Technical Data Sheet

1 Indoor Navigation

Abstract: *Indoor navigation refers to positioning inside buildings. This type of navigation deals with a lot of technical challenges that need to be dealt with in order to obtain good accuracies and provide then relevant services.*

Indoor positioning refers to the process of computing the position of a device inside buildings. It is a challenging task because global navigation satellite signals are only available at very low signal strengths, making its use by standard receivers impossible.

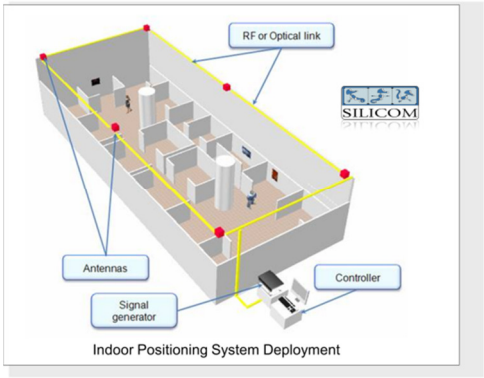
The advantages of indoor positioning to the development of applications are numerous: geo-marketing, indoor guidance in airports or shopping malls, etc. The recent spread of GNSS-enabled terminals, such as smartphones, confirm the growing potential of such applications to the end-users.

The need of indoor positioning technologies has pushed the research community towards different solutions (only the most mature solutions are mentioned here):

- **Proximity sensors:** The user approaches a sensor (RFID, MEMS, bar code, etc.) to a reader which is usually in a fixed know position. The ability to establish a communication link between the reader and the sensor means that the sensor is within a distance that is in the order of 2-3 meters from the reader.


RFID Sensor

- **Antenna coverage:** In the building there are multiple antennas, each one transmitting a dedicated identifier (frequency, code beacon…). The user, who stands inside the coverage area of only one of these antennas, is able to compute his position based on the information he is receiving.
- **Pseudolite:** Pseudolite is an abbreviation for Pseudo Satellite, which is a device that is placed inside a building, transmitting GNSS satellite-like signals. A standard receiver, instead of measuring distances to satellites, measures distances to the pseudolite devices and is then able to compute its position.



Indoor Positioning System Deployment

- **Wi-Fi/Bluetooth:** The user can estimate the distance to a transmitter by measuring the received signal strength (other techniques exist). By repeating the process for different transmitters and by knowing the position of the transmitters, the user is able to estimate his position. An improvement of this technique consists of measuring the signal strength in the entire building (scanning) to be used as a reference (e.g. each 1 meter in horizontal and vertical planes). Both methods may use trilateration to estimate the position.


HotSpot

- **Peer-to-peer (P2P):** This is a collaborative technique implying that multiple users share their position and are able to perform distance measurements among themselves. Some users might have (at least partial) visibility of the sky being able to perform satellite measurements. Distance measurements among users are performed using the Wi-Fi/Bluetooth technique based on the receiver (e.g. smartphone) transmitters.

All these techniques have disadvantages when compared to standard satellite positioning, namely the installations of additional devices with the first three techniques, or the poor accuracy when using the last two.