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(72) Inventor(s):
Farhad Mehran
Richard Mackenzie

(73) Proprietor(s):
British Telecommunications public limited company
81 Newgate Street, London, EC1A 7AJ,
United Kingdom

(74) Agent and/or Address for Service:
BT Group Legal
Intellectual Property Department, Ground Floor,
Faraday Building, 1 Knightrider Street, LONDON,
EC4V 5BT, United Kingdom

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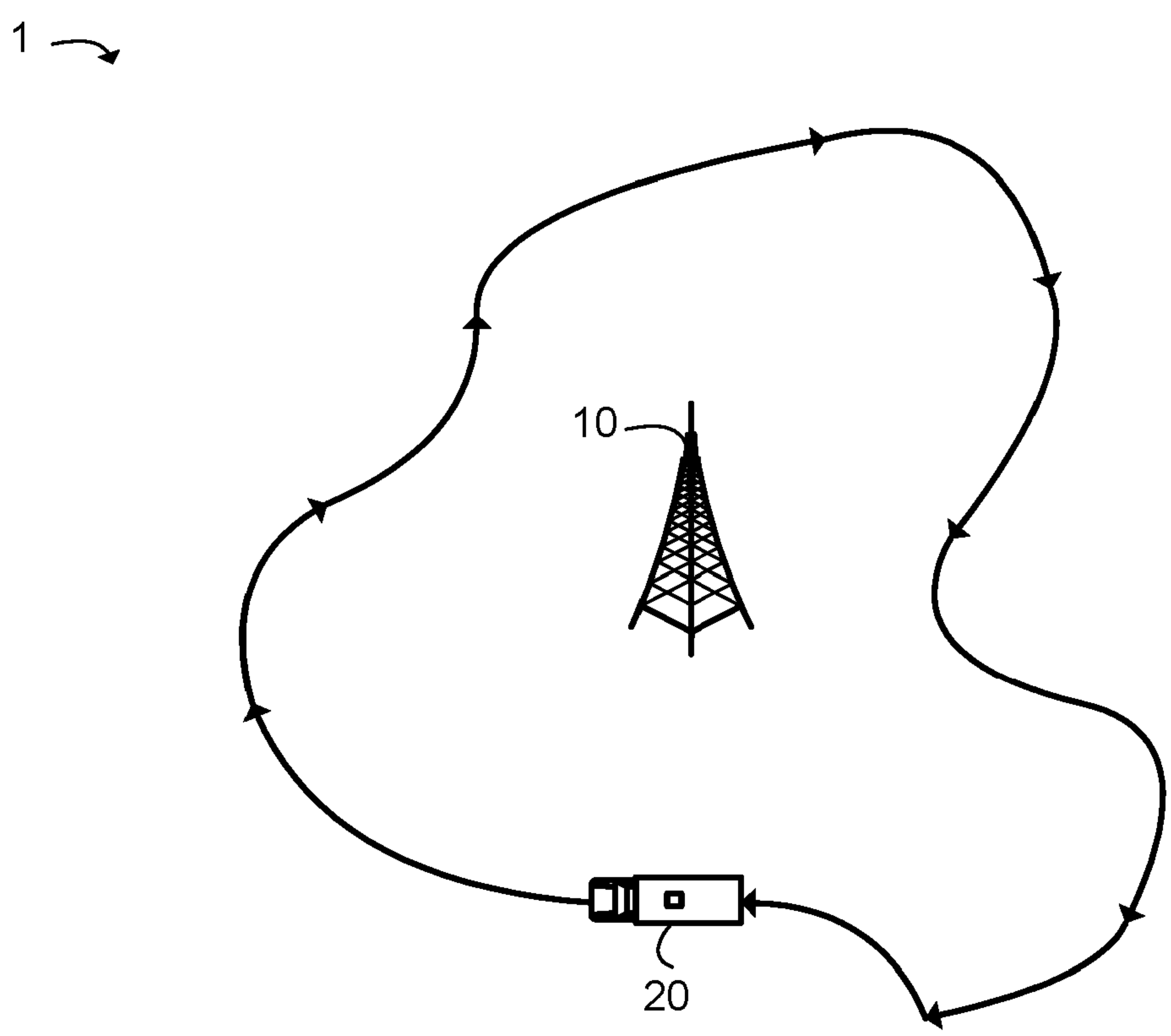

Figure 1

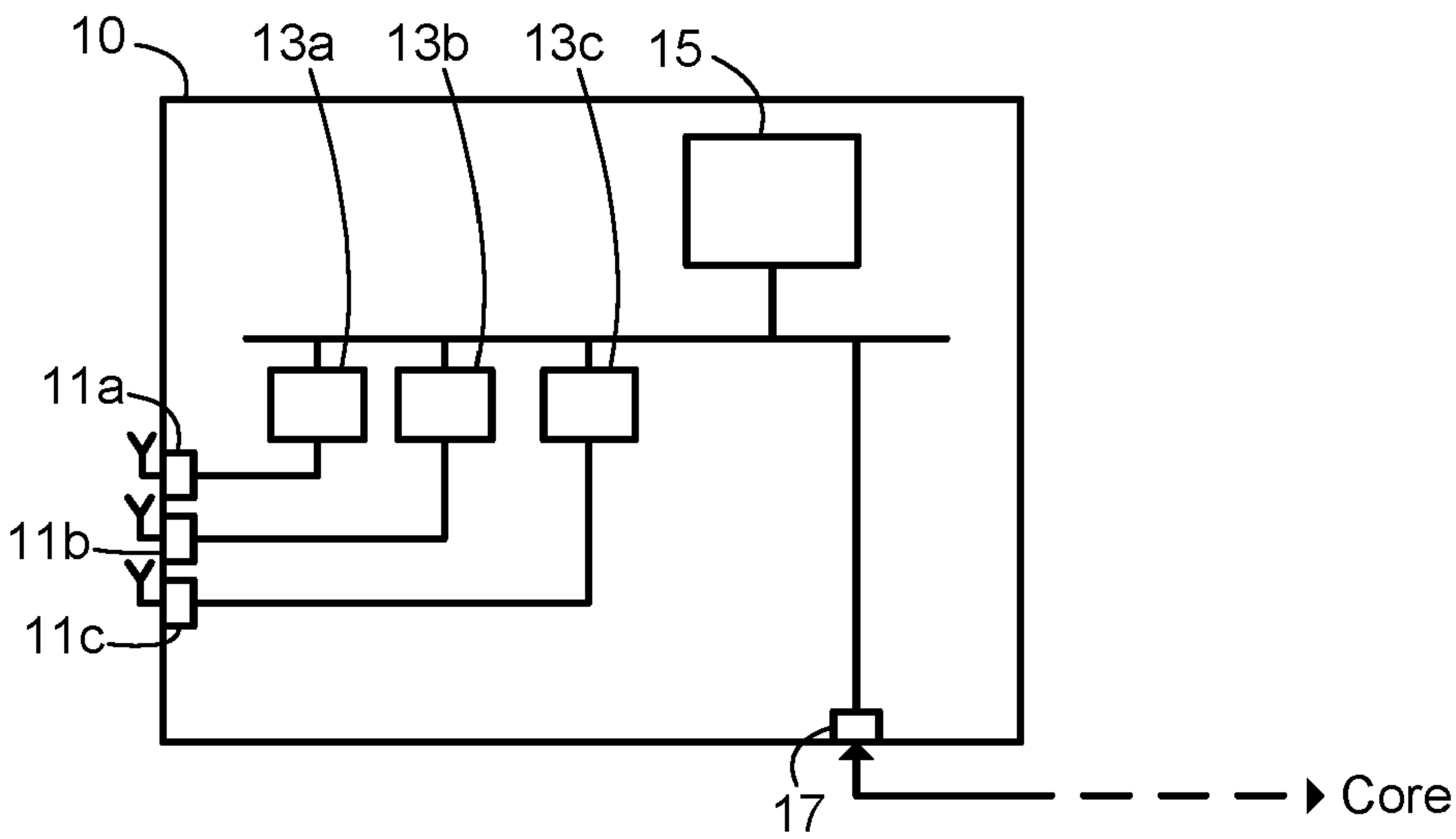

Figure 2

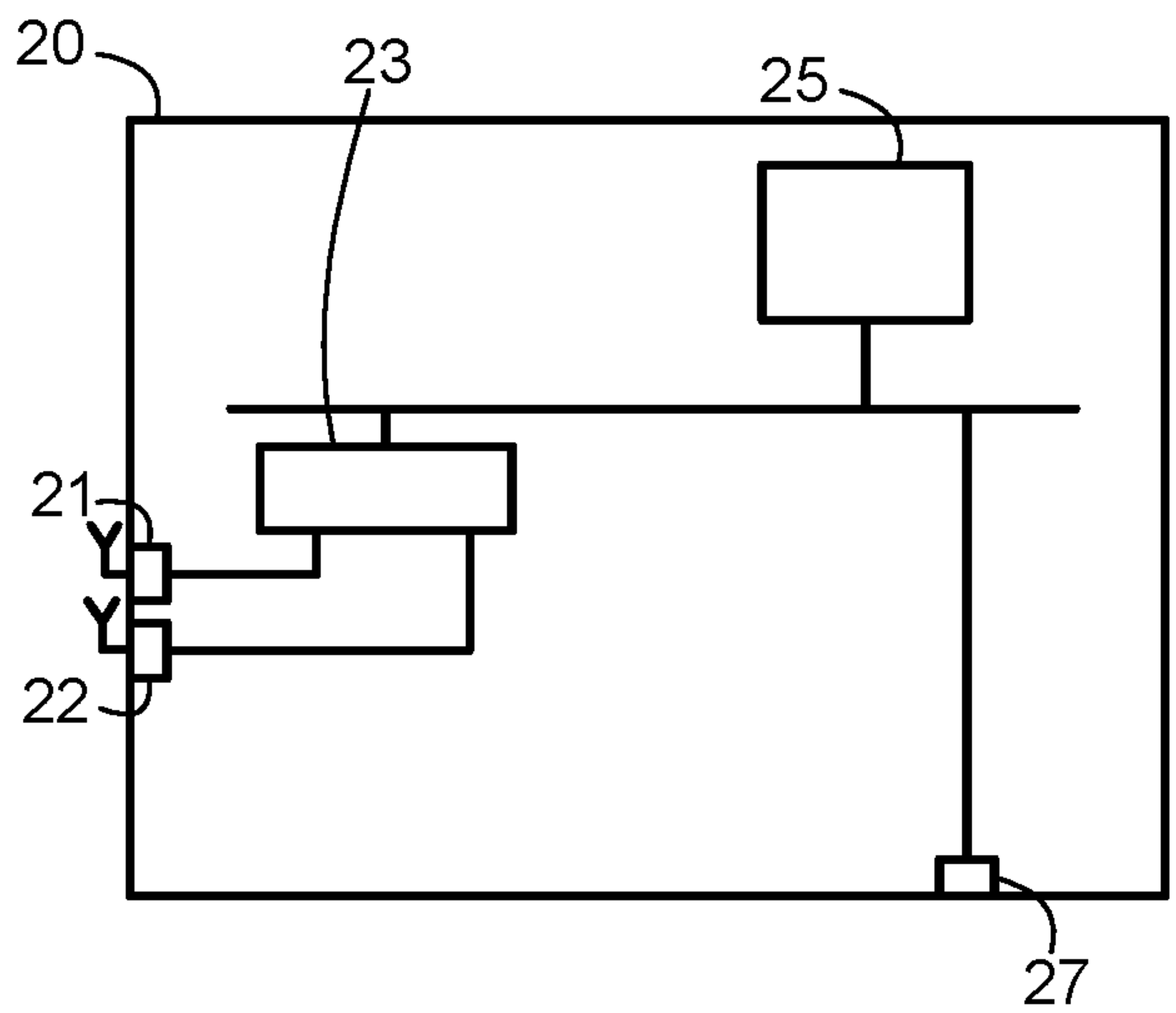

Figure 3

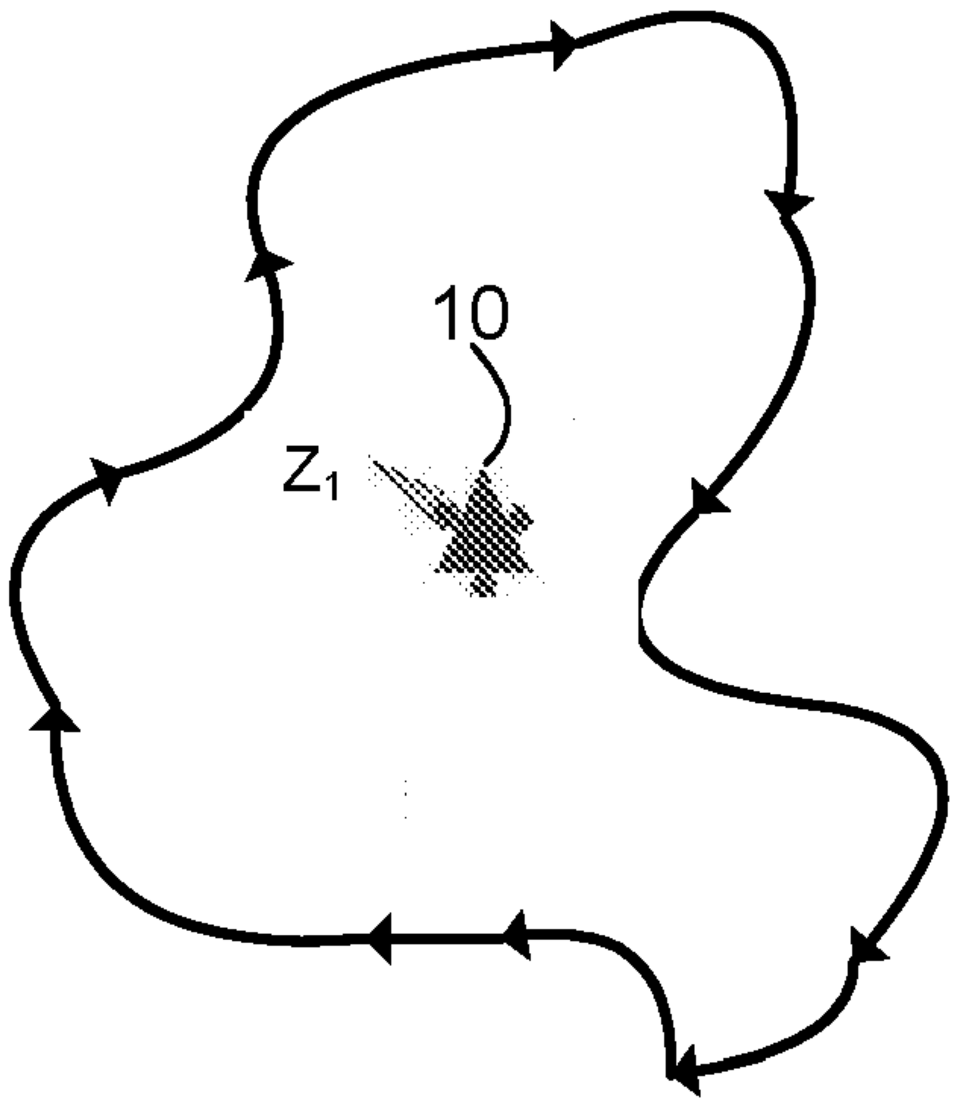

Figure 4a

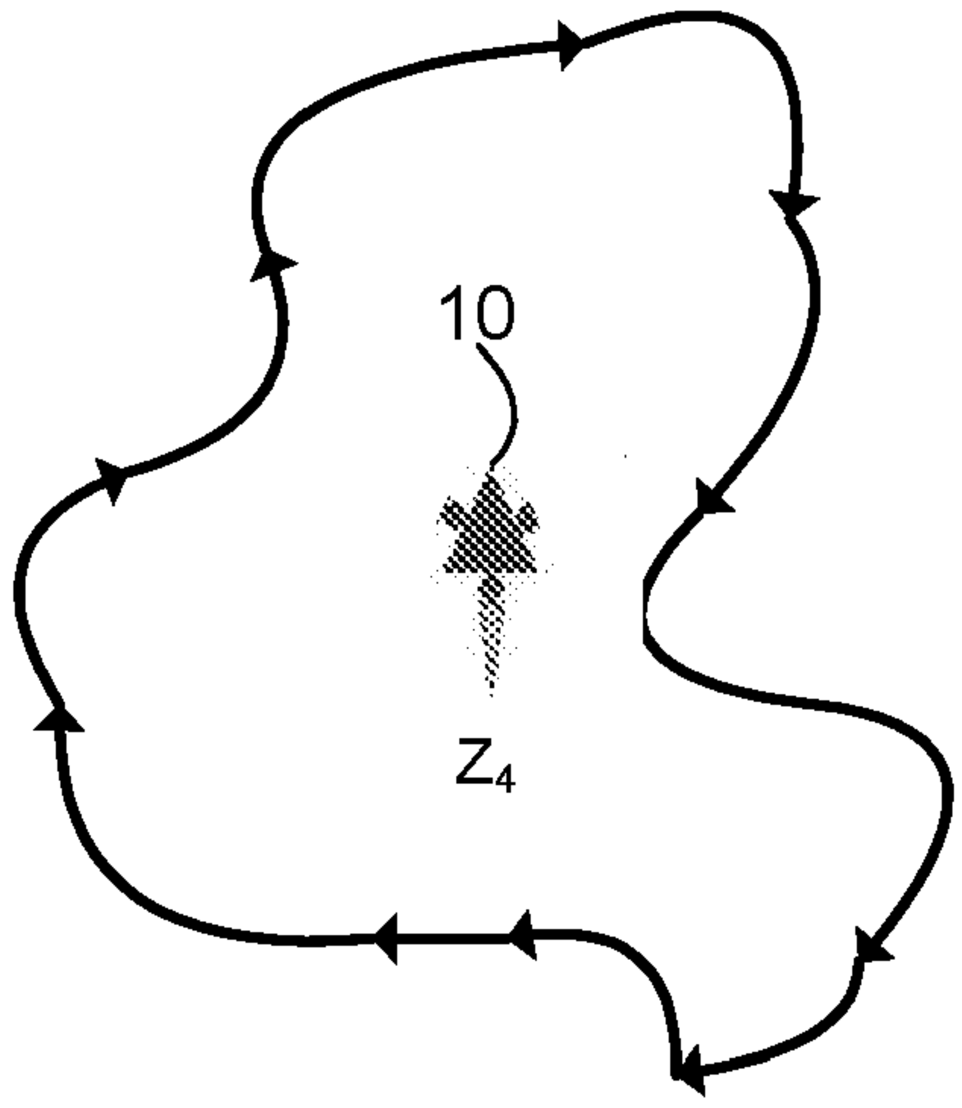

Figure 4d

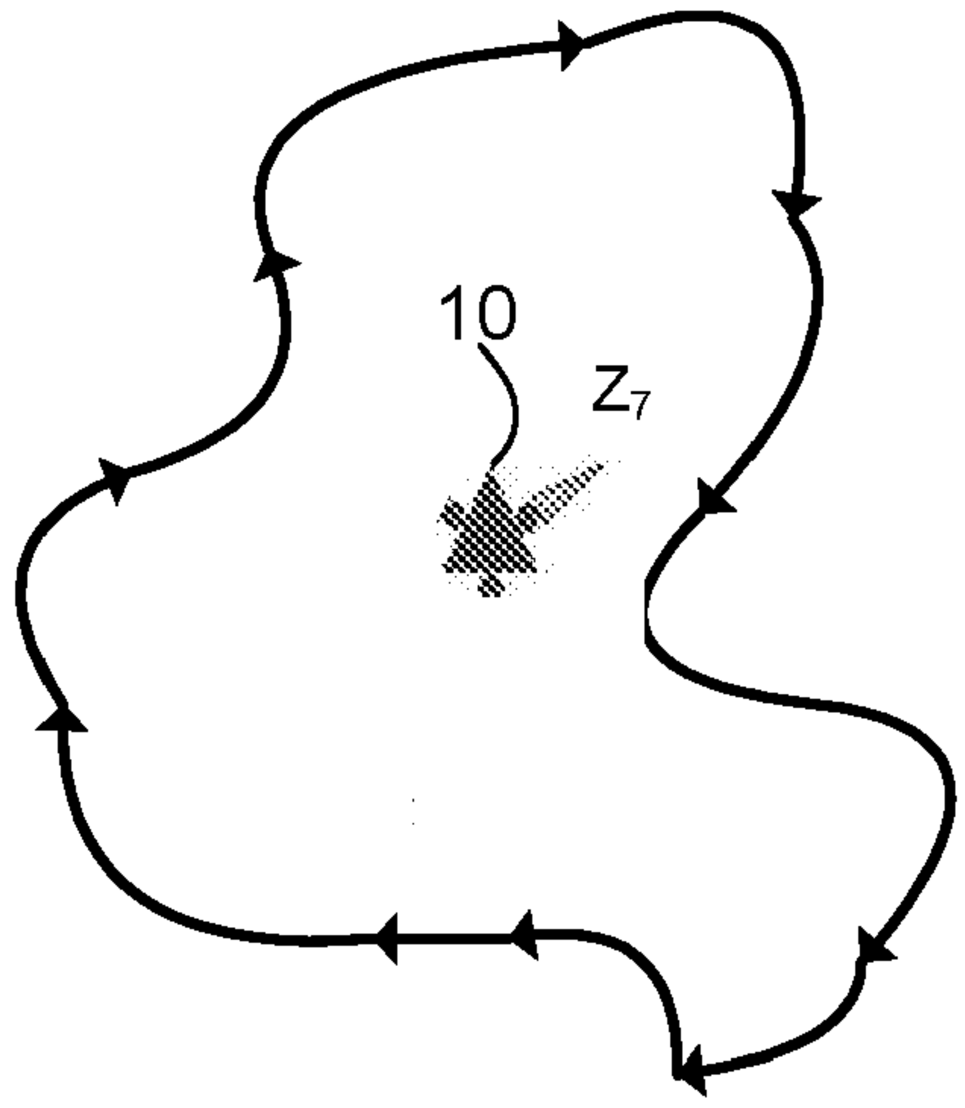

Figure 4g

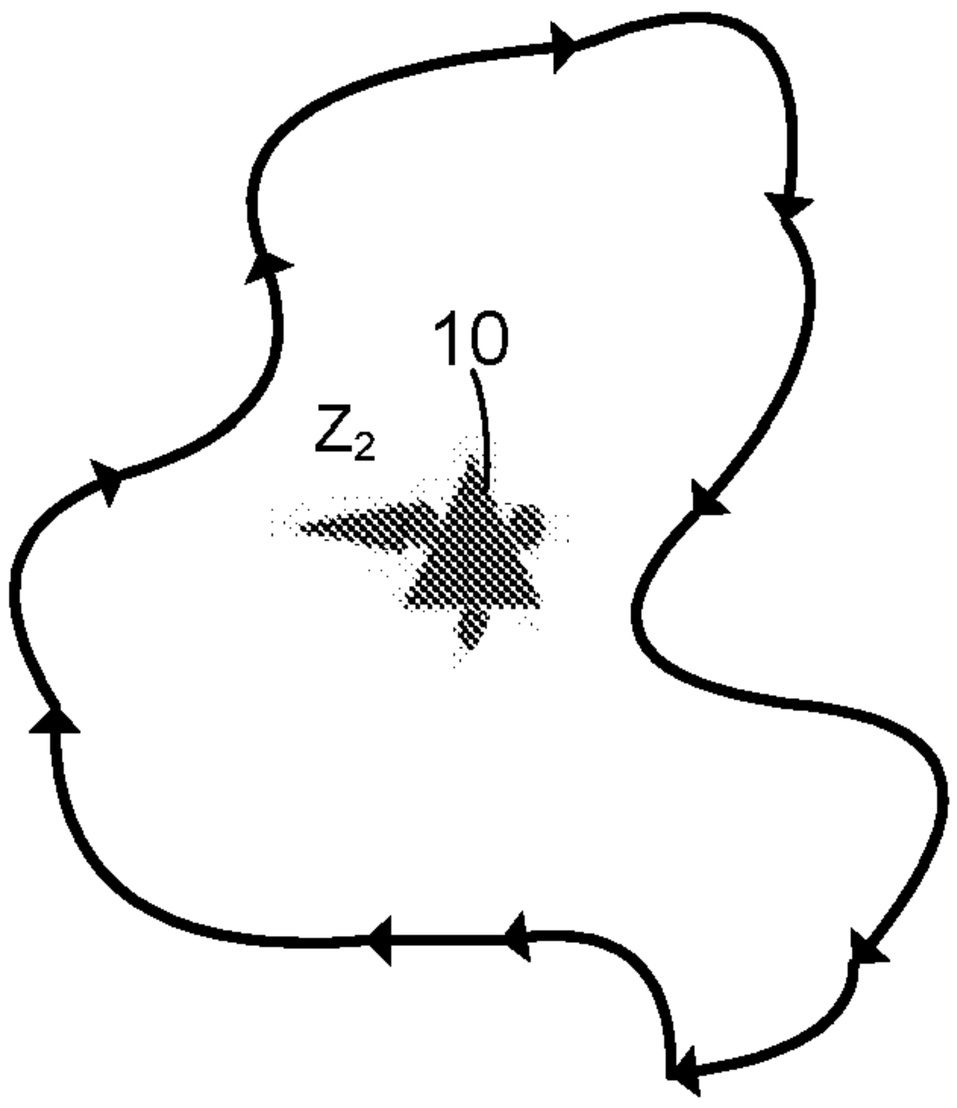

Figure 4b

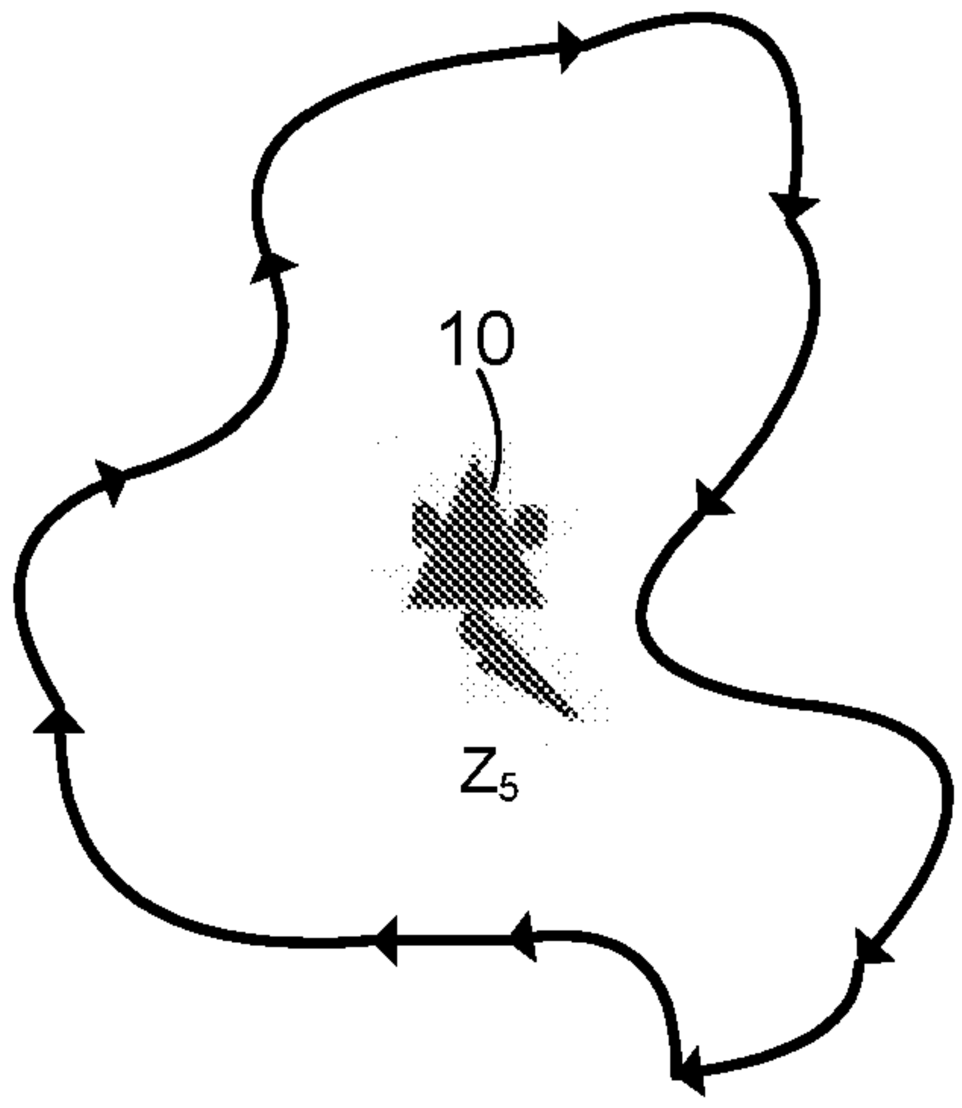

Figure 4e

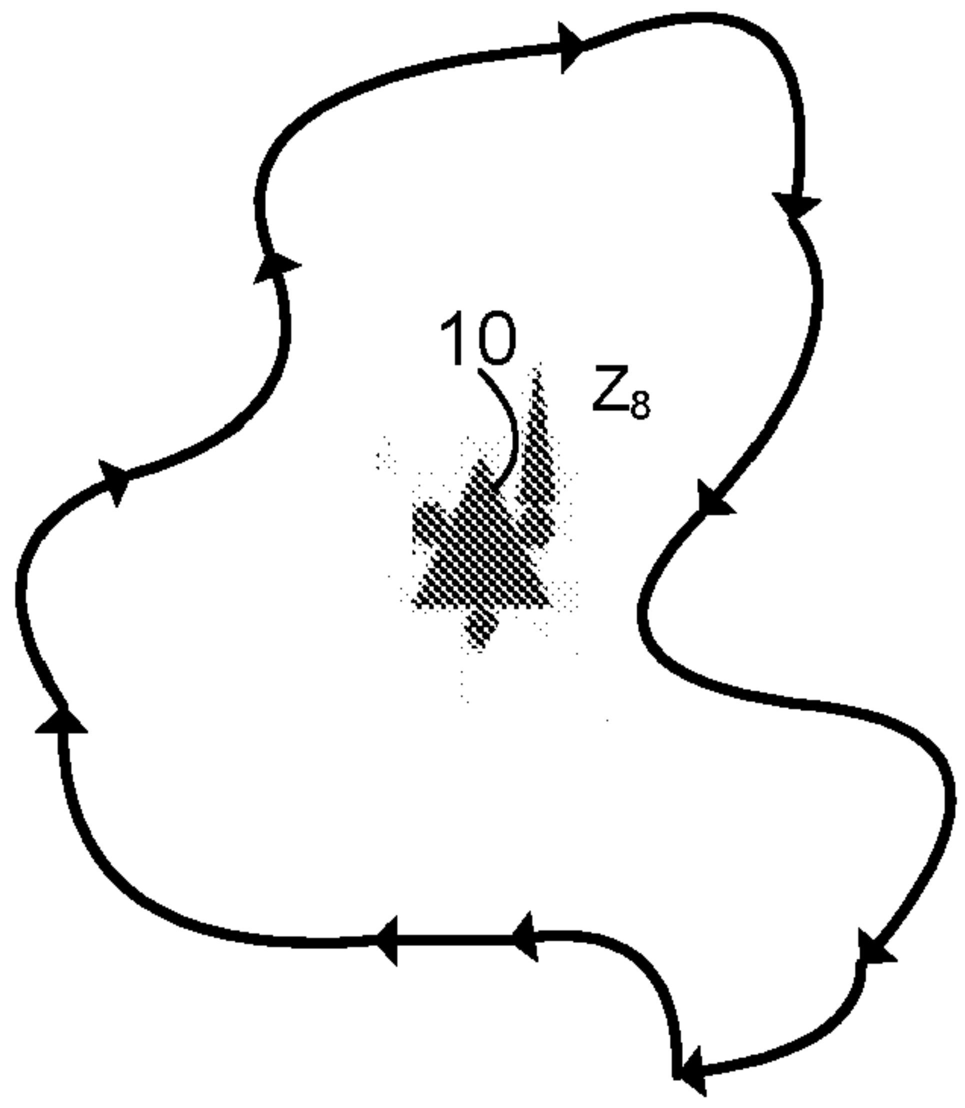

Figure 4h

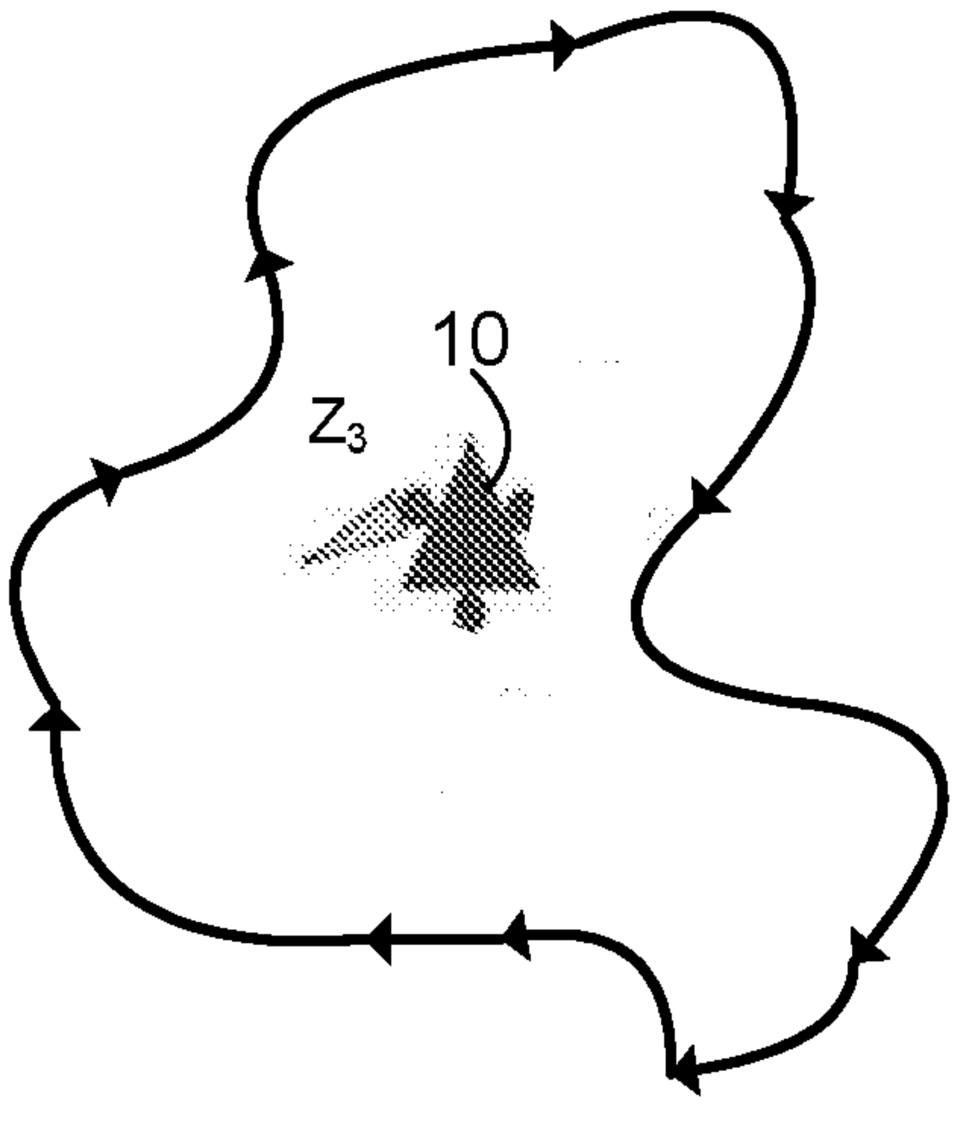

Figure 4c

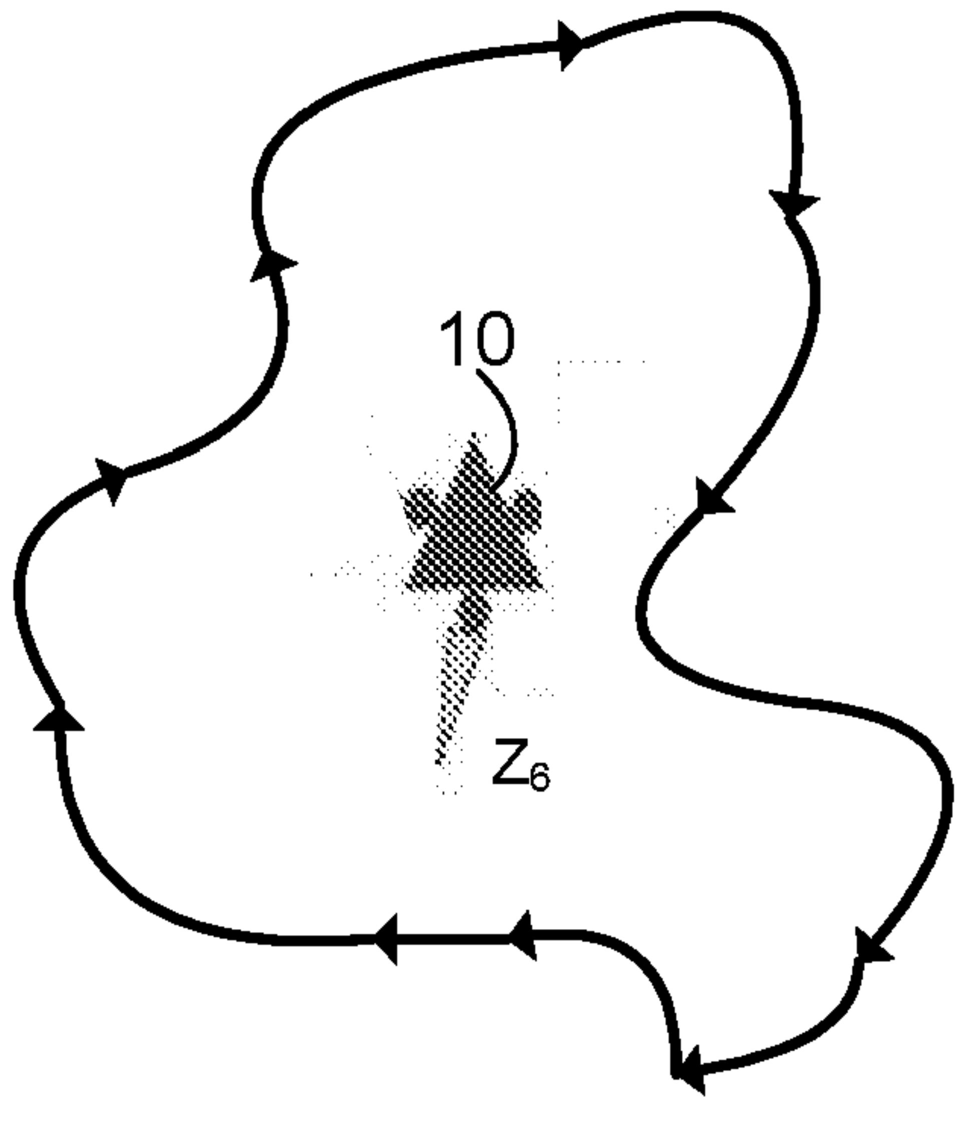

Figure 4f

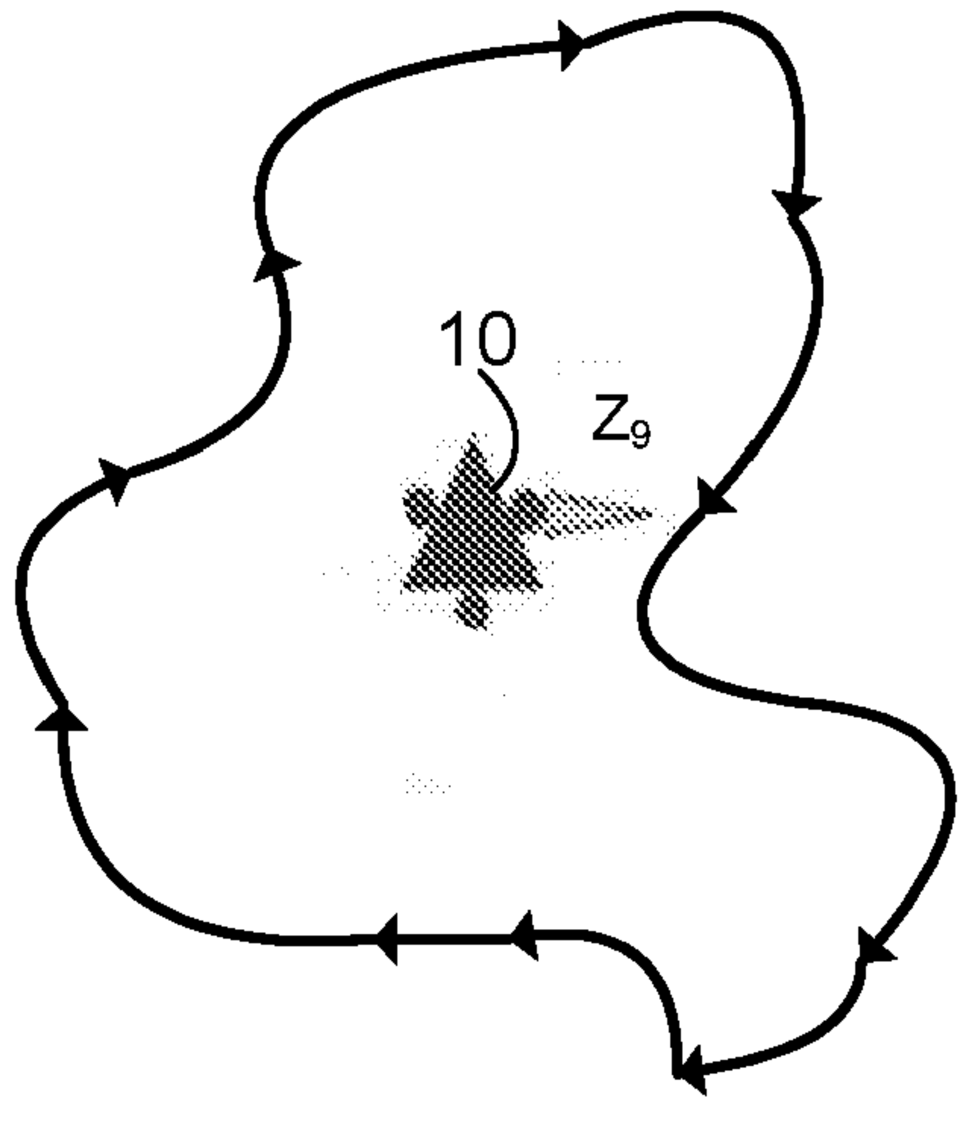

Figure 4i

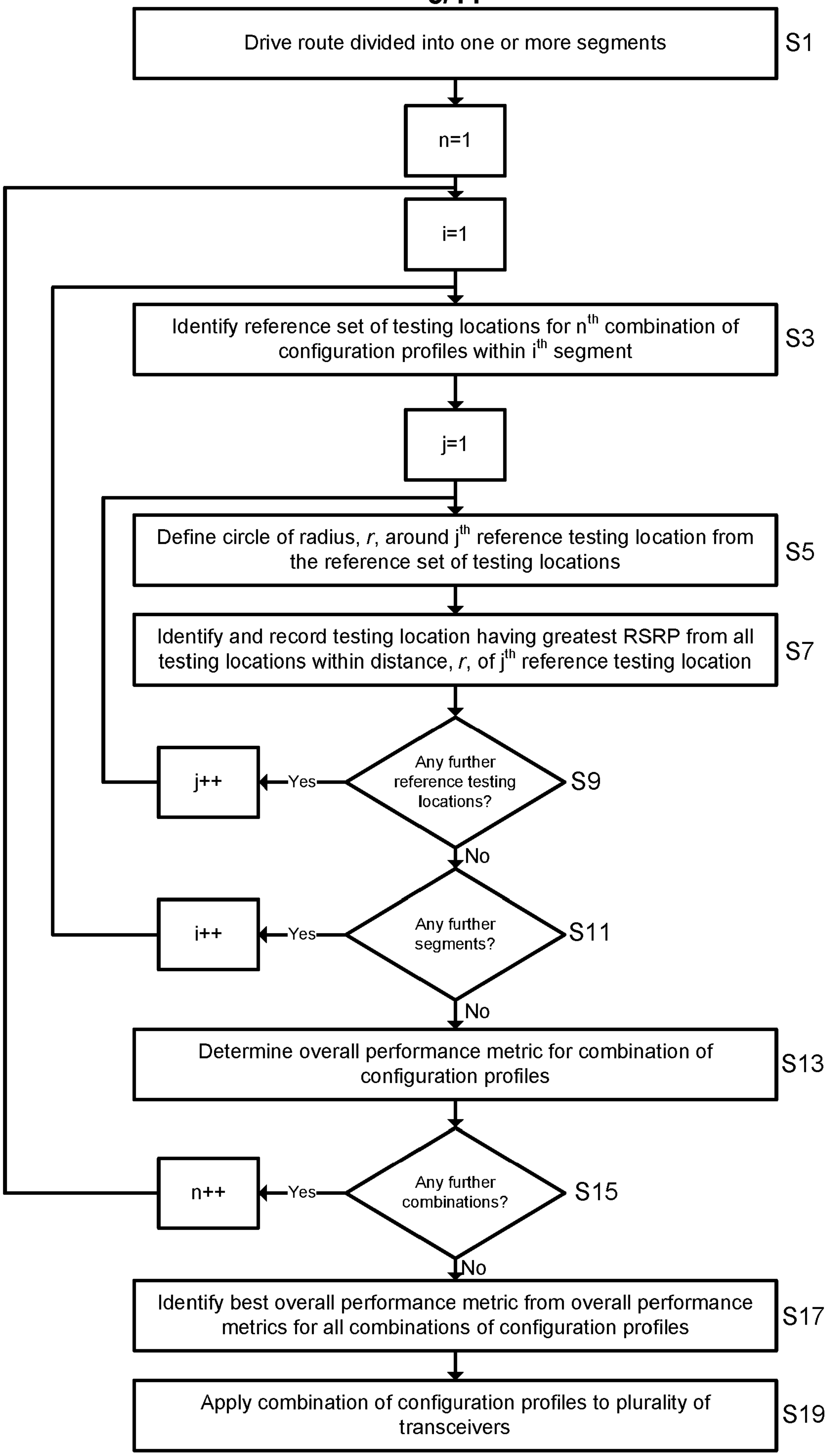
Drive route divided into one or more segments
S1
n=1
i=1
Identify reference set of testing locations for nth combination of configuration profiles within ith segment
S3
j=1
Define circle of radius, r, around jth reference testing location from the reference set of testing locations
S5
Identify and record testing location having greatest RSRP from all testing locations within distance, r, of jth reference testing location
S7
Any further reference testing locations?
S9
Yes
j++
No
Any further segments?
S11
Yes
i++
No
Determine overall performance metric for combination of configuration profiles
S13
Any further combinations?
S15
Yes
n++
No
Identify best overall performance metric from overall performance metrics for all combinations of configuration profiles
S17
Apply combination of configuration profiles to plurality of transceivers
S19

Figure 5

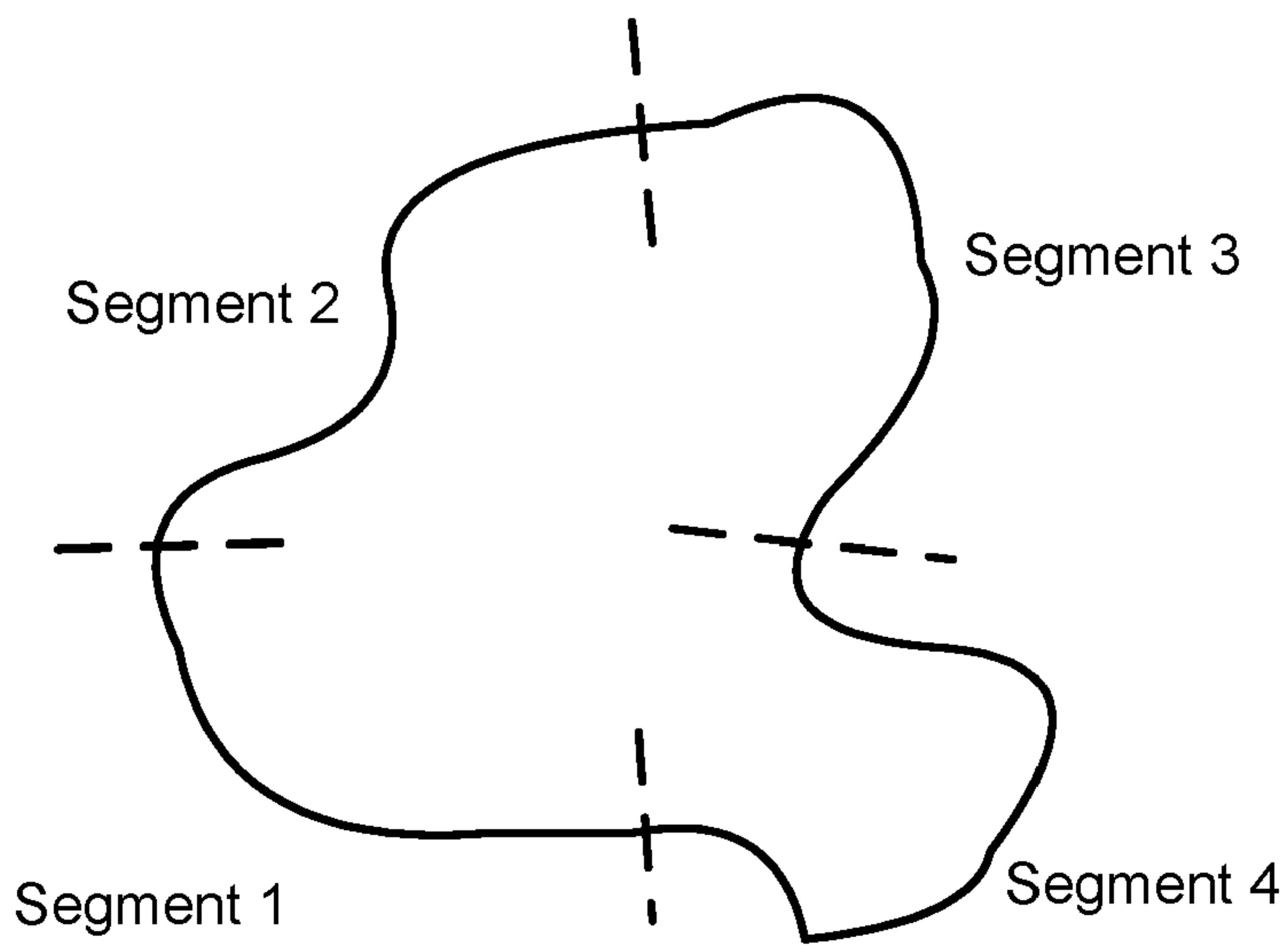

Figure 6

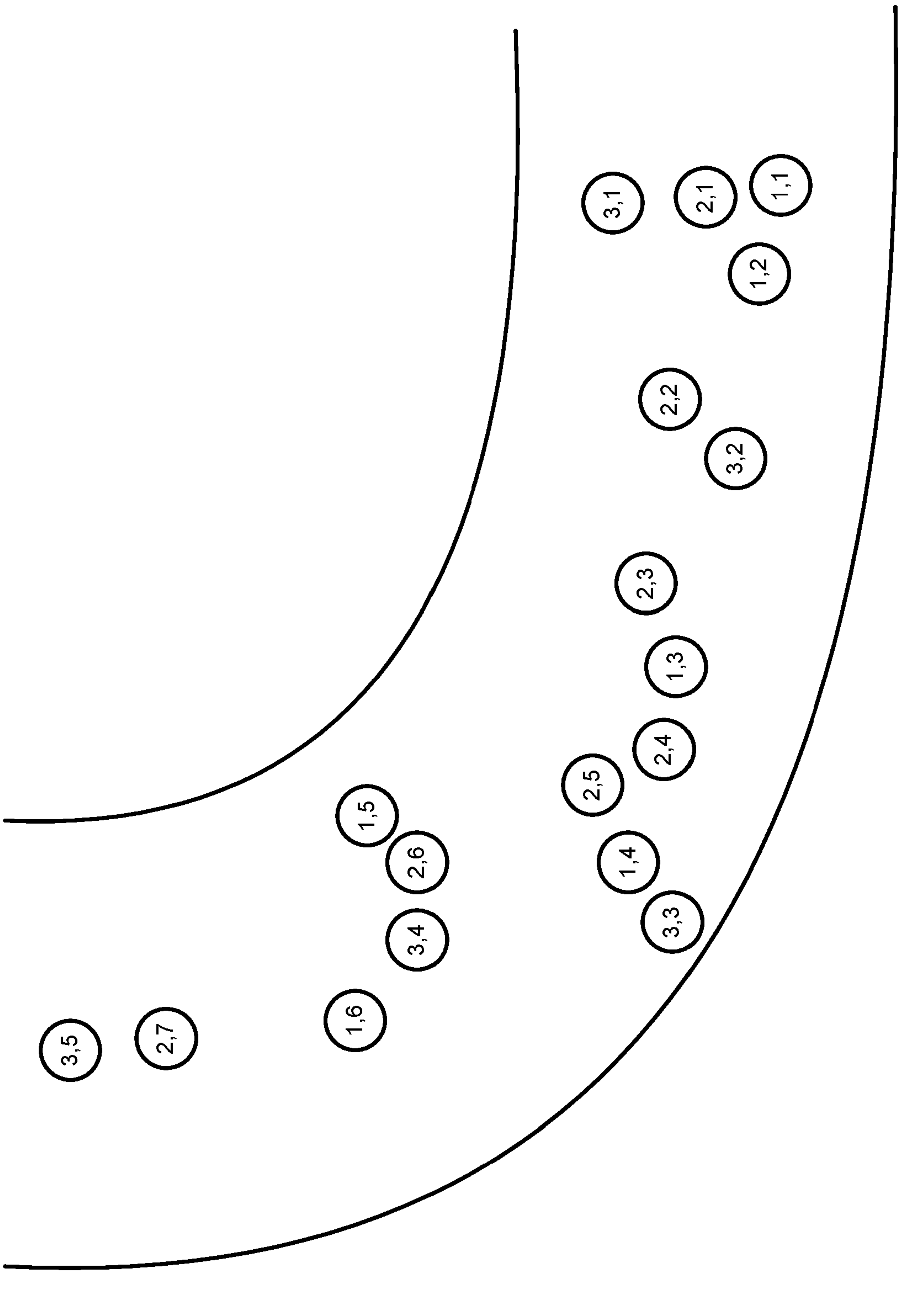

Figure 7

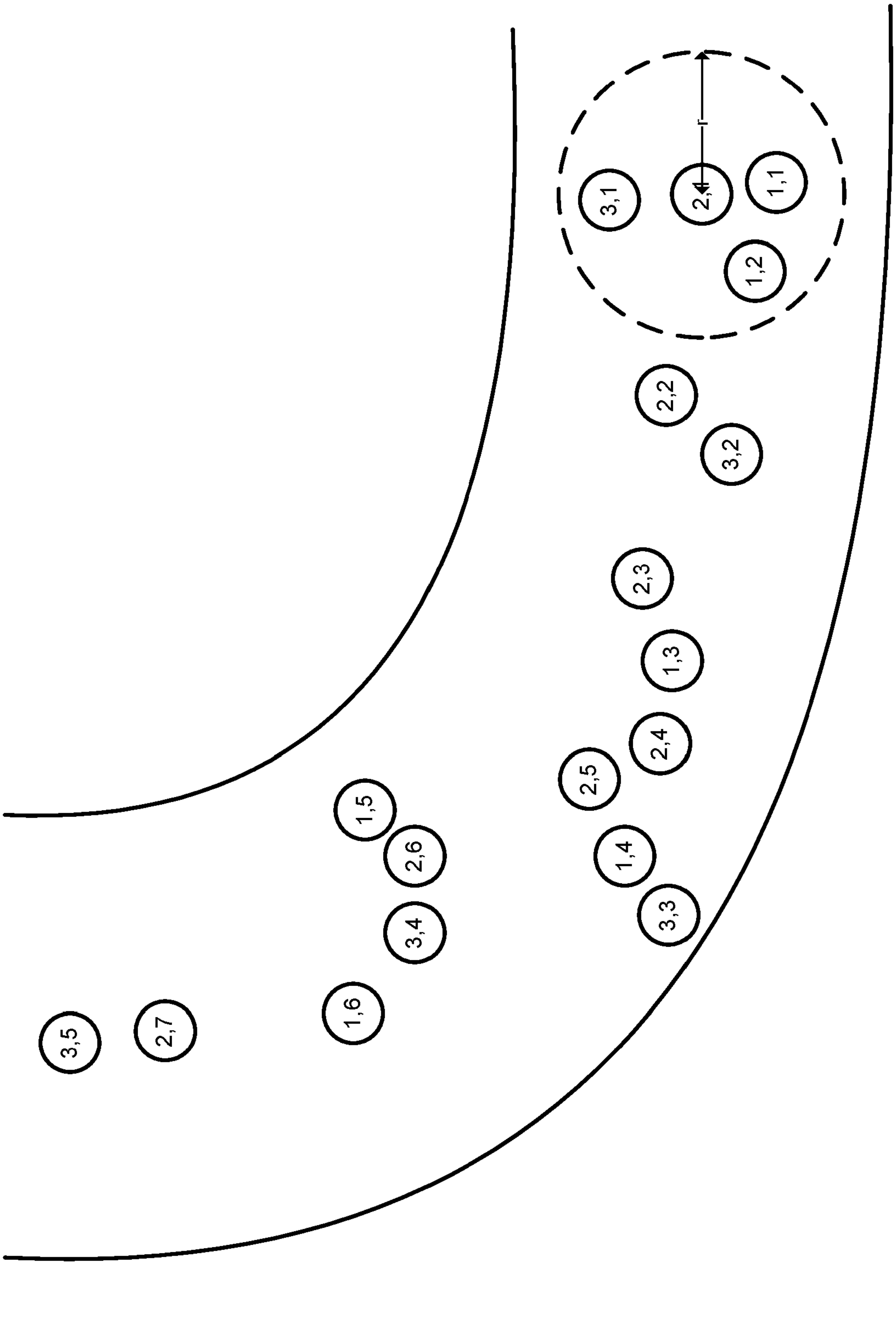

Figure 8

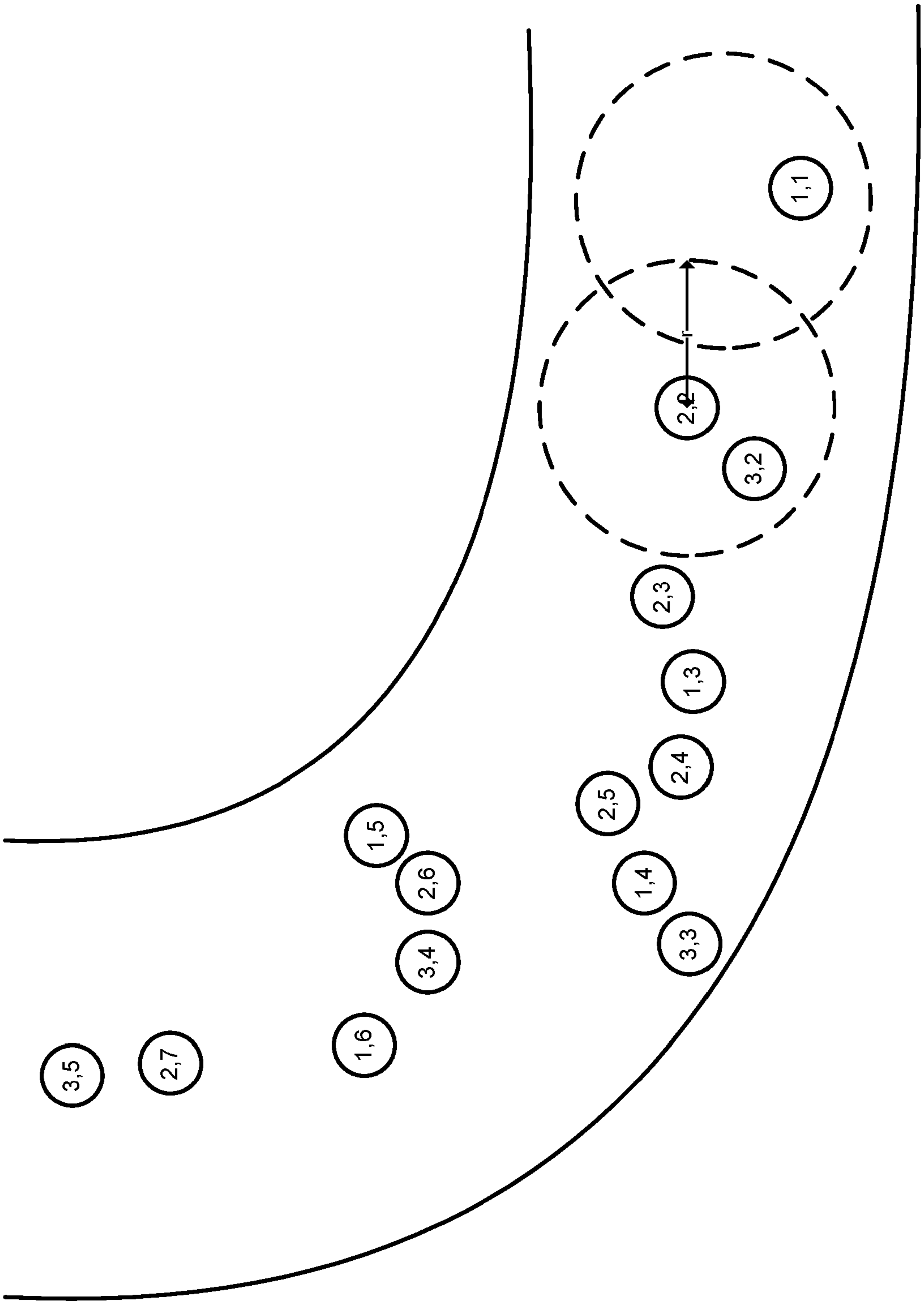

Figure 9

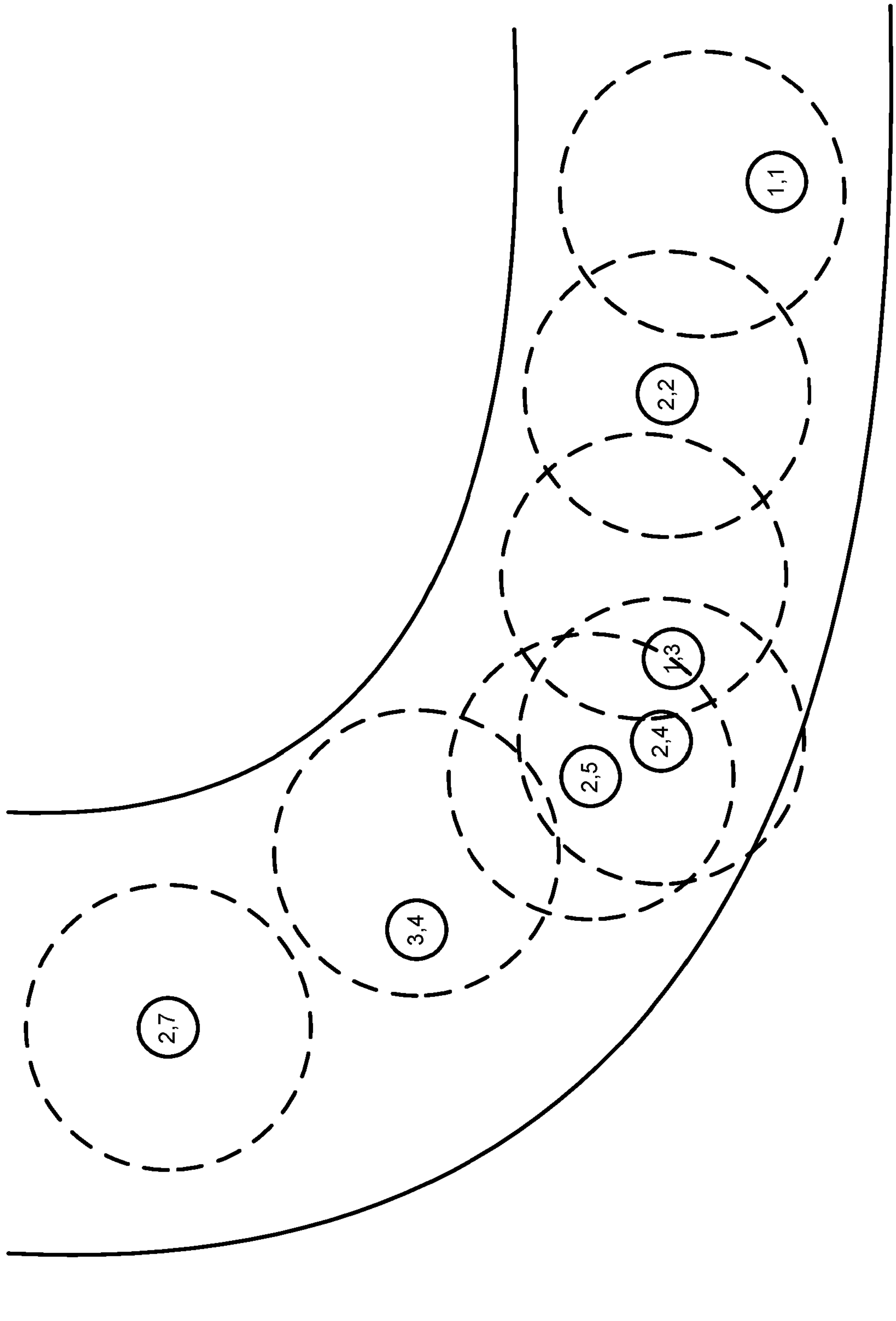

Figure 10

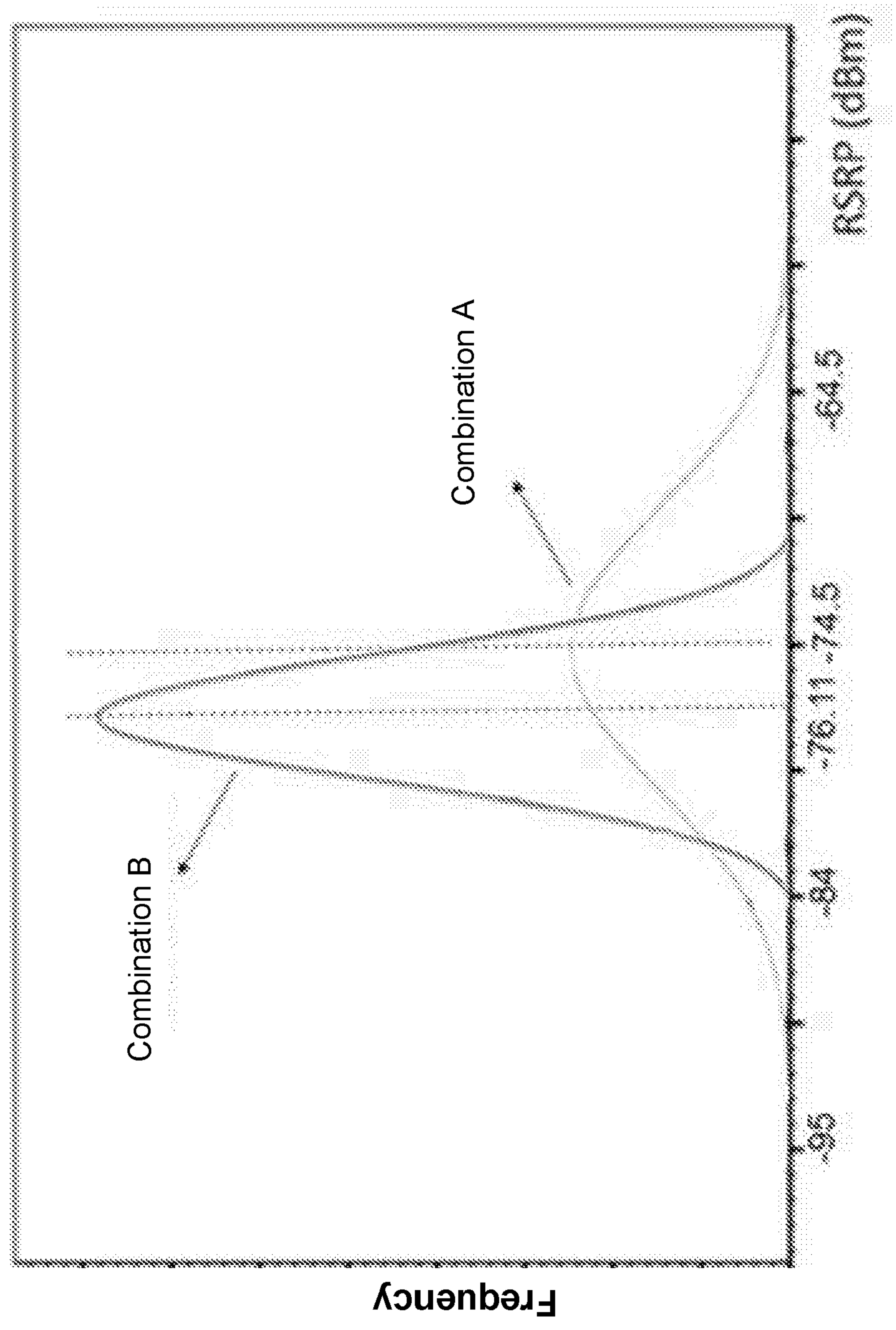
Combination A
Combination B
-95
-84
-76.11
-74.5
-64.5
RSRP (dBm)
Frequency

Figure 11

CELLULAR TELECOMMUNICATIONS NETWORK

Field of the Invention

The present invention relates to a method of configuring a plurality of transceivers in a cellular telecommunications network.

Background

A conventional cellular telecommunications network includes a plurality of base stations which typically each have coverage areas of several squared kilometres. Each base station operates according to a set of configuration parameters (such as transmission power, antenna tilt, azimuth angle, frequency, height, and identifier) which were traditionally manually selected by Mobile Network Operators (MNOs) or automatically selected by Self-Optimising-Network (SON) algorithms. The configuration parameters for a particular base station impacts its own performance, but can also impact the performance of other base stations in the network (for example, if the base station uses a configuration parameter which causes interference on transmissions from/to a neighbouring base station). Accordingly, MNOs adopted processes to carefully select their configuration parameters to optimise the overall performance of the whole cellular network.

One such process was to use “drive tests” in which an engineer would drive a vehicle, equipped with suitable Radio Frequency (RF) receiving equipment, along a test route to receive transmissions from one or more base stations (or, for multi-transceiver base stations, each transceiver for each base station). This feedback data would be stored and analysed (either in-situ or at a separate processing site) to assist the MNOs in their network planning operations.

In order to serve future demands for cellular networking, it is expected that cellular networks will increase in capacity, coverage, density (e.g. of base stations per unit area), and service offerings. It is also expected that these future cellular networks will be much more dynamic due to self-deployment of base stations and the increasing use of SON algorithms. However, this decreases the amount of time for feedback data collected by drive tests to be considered “useful” (in the sense that it may be reliably used in network planning operations). One way to address this problem would be to increase the frequency of drive tests, such that new feedback data for the latest arrangement of base stations and their respective configurations could be used. However, this would place an additional resource burden on the MNO to conduct these additional drive tests.

It is therefore desirable to alleviate some or all of the above problems.

Summary of the Invention

According to a first aspect of the invention, there is provided a method of configuring a plurality of transceivers in a cellular telecommunications network, wherein a first and second transceiver of the plurality of transceivers may each use one of a first and second configuration profile, the method comprising the steps of: receiving a first measurement of a property of the first configuration profile at a first plurality of testing locations along a route; receiving a second measurement of the property of the second configuration profile at a second plurality of testing locations along the route; plotting the first and/or second plurality of testing locations associated with a first combination of the first and/or second configuration profiles for the first and second transceivers; plotting the first and/or second plurality of testing locations associated with a second combination of the first and/or second configuration profiles for the first and second transceivers; calculating a first overall performance metric for the first combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a first identified testing location of the first and/or second plurality of testing locations; calculating a second overall performance metric for the second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a second identified testing location of the first and/or second plurality of testing locations; selecting one of the first and second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and second overall performance metrics; and applying the selected combination of the first and/or second configuration profiles to the first and second transceivers.

The step of calculating the first and second overall performance metrics may include, for each plot of the first and/or second plurality of testing locations: selecting one of the first and/or second plurality of testing locations to be a reference plurality of testing locations; and, for each reference testing location of the reference plurality of testing locations, identifying one of a first testing location of the first and/or second plurality of testing locations or a second testing location of the first and/or second plurality of testing locations within a predetermined distance of the reference testing location based on a comparison of the first and/or second measurement at the first testing location and the first and/or second measurement at the second testing location, wherein the calculation of the first overall performance metric is based on the first and/or second measurement associated with each identified first and/or second testing location within the predetermined distance of each reference point; and the calculation of the second overall performance metric is based on the first and/or second measurement associated with each identified first and/or second testing location within the predetermined distance of each reference point.

The steps of plotting the first and/or second plurality of testing locations associated with first and second combinations of the first and/or second configuration profiles may be within first and second segments of the route; and the method further may further comprise: selecting one of the first and/or second plurality of testing locations to be a first reference plurality of testing locations in the first segment; and selecting one of the first and/or second plurality of testing locations to be a second reference plurality of testing locations in the second segment.

According to a second aspect of the invention, there is provided a computer program product comprising instructions which, when the program is executed by a computer, cause the computer to carry out the method of the first aspect of the invention. The computer program may be stored on a computer-readable data carrier.

According to a third aspect of the invention, there is provided a device for configuring a plurality of transceivers in a cellular telecommunications network, wherein a first and second transceiver of the plurality of transceivers may each use one of a first and second configuration profile, the device comprising: a transceiver adapted to receive a first measurement of a property of the first configuration profile at a first plurality of testing locations along a route and to receive a second measurement of the property of the second configuration profile at a second plurality of testing locations along the route; and a processor adapted to: plot the first and/or second plurality of testing locations associated with a first combination of the first and/or second configuration profiles for the first and second transceivers; plot the first and/or second plurality of testing locations associated with a second combination of the first and/or second configuration profiles for the first and second transceivers; calculate a first overall performance metric for the first combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a first identified testing location of the first and/or second plurality of testing locations; calculate a second overall performance metric for the second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a second identified testing location of the first and/or second plurality of testing locations; select one of the first and second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and second overall performance metrics; and apply the selected combination of the first and/or second configuration profiles to the first and second transceivers.

The device may be configured to carry out any of the steps of the method of the first aspect of the invention. The device may be a vehicle, including an Unmanned Vehicle (UV).

Brief Description of the Figures

In order that the present invention may be better understood, embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a cellular telecommunications network of an embodiment of the present invention;

Figure 2 is a schematic diagram of a base station of the network of Figure 1;

Figure 3 is a schematic diagram of a testing vehicle of the network of Figure 1;

Figures 4a to 4i are schematic diagrams of a test route of the network of Figure 1, with the base station adopting a first, second, third, fourth, fifth, sixth, seventh, eighth and ninth configuration profile respectively;

Figure 5 is a flow diagram illustrating a method of an embodiment of the present invention;

Figure 6 is a schematic diagram of the test route following segmentation;

Figure 7 is a schematic diagram of a first segment of the test route having first, second and third sets of testing locations plotted thereon;

Figure 8 is a schematic diagram of the first segment of the test route having the first, second and third sets of testing locations plotted thereon, further illustrating a best testing location with distance *r* of a first reference testing location;

Figure 9 is a schematic diagram of the first segment of the test route having the first, second and third sets of testing locations plotted thereon, further illustrating each best testing location within distance *r* of the first and second reference testing locations;

Figure 10 is a schematic diagram of the first segment of the test route having the first, second and third sets of testing locations plotted thereon, further illustrating each best testing location within distance *r* of all reference testing locations; and

Figure 11 is a graph illustrating a frequency of measurements for a first and second combination of configuration profiles.

Detailed Description of Embodiments

A first embodiment of a cellular telecommunications network 1 of the present invention will now be described with reference to Figures 1 to 3. The cellular telecommunications network 1 includes a base station 10, which is configured to transmit signals about a coverage area, and a testing vehicle 20. The testing vehicle 20 may travel along a drive route (shown as the sequence of arrowed lines) and perform one or more measurements on the signals transmitted by the base station 10 at any location along the drive route.

The base station 10 is shown in more detail in Figure 2. The base station 10 includes a first, second, and third wireless communication interface 11a, 11b, 11c, which, in this embodiment, are connected to first, second and third antennae respectively. The first base station 10 also includes a first, second and third processor 13a, 13b, 13c, which process signals received or sent via the first, second and third antennae respectively. The base station 10 also includes memory 15, and a wired communication interface 17 towards a cellular core networking entity (not shown). The wired communication interface 17 is typically known as a backhaul.

In this embodiment, the first, second and third wireless communications interface 11a, 11b, 11c may be individually configured such that the wireless transmissions via their respective antennae have unique properties. These properties may include, for example, azimuth angle, tilt, transmission power, frequency, height and identifier. In the following description, a set of properties that may be used by any one of the antennae may be designated by a vector, Z_i, which shall hereinafter be known as a “configuration profile”:

$$Z_i = P_1, P_2, P_n, \dots, P_N$$

In which P_n represents a property of the antenna (e.g. azimuth angle or transmission power) and n is of set 1 to N, where N is the total number of available properties, and Z_i represents a configuration profile having a unique combination of properties P and i is of set 1 to I, where I is the maximum number of available combinations of properties P.

Figure 3 illustrates the testing vehicle 20 in more detail. In this embodiment, the testing vehicle 20 includes a wireless communications interface 21, connected to an antenna, for sending and receiving signals to/from each of the three antennae of the base station 10. The testing vehicle 20 also includes a Global Navigation Satellite System (GNSS) receiver 22, a processor 23 and memory 25. The processor 23 is configured to process signals received from the GNSS receiver 22 to identify the location of the testing vehicle 20. The processor 23 is also configured to process all signals received from the wireless communications interface 21 from an antenna of the base station 10 to produce one or more measurements of the antenna in its current configuration profile. The processor 23 may then store these one or more measurements of the antenna in memory 25, together with a timestamp identifying when the data was collected and a location (i.e. the GNSS coordinates) of the testing vehicle 20 at that time. This processing may be done locally by processor 23 and then stored in memory 25, or, in other embodiments, the data is stored in either raw or pre-processed form in memory 25 for subsequent processing. This subsequent processing may be performed externally, such that the testing vehicle 20 also includes a second communications interface 27 for extracting data from memory 25. This embodiment will use the example that all processing is performed locally by processor 23, such that the one or more measurements of each antennae in their respective configuration profiles is stored in memory 25 together with a timestamp indicating the time the data was collected and a location of the testing vehicle 20 at that time. The processor 23 may then implement embodiments of the method of the invention using this data, which will now be described.

Figures 4a to 4i each illustrate the same drive route as shown in Figure 1 with the base station 10 adopting a unique configuration profile. In this embodiment, the testing vehicle

20 conducts nine drive tests (i.e. a drive test being an individual instance of the testing vehicle 20 traversing the whole drive route and collecting data on signals from the base station 10), which are shown in Figures 4a to 4i respectively. In a first drive test shown in Figure 4a, the base station 10 uses the first antenna only and adopts a first configuration profile, Z_1, for the first antenna; in a second drive test as shown in Figure 4b, the base station 10 uses the first antenna only and adopts a second configuration profile, Z_2, for the first antenna; in a third drive test as shown in Figure 4c, the base station 10 uses the first antenna only and adopts a third configuration profile, Z_3, for the first antenna; in a fourth drive test as shown in Figure 4d, the base station 10 uses the second antenna only and adopts a fourth configuration profile, Z_4, for the second antenna; in a fifth drive test as shown in Figure 4e, the base station 10 uses the second antenna only and adopts a fifth configuration profile, Z_5, for the second antenna; in a sixth drive test as shown in Figure 4f, the base station 10 uses the second antenna only and adopts a sixth configuration profile, Z_6, for the second antenna; in a seventh drive test as shown in Figure 4g, the base station 10 uses the third antenna only and adopts a seventh configuration profile, Z_7, for the third antenna; in an eighth drive test as shown in Figure 4h, the base station 10 uses the third antenna only and adopts an eighth configuration profile, Z_8, for the third antenna; and in a ninth drive test as shown in Figure 4i, the base station 10 uses the third antenna only and adopts a ninth configuration profile, Z_9, for the third antenna.

Although Figures 4a to 4i illustrate the base station 10 using a single antenna in a single configuration profile during the drive tests, during normal operation the base station 10 may use all three antennae at the same time and each antenna may use any one of the nine configuration profiles (although the base station 10 does not use the same configuration profile on several antennae). Embodiments of the invention provide a method for determining which combination of three configuration profiles the base station 10 should adopt for its three antennae. This will now be described with reference to Figures 5 to 11.

Turning to Figure 5, in a first step (S1) of this embodiment, the drive route is divided into a plurality of drive route segments. In this embodiment, the drive route is divided into four drive route segments of equal length (for simplicity), but a detailed approach to this step will be described later. The segmentation of the whole drive route into four segments is shown in Figure 6.

A first combination of three configuration profiles of the nine configuration profiles is then analysed in a first drive route segment. Figure 7 illustrates the first segment in more detail, and also shows (plotted upon the first segment): a first set of testing locations of the testing vehicle 20 for several measurements of the base station 10 when adopting the first configuration profile, Z_1, (of the nine configuration profiles), a second set of testing locations of the testing vehicle 20 for several measurements of the base station 10 when adopting the second configuration profile, Z_2, and a third set of testing locations of the testing vehicle 20 for several measurements of the base station 10 when adopting the third configuration profile, Z_3. Thus, each set of testing locations includes a timestamped sequence of measurements conducted by the testing vehicle 20 of the base station when it was using a particular configuration profile (i.e. as the testing vehicle 20 travelled along the drive route). These testing locations are represented by circles in Figure 7, whereby the position of the circle represents the GNSS coordinates of the testing vehicle 20 at the time the measurement was conducted, the first number inside the circle identifies the configuration profile being measured by the testing vehicle 20, and the second number inside the circle identifies the timestamp associated with that measurement.

In the next step, S3, it is determined which set of testing locations has the greatest density of testing locations within the first segment. In this embodiment, the second set of testing locations (when the base station 10 adopted the second configuration profile) contains the most (i.e. 7) testing locations and thus has the greatest density of testing locations in the first segment. The second set of testing locations is therefore designated as the “reference” set of testing locations, and each testing location within the reference set is designated as a reference testing location.

In step S5, as shown in Figure 8, a circle of a predetermined radius, *r*, is defined around a first reference testing location of the reference set of testing locations. The determination of the radius, *r*, of the circle is discussed later. In step S7, the measurements associated with each testing location within the circle are retrieved from memory 25 and analysed to determine which testing location has the greatest associated RSRP. In this example, the testing locations for testing locations (2,1), (1,1), 1,2) and (3,1) are within the circle and the RSRP measurement for these testing locations were -90, -68, -70 and -85 respectively. Accordingly, the first testing location of the first set of testing locations (that is, when the base station 10 adopted the first configuration profile) obtained the greatest RSRP, and is therefore selected as the “best” testing location within distance, *r*, of the first reference testing location. This is recorded in a database in memory 25, as illustrated in the following table:

Reference Testing Location	**Best Testing Location within distance, *r*, of reference testing location**	**Associated RSRP for the Best Testing Location**
2,1	1,1	-68

Table 1: Table representing the data retrieved and analysed to identify the best testing location within distance, *r*, of the first reference testing location

In step S9, it is determined whether there are further reference testing locations within the reference set. As this determination is positive, the process loops back to repeat steps S5 and S7 for the second reference testing location of the reference set of testing locations. Figure 9 illustrates a circle being defined about the second reference testing location of the reference set of testing locations, and the following table illustrates the data recorded in the database during the analysis of this second iteration:

Reference Testing Location	**Best Testing Location within distance, *r*, of reference testing location**	**Associated RSRP for the Best Testing Location**
2,1	1,1	-68
2,2	2,2	-70

Table 2: Table representing the data retrieved and analysed to identify the best testing location within distance, *r*, of the first and second reference testing locations

This iterative loop continues for the remaining reference testing locations (2,3 to 2,7), to identify the “best” testing locations within distance, *r*, of each reference testing location. These are shown in Figure 10 and recorded in the database in memory 25 (as illustrated in the following table). It is also noted that any testing location which falls outside distance, *r*, of any reference testing location may be considered an anomaly (e.g. due to GNSS inaccuracies).

Reference Testing Location	Best Testing Location within distance, *r*, of reference testing location	Associated RSRP for the Best Testing Location
2,1	1,1	-68
2,2	2,2	-70
2,3	1,3	-72
2,4	2,4	-68
2,5	2,5	-70
2,6	3,4	-71
2,7	2,7	-70

Table 3: Table representing the data retrieved and analysed to identify the best testing location within distance, *r*, of the reference set of testing locations

Once there are no further reference testing locations in the reference set, then this iterative loop ends. In step S11, the processor 23 determines if there is a further segment of the drive route to be analysed for the current combination of configuration profiles. In this example, the second segment (of the four segments of the drive route) needs to be analysed so the process loops back to step S3. Steps S3 to S9 are then performed for the second segment, such that the first, second and third sets of testing locations are plotted upon the second segment, a reference set of testing locations is identified, a circle is defined around each reference testing location, and the best testing location within distance, *r*, of each reference testing location is identified within the second segment. The best testing location and its associated RSRP for each reference testing location in the second segment are recorded in the database.

The process then repeats until the data for each of the four segments is analysed for the combination of configuration profiles. In step S13, a function is applied to the measurements associated with the best testing locations for each reference testing location in all four segments to derive an overall performance metric for that combination of configuration profiles. In this embodiment, the function is to apply a linear average to all the RSRP values recorded in the database for that combination of configuration profiles.

In step S15, it is determined whether there are any further combinations of configuration profiles to analyse and, if so, the process loops back to step S3 for the next combination. The above process is therefore repeated for all possible combinations of the antennae each using any one of the available configuration profiles. Thus, in this example in which there are three antennae and each may use one of nine configuration profiles, there are 84 possible combinations to evaluate. It is further noted that, in this example where all antennae are positioned on the same base station, the order of the antennae' configuration profiles does not matter (i.e. the combination of antenna 1 configuration profile 1, antenna 2 configuration profile 2 is the same as antenna 1 configuration profile 2, antenna 2 configuration profile 1), and there is no repetition of configuration profiles for several antennae (i.e. antennae 1 and 2 cannot both use configuration profile 1, as that would lead to identical physical parameters, such as height, azimuth angle and tilt, which is not allowable on the same base station). Following this analysis, the processor 23 has determined a performance metric (in this example, the linear average from step S13) for all 84 possible combinations of configuration profiles for the three antennae.

In step S17, the processor 23 identifies the best performance metric out of all performance metrics for all possible combinations of configuration profiles. In this embodiment, this is the performance metric being the greatest linear average RSRP. In step S19, the MNO applies the combination of configuration profiles associated with the identified best performance metric to the first, second and third antennae.

This embodiment of the present invention therefore provides a method in which drive tests conducted for different configuration profiles may be combined to evaluate theoretical performance metrics for combinations of those configuration profiles. Combinations of configuration profiles for several antennae may therefore be evaluated despite there being no real world drive test data for that combination. This greatly increases the usefulness of drive test data and reduces the number of drive tests that need to be conducted.

In step S1 above, the drive test route was divided into four segments of equal length. A more detailed approach to the segmentation process will now be described. In this approach, a minimum density of testing locations per unit area is defined. In a first step of the segmentation process, the drive test route is divided into two segments (known as segments of the first "segmentation level"). It is then determined if the density of testing locations (for all testing locations for the combination of three configuration profiles being investigated) in each segment at the first segmentation level is above the minimum density. If not, then the whole drive route is used as a single "segment" in the method of steps S3 to S19. If both segments do satisfy the minimum density, then the drive test route is further divided into four segments (known as segments of the second segmentation level). It is then determined if the density of testing locations in each segment at the second segmentation level is above the minimum density. If any of these segments do not satisfy this density, then the segment of the first segmentation level that included that segment of the second segmentation level is thereafter used in the method of steps S3 to S19, and, if any of these segments do satisfy this density, then that segment is further subdivided at a third segmentation level. This sub-process is continued until the whole drive route is divided up into segments having a testing location density above the minimum density, but cannot be further subdivided without dropping below the minimum density. The minimum density can be selected by the operator to strike an appropriate balance in the size of each segment. That is, if the minimum density is too low then the method evaluates combinations of configuration profiles across a very large area and there is no accounting for local deviations; however, if the minimum density is too high then the segments become so small that the difference in densities of testing locations in each segment for different sets of testing locations decreases so much that it becomes arbitrary which set is selected as the reference set. Nonetheless, the skilled person will understand that it is possible to implement the invention without any segmentation of the drive route.

In the above embodiments, a circle of radius, *r*, is defined around each reference testing location and all testing locations within that circle are evaluated. Put another way, any testing location within a distance *r* of the reference testing location is evaluated. The distance *r* can be selected by the operator to get the most appropriate solution. If the distance is too small, then very few other testing locations will be within the distance and the likelihood of the reference testing location itself being deemed the "best" testing location will increase. If the distance is too large, then many other testing locations will be within the distance and any testing location having a particularly good measurement will dominate the analysis over a larger area (that is, the process loses granularity).

Furthermore, in the above embodiment, the "best" testing location is the one having the greatest RSRP within distance, *r*, of the reference testing location. However, the skilled person will understand that there are other suitable measurements that may be used, such as Signal to Noise Ratio (SNR), Bit-Error Rate (BER), BLock Error Rate (BLER), power levels of unmodulated signals etc., and certain measurements may be more suitable than others depending on the service offerings of the base station.

In an enhancement to the embodiment described above, the step of identifying the best performance metric out of all performance metrics for all possible combinations of configuration profiles is based on a different concept. In this enhancement, the function applied to the measurements (associated with the best testing locations for each reference testing location in all four segments) takes into account both the linear average and the deviation of measurements from this average. By taking into account the deviation as well as the average, this enhanced method may favour a combination that yields a good (if not the best) average RSRP but has a favourable range of RSRPs across the whole drive route. This is illustrated in Figure 11, which is a graph illustrating the frequency of RSRPs (i.e. the number of times a particular RSRP value was recorded as being associated with a “best” testing location for all reference testing locations in all segments) for two possible combinations, which shows that combination B has a lower average RSRP but its range is so small that it doesn’t encompass RSRPs that are below a minimum acceptable value. Therefore, by using combination B over combination A, it is more likely that UEs will experience better service (e.g. fewer outages).

In the above embodiments, data from multiple drive tests along the same drive route is analysed by identifying different combinations of configuration profiles along that drive route. However, the skilled person will understand that it is not essential that the multiple drive tests have to share the entire drive route. That is, if any two drive tests have a common drive test portion, then the data from the multiple drive tests can be analysed to identify different combinations of configuration profiles along that drive test portion using the method outlined above.

The skilled person will also understand that the method may be applied to drive test routes that collect data from different transceivers of different base stations. However, in that case the order of combinations would make a difference and repetition of configuration profiles is now possible. Thus, if there are three configuration profiles for three antennae of three base stations, then there are 729 combinations to evaluate. Furthermore, the method may also be applied to data retrieved from drive tests that were conducted when the base station transmits from multiple antennae (e.g. all three antennae of the first base station 10). In this scenario, the configuration profile may be a unique combination of configuration parameters for all transceivers of the base station. The method may then be used to identify a combination of configuration profiles (e.g. a combination of the configuration profile for all transceivers of the base station and another configuration profile for one or more transceivers of another base station).

In the above embodiment, the reference set of testing locations was chosen based on which set of reference locations had the greatest density in the segment. In the event that two sets of reference locations have the same density, then one may be chosen at random to be the reference set of testing locations.

In the above embodiments, a vehicle is used for the dive test. The skilled person will understand any mobile testing device could also be used, including an Unmanned Vehicle (UV), such as a Unmanned Aerial Vehicle (UAV).

The skilled person will understand that any combination of features is possible within the scope of the invention, as claimed.

CLAIMS

1. A method of configuring a plurality of transceivers in a cellular telecommunications network, wherein a first and second transceiver of the plurality of transceivers may each use one of a first and second configuration profile, the method comprising the steps of:

receiving a first measurement of a property of the first configuration profile at a first plurality of testing locations along a route;

receiving a second measurement of the property of the second configuration profile at a second plurality of testing locations along the route;

identifying a first combination of the first and/or second plurality of testing locations associated with a first combination of the first and/or second configuration profiles for the first and second transceivers;

identifying a second combination of the first and/or second plurality of testing locations associated with a second combination of the first and/or second configuration profiles for the first and second transceivers;

calculating a first overall performance metric for the first combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a first identified testing location of the first combination of the first and/or second plurality of testing locations;

calculating a second overall performance metric for the second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a second identified testing location of the second combination of the first and/or second plurality of testing locations;

selecting one of the first and second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and second overall performance metrics; and

applying the selected combination of the first and/or second configuration profiles to the first and second transceivers.

2. A method as claimed in Claim 1, wherein the step of calculating the first and second overall performance metrics includes, for each of the first and second combination of the first and/or second plurality of testing locations:

selecting one of the first and/or second plurality of testing locations to be a reference plurality of testing locations; and, for each reference testing location of the reference plurality of testing locations,

identifying one of a first testing location of the first and/or second plurality of testing locations or a second testing location of the first and/or second plurality of testing locations within a predetermined distance of the reference testing location based on a comparison of the first and/or second measurement at the first testing location and the first and/or second measurement at the second testing location, wherein the calculation of the first overall performance metric is based on the first and/or second measurement associated with each identified first and/or second testing location within the predetermined distance of each reference point; and
the calculation of the second overall performance metric is based on the first and/or second measurement associated with each identified first and/or second testing location within the predetermined distance of each reference point.

3. A method as claimed in Claim 2, wherein the first and second combinations of the first and/or second plurality of testing locations associated with first and second combinations of the first and/or second configuration profiles are identified within first and second segments of the route; and the method further comprises:

selecting one of the first and/or second plurality of testing locations to be a first reference plurality of testing locations in the first segment; and

selecting one of the first and/or second plurality of testing locations to be a second reference plurality of testing locations in the second segment.

4. A computer program product comprising instructions which, when the program is executed by a computer, cause the computer to carry out the method of any one of the preceding claims.

5. A computer-readable data carrier having stored thereon the computer program of Claim 4.

6. A device for configuring a plurality of transceivers in a cellular telecommunications network, wherein a first and second transceiver of the plurality of transceivers may each use one of a first and second configuration profile, the device comprising:

a transceiver adapted to receive a first measurement of a property of the first configuration profile at a first plurality of testing locations along a route and to receive a second measurement of the property of the second configuration profile at a second plurality of testing locations along the route; and

a processor adapted to:

identify a first combination of the first and/or second plurality of testing locations associated with a first combination of the first and/or second configuration profiles for the first and second transceivers;

identify a second combination of the first and/or second plurality of testing locations associated with a second combination of the first and/or second configuration profiles for the first and second transceivers;

calculate a first overall performance metric for the first combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a first identified testing location of the first combination of the first and/or second plurality of testing locations;

calculate a second overall performance metric for the second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and/or second measurements associated with a second identified testing location of the second combination of the first and/or second plurality of testing locations;

select one of the first and second combination of the first and/or second configuration profiles for the first and second transceivers based on the first and second overall performance metrics; and

apply the selected combination of the first and/or second configuration profiles to the first and second transceivers.

7. A device as claimed in Claim 6, being a vehicle.

8. A device as claimed in Claim 7, being an Unmanned Vehicle (UV).