# Positioning basics Mobile Network Fundamentals

Creating an application for the Ericsson Positioning System is easy. With the help of the Software Development Kit, you will be able to create positioning applications faster than ever before.

#### Understanding the results you get

A few facts are good to know to understand the positioning result and the accuracy given. This two-pager will introduce you to the telecom fundamentals needed to get started with mobile positioning.

Among the most important parts of a mobile network are:

- The mobile phone
- The base station

The base station is responsible for the radio communication to and from the mobile phone. It is made up of antennas, transmitters, receivers and control units.

#### The cell

A cell is the basic unit of a mobile system and is defined as the geographical area where the radio coverage is given by one base station. When a call is setup, the phone is always connected to the base station belonging to the cell where you are located. In a complete network, the number of cells is large. The size of one cell depends on the demand for capacity and geographical topology. In an urban area the size of one cell is usually between 100 meters and up to a few kilometers. In rural areas the radius is generally up to 35 kilometers. Alongside highways with heavy traffic, cells are usually placed denser than in areas with just small roads (which means fewer people are using mobile phones in the countryside). A cell is represented simplified by a hexagon. Every operator has its own cell plan.

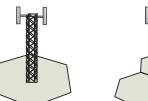
#### **Omni cells and sector cells**

If the demand for capacity in a certain area is low, it is common to place the base station in the middle of the cell, and let the antenna be omnidirectional, covering  $360^{\circ}$ . This gives the widest geographical coverage. In



5-min

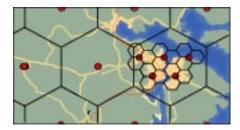
Base station serving a part of a city center





Omni cell

Three sector cells



Example of a cell plan. Red dot represents the location of the base station. Cells are smaller in cities.



urban areas, sector cells are often used. One base station is then placed where three smaller cells meet, with  $120^{\circ}$  coverage for each antenna. Many small cells together give higher capacity than a few big cells.

### **Timing Advance**

A phone signal from a base station far away requires longer time to reach the phone than a closely located one. Depending on the distance, the base station starts sending earlier to match the given time slot to stay in sync. This fact is used in the Timing Advance positioning method, because the distance from the base station can be calculated.

## Phone status: Idle / Busy

When the phone is turned on but no call is set up, it is in *idle* mode. During a call, it is in status *busy*. This status may affect the positioning method used, and result in different position accuracy. A detached phone cannot be located.

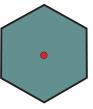
# How cell type and cell size affect positioning accuracy

It is not possible to give a specific value for the accuracy since it depends on several things like: if it is an omni cell or a sector cell, and the distance to the base station. Topology is also a factor that can cause reflections, affecting the positioning accuracy. Sector cells are usually smaller than omni cells, thus giving better accuracy than big omni cells. If timing advance can be used as positioning method, the result will generally be more accurate than with just a cell area.

## The future

The figures given here apply to the Mobile Positioning System 3.0. In coming versions, details may change and accuracy will be improved. In the future, more positioning methods, like GPS, will be supported as well as other positioning methods. Ericsson is one of the founders of LIF, Location Interoperability Forum, an organization developing and promoting an inter-operable location service solution that are open, simple, and secure. This solution allows user appliances and internet-based applications to obtain location information from the wireless networks independent of their air interfaces and positioning methods.

### The four representations of the phone location (darker area)



Complete omni cell



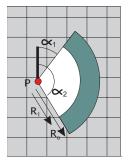
Omni cell with timing advance value



Complete sector cell



Sector cell with timing advance value



This is the result you get using the MPS-SDK 3.0. P is represented by a latitude and longitude value.