

CONSTRUCTION OF CELLULAR RDD SAMPLING FRAMES BASED ON SWITCH LOCATIONS

Constructing cellular sampling frames for small geographic domains is subject to both operational and definitional challenges. Many of such challenges are due to the simple fact that, unlike landline telephone numbers, cellular numbers are assigned to mobile devices that may be located across the nation – if not the globe. In spite of this indeterminable mobility, however, most US cellular telephone numbers are assigned to exchanges that are native to specific locations as is the case with landline telephone numbers. Cognizant of these dynamics, MSG has developed a methodology for constructing cellular sampling frames for small areas based on the location each 1000-series block of cellular numbers is associated with. While not a one-to-one correspondence, with this methodology it is possible to identify the broader area (e.g., county) where the subscriber of a specific cellular number has a higher likelihood of residing.

Briefly, the North American Numbering Plan Administration (NANPA) is the governing body that regulates the assignment of all area codes, exchanges, and 1000-series blocks of telephone numbers in the US. The NANPA assignment protocols, which tend to be location-centric, apply uniformly to all types of numbers including those used for landline, cellular, and paging services. While area codes conform to state boundaries, for 1000-series blocks Switch Centers¹ serve as the basic unit of geography for the telecom industry. Moreover, newly activated cellular numbers are assigned within a finite set of 1000-series blocks allocated to these switch centers.

Given that each switch center has a unique latitude and longitude, cellular switch centers and the set of 1000-series blocks they serve can be identified and included in the sampling frame for specific geographic locations. Unlike landlines for which their associated centers blanket the entire country, cellular switch centers tend to cluster around larger population centers. As such, in metro areas with high volume of telephone calls there can be many cellular switch centers whereas in rural areas such centers may cover several counties. In fact, less than half of the counties in the US have dedicated cellular switch centers. Consequently, the proposed methodology tends to have better coverage properties in populated areas. In order to better understand this situation, in what follows a brief description of the US cellular network topology is provided.

When a call is initiated by a cellular device the resulting signal is detected by the nearest Cell Site, which typically includes a tower or other elevated structure for mounting antennas and associated equipments for signal transmission. Most cell sites are connected to switch centers on a wired network, while others may rely on microwave technology for transmitting information through radio waves. Once a call has been detected and transmitted – either over the wired network or radio waves – the corresponding switch center determines the destination point for the given call and routes it out on the US telephony network. If the destination is a wired residence or business, the call is routed to the local Central Office to be connected to its final destination point. When the destination point is another cellular telephone, however, the closest cell site to the cellular device is identified in order to route the call to the corresponding switch center.

Since in rural areas cell sites and their controlling switch center can be far apart, cellular frame construction in such instances may require inclusion of switch centers that are well outside of the target geography. While improving coverage, however, this inevitable dilution of the frame will increase the likelihood of reaching individuals who reside outside of the geography of interest. As such, determining the optimal set of rural switch centers for a small geographic location is somewhat indecisive and subject to under- and over-coverage.

¹ Switch or wire centers describe the organization of the local telephone exchange system, with each center serving a unique set of exchanges and their associated telephone numbers.