon Delaware LLC) - 1
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- CenturyLink (CenturyLink, Inc., CenturyLink Communications, LLC) - 6
- Cox (Cox Communications) - 6
- Charter (Charter Communications, Inc.) - 5
- Frontier (Frontier Communications Corporation) - 13
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The sample sizes for each stratum are a reflection of the offer weights in the stratum and the estimated variability of offered rates from the previous Urban Rate Survey. Sampling units will be selected randomly from each stratum, unweighted and without replacement.

Once each 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

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

where  $Y_j$  is the rate and  $K_j$  is the weight of the  $j$ th sampling unit. Similarly, the estimate of the standard deviation is

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

Estimates will take the following considerations into account:

- For the voice survey, the sample will be selected based on probability proportional to the offer weight of each sampling unit. Consequently, the weight  $K_j$  in the above equations will be equal to 1 when estimating the mean and standard deviation within one of the strata.
- For the broadband survey, the sample will not be selected based on probability proportional to the offer weight of each sampling unit. Consequently, the weight  $K_j$  in the above equations will be equal to the offer weight when estimating the mean and variance within one of the strata.

When estimating the mean across strata, the means of the strata will be combined by weighting according to the proportion of the total offer weight for the stratum with respect to the universe. Similarly, when estimating the standard deviation across strata, the variances of the strata will be combined by weighting according to the proportion of the total offer weight for the stratum with respect to the universe.

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 benchmarks.

B.4. The sample sizes for the voice survey strata will be equal to those successfully used in the 2015 Urban Rate Survey. The implementation of a new stratum structure for the broadband survey required further analysis to calculate appropriate sample sizes for the individual strata. The objective was to use the same survey sample size as in last year's survey (500). The sample size for each stratum was calculated using the following formula:

$$\text{Stratum Sample Size} = 500 \times \text{Stratum SD} \times [\text{Stratum Units} \times \sum \text{Offer Weights}]^{1/2} / T$$

where  $T = \sum [\text{Stratum SD} \times [\text{Stratum Units} \times \sum \text{Offer Weights}]^{1/2}$  over all strata.

Stratum SD is an estimate of the standard deviation of rates by service plan for the service providers in the stratum. Stratum SD was based on fixed broadband service rates provided in last year's Urban Rate Survey. For a particular stratum identified with a service provider, all service rates were partitioned by service plan according to download speed, upload speed, and usage allowance. The variance of rates was calculated for each service plan. The Stratum SD was calculated as the square root of the average of these variances. For the Major and Minor strata, the standard deviation was calculated by applying the above procedure to all service plans from last year's broadband Urban Rate Survey.

Separate Stratum SDs were calculated 1) based on all service plans and 2) based only on service plans with download speeds between 2 and 40 Mbps, inclusive. The Stratum SD used for calculating the Stratum Sample Size was the average of these two SD values. This process gave extra weight to those service plans used in the analysis to determine fixed broadband benchmark rates in prior years. In some cases, the stratum had no variance of rates in the past survey. Such strata were assigned the minimum positive standard deviation of rates among the strata for purposes of the calculation described above. Finally, adjustments were made to the sample sizes so that a minimum of 5 sampling units is in each stratum except for Verizon which was split into multiple strata, each with one sampling unit.

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

Jay Bennett, Mathematical Statistician, 202-418-2761

Craig Stroup, Industry Economist, 202-418-0989

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.