



Vodafone Terminal Capability Definition

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(4) Positioning Method

To meet the requirement that defines the positioning accuracy under the best positioning environment to the radius of 15m, The GPS positioning method (though other satellite positioning methods that have a similar positioning accuracy can be assumed in the future, “GPS positioning method” is described here as the method available at this point. The same applies hereafter) will be implemented as the basic positioning method. Either “Multi-base-station positioning method” or “Cell-based positioning method” or both of them, too, will be implemented as an alternative method in order to position in case where the GPS positioning method does not work (Table 3-4).

Table 3-4 Positioning Method Types
and Implementation Conditions

Positioning Method Type (Implementation Condition)	Overview	Example	Accuracy	Assumed to be used
GPS Positioning Method (Basic method)	Calculate the location based on the signals from more than four GPS satellites	A-GPS GPS	Some meters - Some 10m	In an open sky environment
Multi-base-station positioning method (Alternative method)	Calculate the location based on the sync signals from more than three base stations	E-OTD OTDOA A-FLT	Some 10m - Some 100m	In the city, Indoors
Cell-based positioning method (Alternative method)	Calculate the location based on the cell information at the base station to which the handset is connected	Cell ID	Some 100m - About 10,000m	Indoors, In underground cities (Places where the two methods above are not available)

The technical conditions for the GPS positioning method, the Multi-base-station positioning method and the Cell-based positioning method are as described between <1> and <3>.

<1> GPS Positioning Method

The positioning accuracy satisfies “within 10m” for 1CEP43 and “within 30m” for 2CEP for TTFF42 in an open sky environment (an environment in which no obstacles exist in the sky of elevation angle of about 5 degree and above) comprehensively considering the requirement and the current technical standards. To perfectly meet the requirement, the target for the future is “with 15m” for 2CEP.

Of a series of procedures to perform a positioning, the positioning procedure on the handset side complies with the Network-assisted GPS positioning method44 standardized in 3GPP or C.S0022-A45 standardized in 3GPP2.

<2> Multi-base-station Positioning Method

Not defined since the positioning accuracy depends on how dense base stations are established and how the base stations are located46.

The positioning procedure on the handset side complies or mostly complies with the OTDOA positioning method44 standardized in 3GPP.

<3> Cell-based Positioning Method

Not defined since the positioning accuracy depends on how dense base stations are established 47. The positioning procedure should be either of the below:

- (A) The cell ID obtained by a subscriber MSC to connect a voice call, etc. is provided to the positioning server defined in (5) <1> when a positioning request is made to the server. The positioning server searches the database in which cell location information is stored using the cell ID to acquire the location information of the cell.
- (B) A base station or the handset calculates the cell's location information and provides it to the positioning server every time it receives a positioning request.

The procedure that the MSC gets the subscriber's cell ID complies or mostly complies with the Cell ID based positioning method⁴⁴ standardized in 3GPP.

⁴² TTFF(Time To First Fix): Positioning time related to the GPS part only (excluding the communications time necessary for GPS positioning on the handset network). Although this varies according to the GPS maker, within 10 seconds is achieved with the current technology in an open sky environment.

⁴³ CEP(Circular Error Probability): In the positioning criteria, the top 68% accuracies (radiuses) from the number of positionings that is considered statistically significant is called 1CEP, 95% is called 2CEP.

⁴⁴ 3GPP TS 25.305, "Stage 2 functional specification of User Equipment(UE) positioning in UTRAN".

⁴⁵ 3GPP2 C.S0022-A, "Position Determination Service for Dual-Mode Spread Spectrum Systems".

⁴⁶ Positioning accuracy of the multi-base-station positioning: E911 of the U.S defines that the positioning accuracy in the multi-base-station positioning should be "within 100m" in 67% or more of the positioning results and "within 300m" in 95% or more. Since these values are taken from tests in an ideal positioning environment where base stations are located in octagon, the defined positioning accuracies are not satisfied in many cases in actual environments, mostly rural areas and coast areas, where not many base stations are established or they are located irregularly.

⁴⁷ Positioning accuracy of the Cell-based positioning: Handset entities establish base stations with the cell radius of within about 500m for indoors/underground cities, about 500m - 2,000m for outdoors in the city areas, about 1km - 15km for outdoors in the rural areas, which give an indication of positioning accuracy.