5.2.1. Estimating change of residence

**Basic assumptions.** To define a change of residence, home locations have to be assigned. Some scholars are offering the method discussed in this subsection with the following assumptions:

1. using the locations from which a person has made calls, that is, the places that the person has physically visited, and based upon the intensity of calls and when the calls are made, it is possible to assign meaning to each location;
2. a cluster of home anchor points that can be derived from the anchor point model for at least seven months over the course of a 13-month period is defined as a stable home area (SHA) which itself can be interpreted as a usual place of residence; and
3. change in a SHA is defined as a change of residence.

**Anchor points** are locations where people regularly stay. Regular cells are referred to as anchors when the model gives meaning (home, work-time, multifunctional) to them. Frequent use of certain mobile phones in specific locations gives the possibility to learn about important or meaningful places for this phone (person). Meaningful places or meaningful locations are defined as regularly visited places that have meaning for individuals. Technically, they are similar to personal anchor points; home and work anchors are the most common among them. Anchor points are important variables in describing humans’ behaviour in time and space. Anchor point modelling is one of the possibilities for making useable the anonymous data of passive mobile positioning, GPS tracking, etc.

Anchor points can be classified as follows:

- **Home** anchor point: An everyday anchor point which, based on the model, is the probable location of the person’s home.
- **Work-time** anchor point: An everyday anchor point which, based on the model, is the person’s probable work-time location. The anchor is called a work-time location because it is not possible to differentiate between work, school and other activities in the place where a person regularly and most often spends time in business hours during a month.
- **Multifunctional** anchor point: An everyday anchor point in which the home and work-time anchor points are located in the same network cell and cannot be separately identified.

**Basic considerations.** Three factors must be considered to determine whether a change of residence has occurred:

1. Certain people are more physically mobile than others, including second home owners, people who are seasonally or temporarily mobile, students who visit their parents’ houses, long term commuters who may use a second residence and also people with random temporary stays.
2. Also, “skipping”, “switching” or “tossing” has to be considered between neighbouring sites and the construction of new sites. **Skipping** is defined as a phenomenon in which for some reason (such as a change in the strength of the signal, etc.) a stationary cellular phone switches antenna by which it is positioned and the cellular phone is identified in a new location, which might be affected by the strength of the radio coverage, the number of users or the “visibility” of mobile towers.
3. Some gaps occur in data series when anchor points for month(s) are not available (a person might have periods of low call activity, for example going on a holiday to another country for several weeks), most likely caused by low calling activity, and therefore, the anchor point model is not capable of extracting the anchor points. In these cases, the gaps are treated in the same way as random stays.

**Estimation Method.** The steps are undertaken to define the change in stable home areas; calculate anchor points and find the home and work-time locations, and secondary anchors for every ID, are described in the ensuing section.

**Steps for defining change in stable home areas:**

1. Dividing anchor points into areas - all of the anchor points are divided in one time series into areas based on the neighbouring criterion;
2. Finding the relevance of anchor points - defines whether an area is sufficiently strong based on a time criterion;
3. Finding migration events based on the relevance of anchor points - defines whether a new SHA has developed and whether a change of residence has occurred.
Steps for calculating anchor points, finding the home and work-time locations, and secondary anchors for every ID based on the model include:

Step 1. Determine points of regular cells and separate them from random cells;

Step 2. Remove from the database, persons with too high or too low number of calls. If the number of calls made is too low, it is not possible to calculate anchor points. The reason for there being too many calls is an organized call procedure (service center etc.) or a technical device using a GSM network;

Step 3. Define home and work-time anchor points. Home and work-time anchor points are determined using regular cells, based on the average start time of calls (the average of all calls made during a 24 h day) and the standard deviation of call commencement times;

Step 4. Consider the neighbouring relationship in the case of two homes or two work-time anchor points;

Step 5. Assess the proportion of days spent at an anchor point;

Step 6. Determine the missing home or work-time anchor point by the addition of a third point;

Step 7. Classify an anchor point as the missing home or work anchor point; and

Step 8. Format every day and secondary anchor points.