

Antenna arrangement

Field of the invention

The present invention relates to communications systems and more particularly to an antenna and a module for locating user equipment in a communications system.

Background of the invention

The accurate location of user equipment, such as a GSM (Global System for Mobile Communications) mobile device, cannot be determined using the information from a cellular network. The information enables the location only of an accuracy of about 100-300 meters in rural areas and 50-100 meters in city areas. For example, in a case of an emergency call, it is vital to find out the exact location from which the call was made to be able to get help to the site as fast as possible.

For better accuracy, one possibility is the use of GPS (Global Positioning System) receivers, which offer better accuracy. However, they are expensive and not widely carried and used by public. In addition, GPS receivers do not work reliably or at all indoors and in canyons, like in between high buildings.

Another possibility is to add high accuracy satellite positioning system functionality to the existing non-satellite positioning system user equipment without any modifications to the equipment itself but only by inserting a subscriber identity module, a SIM card comprising a satellite positioning system receiver and an antenna.

However, the problem with the SIM card with such a receiver and especially an antenna is the radio signal reception. One of the disadvantages associated with the above arrangement is that the receiver and antenna are inside the mobile device in proximity of a ground plane and other metallic parts and often covered with a battery. In this kind of circumstances traditional antennas are too big and do not work.

Brief disclosure of the invention

It is thus an object of the present invention to provide an apparatus to solve the above problems. The objects of the invention are achieved by an arrangement, which is characterized by what is stated in the independent claims. The preferred embodiments of the invention are disclosed in the de-

pendent claims.

The invention is based on the idea of providing an antenna for use in a mobile device, the antenna being characterized in that it comprises means for receiving a signal from a satellite positioning system, a first layer of dielectric material and a second layer of dielectric material, wherein the means for receiving the signal is at least partly between the first dielectric layer and the second dielectric layer.

It is an advantage of the arrangement of the invention that the GPS receiver can be used in circumstances where traditional antennas would not work.

Brief description of the drawings

In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 shows a cross section view of a mobile device;

Figure 2A shows a subscriber identity module according to the invention and its embodiments;

Figure 2B shows a cross section view of the subscriber identity module according to the invention and its embodiments;

Figure 3 illustrates an antenna structure according to the invention and its embodiments;

Figure 4 illustrates an antenna structure according to the invention and its embodiments;

Figure 5 illustrates an antenna structure according to the invention and its embodiments;

Figure 6A shows a subscriber identity module according to the invention and its embodiments;

Figure 6B shows a cross section view of the subscriber identity module according to the invention and its embodiments;

Figure 7 shows a non-radiating resonator antenna according to the invention and its embodiments; and

Figure 8 shows a non-radiating resonator antenna according to the invention and its embodiments.

Detailed description of the invention

According to the mirror image principle of the antenna theory, the antenna should be $1/4$ wavelength (in case of the GPS frequency of 1.575GHz about 47.6 mm) distance away from a metal or a conducting ground level or other metal part(s) to be efficient.

5 In one embodiment, by adding carefully measured dielectric material layers on both sides of an antenna element, the element can be distanced electronically from the metal parts, thus making the antenna efficient without extending its physical dimensions, especially its thickness.

The mobile device of the invention and its embodiments can be any
10 mobile device like 2G (Generation), 2.5G, 3G or 4G mobile device. It can be e.g. a mobile station, a cellular mobile station, a communicator or a computer. The detailed structure and operation of the mobile device and the communications systems are not relevant to the invention, and therefore they are described only to the extent that helps understanding the invention. Furthermore,
15 it should be noted that the invention can be applied to different kind of positioning systems and satellite systems and to different kind of communications systems and networks like fixed networks and packet switched networks or combination thereof and/or to wireless data transmission networks, such as Mobile-IP (Internet Protocol) networks and user equipment thereof.

20 For the invention and its embodiments a SIM (Subscriber Identity Module) card can be defined to be a card removably insertable into the user equipment containing data for subscriber identification and/or encipherment of radio communication and/or other security related information. However, it is to be noted that the SIM card according to the invention and its embodiments can
25 but does not have to be able to identify the subscriber. The card can be e.g. a SIM card or a USIM (Universal Subscriber Identity Module) card. The structure, the size, the physical dimensions, the weight and the layout of the card can be as described as follows, but they can also be different ones.

A processor in the SIM card or working with the SIM card can control the access to a memory of the SIM card or to a memory working with the
30 SIM card used for the location of the user device e.g. in response to the identity of the location request initiator. The control can mean e.g. the prevention of a location initiator from getting to the information of the memory. This means that in one way of using the SIM card there is no direct access to the memory
35 of the SIM card although there can be one. The SIM card can also recognize the location initiator being authorized to get the information directly from the

memory of the SIM card without any authorization requests for locating the user equipment. It is also possible that the user has given for some or all persons and/or authorities preauthorization for the direct access to the memory.

The SIM card can also be a so-called tamper-proofed device offering enough protection in relation to the location of a single person.

The SIM card can also be adapted to fit to different kinds of user equipment, to different kinds of mobile devices such that when inserted e.g. into a conventional cellular mobile station it can adapt to the system of the conventional mobile station and cause it to operate for locating the mobile station.

The SIM card can also comprise and/or be in cooperation with logic(s) and/or software program(s) or application(s), which can control the operation of the invention and its embodiments. The logic(s), the program(s) and/or the application(s) can be in the SIM card, in communication with the SIM card and/or it/they can be loaded to the SIM card and/or to the user equipment for carrying out the invention and its embodiments. The applications comprise e.g. Java and Symbian applications.

In other words, the SIM card can comprise means e.g. a program, for calculating the current location, like the coordinates, of the user equipment. Thus the whole processing of the positioning data and/or the current location can be done with the GPS chip and the SIM processor. The processor(s) of the user equipment are not needed in the calculation but it/they can also be used.

The SIM card can also comprise means e.g. a program, for sending the temporary data, pseudo data to the server for the calculation of the current location of the user equipment.

The Java and Symbian applications can process the location information received from the SIM card and/or from the server in many ways. The Java application can get the location information over the GPRS (General Packet Radio Service) network via the MSLC (Mobile Serving Location Center) server.

The SIM card can be virtual or separate, stand-alone card. For the invention and its embodiments the SIM card can be partly or wholly fixed to the user equipment or partly or wholly removably insertable into the user equipment. It can thus comprise one or more parts. The SIM card can also have different sizes, thicknesses and volumes. Although in the following the name SIM card will be used, it is to be understood that it also refers to different kind of

smart cards like to an ICC card (Integrated Circuit Card) or to a chip card. What is important for the invention and its embodiments is that it is a module with embedded information receiver and/or antenna.

The antenna element and other functional blocks can receive information for locating or for assisting the locationing of the equipment. Thus they can be in communication with e.g. a GPS (Global Positioning System) or an AGPS (Assisted GPS) system or other satellite-positioning systems like NAVSTAR (NAVigation System using Timing And Ranging), GLONAS (Global Navigation Satellite Service) or GALILEO. It must be noted that the module can comprise one or more receivers and/or antennas each of which is adapted to e.g. different positioning systems and/or frequencies.

In other words, the accurate location of a mobile device can be detected by using a satellite positioning system, such as GPS or other radio receiver or transmitter. The GPS receiver can be embedded in a SIM card.

The antenna, antenna element can be within the module or it can be provided as a separate component. Also the antenna and/or a ground of the user device can be used. If then the receiver unit is in the module, the sensitivity of the system can be increased compared to the situation where both the receiver and the antenna are in the module. This however can require the use of new user device.

The invention and its embodiments are based on the idea of adding a high accuracy satellite positioning system, like GPS, functionality to the existing non-satellite positioning system, like non-GPS, user equipment without any modifications to the device itself but only by inserting a new positioning system module, like AGPS enabled SIM card in it. It is also possible to insert the high accuracy satellite positioning system functionality to the existing satellite positioning system user equipment.

It is possible that the user can locate his/hers position by his/hers own initiative or the user can be located by the initiative of a third person or a service. However, before the third person or an external service can locate the user equipment, it is possible for the user to accept or reject the external positioning initiative unless it is generated by emergency services with an authority to do so by law, or by an application or service, which is authorised by the user. In these cases the remote location request sender can be authenticated by a positioning application, like the AGPS application on the SIM card prior to requesting a positioning subsystem, like the AGPS subsystem to generate the

location data. The authentication can use digital signature (PKI) or other available secure authentication methods to control the access to the AGPS subsystem functionality. The authentication can also be used for controlling the accessing to the location information for applications running on the SIM or mobile device.

The SIM module can also comprise means for controlling the access to the positing data. When an inquiry for positioning data is received, said means can check the right to use and/or the right to get said positioning data based on e.g. the identity of the sender of the inquiry. The SIM module can transmit the positioning data or deny its transmission. The SIM module can also calculate the location and transmit e.g. the coordinates to the initiator of the inquiry. The SIM card can also ask the user of the user device for the acceptance of the transmission of said data.

Figure 1 shows a cross section view, a side view of a mobile device 1-1. It comprises of a ground plane 1-2 of the mobile device, which plane can be e.g. a metallic layer, plane or wire with different sizes and shapes in the device and/or in the circuit board to be attached to the mobile device. It comprises an antenna 1-5 of the mobile device, and a battery 1-3. The Figure 1 also shows an element 1-4 according to the invention and its embodiments. The element 1-4 can be e.g. the SIM card, and it can be used for receiving RF signals from different positioning systems like from the satellite positioning system for determining positioning data at least partly in response to said signals. The element can comprise RF receiver/transmitter that can be embedded in a SIM card and/or in a USIM card (Universal Subscriber Identity Module). As shown in the Figure 1, the element, subscriber module(s) is typically inserted in the mobile device in proximity of the ground plane 1-2 and potentially covered by a battery 1-3.

The device chassis consists typically on printed circuit board (PCB), electronics and a metal ground plane. The structure and measures can vary depending on the device model. The SIM card including the antenna and being 0.76 mm thick, may be located in close proximity (~1 mm) of the ground plane and other parts containing metal, like battery.

Figure 2A shows the element 1-4 of Figure 1 and it is named as a subscriber identity module, the SIM card, although, as stated above, it can also be another type of a card, a circuit board, electronics and/or software that can receive data from a positioning system and/or process said data for determin-

ing positioning data and/or conveying positioning data. The element 2-1 can comprise of one or more modules, which can be separate modules or integrated modules and which modules can process one or more independent or interrelated functions. The element 2-1 comprises one or more contacts 2-2
5 and an RF receiver/transmitter, transceiver element 2-3. The element 2-3 can be a circuit board with functions for receiving and/or transmitting signals. The element 2-3 can handle different types of signals, like RF (Radio Frequency) signals, IF (Intermediate Frequency) signals and baseband signals e.g. to and from wireless transmissions, wireline transmissions and local area network.
10 One or more antenna elements are denoted as 2-5 and the element, which can adapt to different frequencies is denoted as 2-4. This adapting means can comprise one or more dielectric layers. One or more dielectric layers 2-4 can surround the antenna element 2-5 wholly or partly. The layers can be such implemented that on one side of the antenna element is arranged a first dielectric
15 layer and on another side of the antenna element is arranged a second dielectric layer. The dielectric layers can also be on top of each other. The first dielectric layer and/or the second dielectric layer can also be in contact with another dielectric material, with conducting material, with (semi)insulating material or other material with certain electromagnetic properties. The antenna 2-10
20 can comprise antenna elements 2-5 and adapting means 2-4. The receiving means can be adapted to receive the signal from a satellite positioning system. At least one of the dielectric layers can be adapted to the frequency of the signal.

The ground layer of the RF transceiver relative to the antenna can
25 be connected to the electrical ground contact of a subscriber identity module.

Figure 2B shows a cross section view of the module according to Figure 2A.

Figure 3 illustrates an antenna and the adapting means according to the invention and its embodiments. The structure can be named as a Symmet-
30 ric Dielectric SIM Antenna. The structure can comprise of three layers: a bottom dielectric layer 3-3, one or more antenna elements 3-1 and a top dielectric layer 3-2. Both the bottom dielectric layer and the top dielectric layer can be made of a thin ceramic or other material with high dielectric constant and/or low dielectric loss. The dielectric layers can be made of same material or of dif-
35 ferent materials. The thicknesses of the dielectric layers can be so designed that they equal to $1/4$ of the RF signal wavelength in the used dielectric mate-

rial, thus maximizing the signal gain. The structure 3-1, 3-2, 3-3 does not have form, build metallic or other ground plane, but it can alternatively use the ground plane 3-6 of the mobile device as its own ground plane.

As a result, the structure, the antenna can be electronically large in
5 volume but physically thin and small in volume, and fulfilling the desired $1/4$ wavelength distance from the metal parts for maximum gain. However, the dielectric loss of the used material(s) 3-2 and 3-3 and small physical size of the antenna can cause some reduction of the performance of the antenna. The antenna element can be fed 3-8 to the circuit board 3-9. The battery 3-7 can
10 cover the structure.

The structure of the antenna can be e.g. a monopole, a dipole, an inverted-F, a PIFA, a fractal, a ceramic chip and a patch antenna providing different radiation patterns and developed for and used with mobile devices.

Also one or more layer of plastic 3-4, 3-5 can cover said structure.
15 The plastic covering can be e.g. for packaging purposes and against wear.

The antenna and the RF transceiver can be integrated on the same substrate of an integrated circuit or a circuit board or they can be separate integrated circuits or components.

Figure 4 illustrates an antenna and the adapting means according to
20 the invention and its embodiments. The antenna element 4-1 and the circuit board 4-9 can be one integral structure 4-8. The antenna element can have the same length 4-10 within the dielectric material as the dielectric material 4-11. Alternatively the length of the antenna element can be longer or shorter than the length of the dielectric material. The antenna element can be sur-
25 rounded by dielectric layer(s) 4-2, 4-3 and the whole structure can be covered by thin layer of plastic, 4-4, 4-5. The subscriber identity module can be covered at least partially by at least one layer of plastic possibly excluding the contacts.

The ground plane 4-6 can be the ground plane of the device or a plane attached to the card.

30 Figure 5 illustrates an antenna 5-1 and the adapting means 5-2, 5-3 according to the invention and its embodiments. It can be named as an Asymmetric Dielectric SIM Antenna. The structure has been adjusted such that the top layer thickness and the bottom layer thickness of dielectric material are different. The adjustment can be e.g. such that either the top layer thickness or
35 the bottom layer thickness is exactly or approximately 2 times thicker than the other layer. The thicker layer can be e.g. $\frac{1}{2}$ of the wavelength in the dielectric

material while the thickness of the other layer remains as $\frac{1}{4}$ wavelength. Based on the mirror image principle, this arrangement can substantially cancel the RF radiation or reflections from one side of the antenna and make it immune of near by metal parts on that side.

5 This structure can also be surrounded by plastic layers 5-4, 5-5. The Figure also shows the battery 5-7 and the ground plane 5-6.

Instead of a wire antenna element, a dielectric resonator and/or a non-radiating resonator can be used to detect and receive the RF signal(s). The resonator element can comprise a metallic layer, a plane 6-5. Figure 6
10 shows said subscriber identity module and a cross section view of the module. The module 6-1 comprises of one or more contacts 6-2 and a RF receiver/transmitter element 6-3. The module also comprises of dielectric layer(s) 6-4, a ground plane 6-6 and one or more contacts 6-7 from the SIM card to the ground plane. By this structure a capacitive element can be implemented be-
15 tween the dielectric layer(s) and the ground plane. The antenna of Figure 6 can be named as a Non-radiating Resonator as a SIM antenna.

In this embodiment a resonator element 6-5 is used in the antenna elements and/or in the SIM card in conjunction with the mobile devices ground plane 6-6 and chassis, which can act as the other element of the resonator.
20 The resonator element in the SIM card can be capacitive, inductive or dielectric. The connection to the resonator element in the SIM card can easily be arranged internally and the connection to the other element, i.e. the mobile device ground plane 6-6 via one or more SIM card contacts 6-2, 6-7.

The resonator element in the SIM card can form together with the
25 mobile device ground layer a resonator with sufficiently broad bandwidth to work with mobile device models with different sizes of ground plates and when located in different places in the phone.

The resonator element can form the capacitive or the inductive coupling with the ground plane of the mobile device utilizing an electromagnetic
30 field 6-8 in between them. However, the distance 6-9 between the resonator (the SIM card) and the ground plane may vary depending on the model and mechanical structure of the used mobile device. The values of the distance are typically about 0.5 mm - 5 mm. The distance 6-9 between the capacitive elements are affecting to the capacitance and consequently the impedance, the
35 bandwidth and the tuning frequency. To decrease the detuning effect there can be arranged dielectric layers 6-4 on both sides of the resonant element in the

SIM card. In addition, by selecting material with high dielectric constant, the effect of the variation of the distance between the SIM card and the ground plane on the resonator performance can be reduced to acceptable level. In other words, the second metal layer can be arranged to the SIM card, to the
5 mobile device and/or to the circuit board to be attached to the mobile device.

The resonator can also be without coupling with the ground plane. It can be for example a simple resonator circuit (RLC) connected in between the antenna input of the receiver and the ground of the SIM card and/or a filter to isolate the receiver subsystem (including SIM processor) from the RF frequency currents in the ground plane of the mobile device.
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Figures 7 and 8 show a non-radiating resonator antenna according to the invention and its embodiments. The non-radiating resonator antenna can comprise a resonator circuit 7-4 tuned according to the receiver 7-6 frequency within the bandwidth of the receiver, connected to the receiver antenna input 7-5 and to the ground of the mobile device 7-1, which can be connected
15 via the SIM contacts 2-2, 8-7 to the mobile device's ground plane 1-2, 8-6. The resonator circuit can be e.g. an LC oscillator. The resonator circuit can also be implemented as a filtering means, e.g. band pass filter. The grounds of the receiver and other circuits in the SIM card can be connected to the filtered ground, the SIM card ground 7-3, which can be connected to the ground 7-1
20 via the filter 7-2, which can allow DC current to pass, but is tuned to filter at least the frequency range of the receiver 7-6. A second or an alternative filter 7-2 can be implemented to filter the SIM Supply Voltage 7-8. The input/output (I/O) contact of the SIM card is shown by 7-7. 7-10 shows other possibly
25 blocks to be used e.g. for processing purposes. The ground 7-3 can also be called as a virtual ground.

In other words, one or more filters 7-2 can be used to separate those frequencies coming from the ground plate so that the frequency of interest is passed through to the receiver input. For DC and low frequency return
30 currents there can be a low pass filter in order to have noise free operation of the SIM card. The filter 7-2 can thus pass low frequencies and DC voltage, but it can block the RF signal.

In Figure 7 the only antenna plate can be the ground layer of the mobile device and the resonator can sense the signal from that layer.

35 In this arrangement the RF signal radiation 8-1 can cause high frequency currents and subsequent voltages 8-2 into the ground plane 1-2, 8-6 of

the mobile device, which can be connected to the ground 7-1 of the mobile device via the SIM contacts 2-2, 8-7. The ground 7-1 can thus be said to be noisy containing various radio frequency components. The filter 7-2 can remove high frequency component and passes the DC current to the clean filtered ground 7-3. The difference of the noisy ground 7-1 and clean filtered ground 7-3 can contain the received signal, which is passed to the receiver antenna input 7-5 via the resonator 7-4. The places of the filter 7-2 and the resonator 7-4 can be changed.

The resonator 7-4 can be implemented in several ways. It can comprise e.g. one or more of a dielectric component and/or one or more of a resistor and/or one or more of a capacitor and/or one or more of an inductor.

Also the filtering means 7-2 can be implemented in several ways. It can comprise one or more of a dielectric component and/or one or more of a resistor and/or one or more of a capacitor and/or one or more of an inductor and/or one or more of a transconductor. It can be active or passive, digital or analog, symmetric or asymmetric and be implemented by many different techniques, like gm-C technique.

The resonator, the receiving means and the filtering means can be implemented by one or more functional blocks.

The SIM card is represented by 8-3, the circuit board of the mobile device is represented by 8-4, the connection of mobile device ground plane 8-2 to the circuit board 8-4 is represented by 8-5 and the ground plane of the mobile device is represented by 8-6.

The antenna or the antenna arrangement according to the invention and its embodiments can be implemented in several ways. The first and the second metal layers can alternatively or in addition be conductive or semi conductive layers of other materials than metal, e.g. of plastic. The ground level of the SIM card can be connected to the ground level of the mobile device. The antenna can comprise a first metal plane which is at least partly between the first dielectric layer and/or the second dielectric layer, the first metal plane layer being adapted to be coupled with a second metal plane layer of the subscriber identity module and/or the mobile device whereby a resonator is formed between the first metal layer (6-5) and the second metal layer. When the metal layer of the mobile device is used, the resonator is formed when the antenna arrangement is installed in the mobile device.

The antenna can be manufactured in several ways. For example, it can be made as an ceramic component with the antenna element(s) built-in (3) using a LTCC method, or as (flexible) Printed Circuit Board (PCB) (4) with ceramic layers attached on both sides of it. Alternatively, the dielectric material
5 can be sputtered on the surface of a ceramic chip antenna.

According to the invention and its embodiments many different types of dielectric materials can be used. These materials comprise e.g. SrTiO_3 and $\text{Ba}_{1-x}\text{Sr}_x\text{TiO}_3$. The materials can have very high dielectric constant ($\epsilon_r \sim 300$ or even more) and low dielectric loss.

10 If the dielectric material, such as SrTiO_3 with dielectric constant $\epsilon_r \sim 300$, is used for layers 3-2, 4-2 and 3-3, 4-3, the electromagnetic wavelength in this material is substantially $1/300$ of the wavelength in free space. As an example, GPS L1 system can use the frequency of 1.575 GHz with free space wavelength about 190 mm. In said dielectric material the wavelength is $1/300 \times$
15 $190 \text{ mm} = 0.633 \text{ mm}$ and $1/4$ wavelength is 0.158 mm , respectively.

The invention and its embodiments have many advantages. It is cost efficient and easy to manufacture enabling thus the use of the GPS receiver in circumstances where traditional antennas would not work.

It will be obvious to a person skilled in the art that, as the technology
20 advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. An antenna (2-10, 6-10) for use in a mobile device (1-1), **characterized** in that the antenna (2-10) comprises

- receiving means adapted to receive (2-5, 3-1, 4-1, 5-1, 6-5, 7-6) a signal from a satellite positioning system;
- a first layer of dielectric material (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15); and
- a second layer of dielectric material (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15), wherein the receiving means (2-5, 3-1, 4-1, 5-1, 6-5, 7-6) is at least partly between the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) and the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15).

2. An antenna (2-10) according to claim 1, **characterized** in that the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) and the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) have the same dielectric constants.

3. An antenna (2-10) according to claim 1, **characterized** in that the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) and the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) have different dielectric constants.

4. An antenna (2-10) according to any one of the previous claims 1 to 3, **characterized** in that at least one of the dielectric layers (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) is adapted to the frequency of the signal.

5. An antenna (2-10) according to any one of the previous claims 1 to 4, **characterized** in that the dielectric constant and/or the dielectric loss and/or the thickness of at least one of the dielectric layers (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) is adapted to the frequency of the signal.

6. An antenna (2-10) according to any one of the previous claims 1 to 5, **characterized** in that the thickness of the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) substantially equals to the thickness of the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15).

7. An antenna (2-10) according to any one of the previous claims 1

to 6, characterized in that the thickness of the dielectric layers (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) is one quarter or one half of the wavelength of the received signal.

8. An antenna (2-10) according to any one of the previous claims 1 to 5, characterized in that the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) is substantially two times thicker than the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15).

9. An antenna (2-10) according to claim 8, characterized in that the thickness of the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) is substantially one half of the wavelength of the received signal and the thickness of the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) is substantially one quarter of the wavelength of the received signal.

10. An antenna (2-10) according to any one of the previous claims 1 to 9, characterized in that means for receiving (2-5, 3-1, 4-1, 5-1, 6-5) the signal comprises a wire (2-5, 3-1, 4-1, 5-1).

11. An antenna (2-10) according to any one of the previous claims 1 to 9, characterized in that means for receiving (2-5, 3-1, 4-1, 5-1, 6-5) the signal comprises a first metal plane layer (6-5), which is at least partly between the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) and/or the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15), the first metal plane layer being adapted to be coupled with a second metal plane layer, whereby a resonator (6-5, 6-6) is formed between the first metal layer (6-5) and the second metal layer (6-6).

12. An antenna (2-10) according to claim 11, characterized in that the resonator (6-5, 6-6) is capacitive, inductive, dielectric and/or non-radiating.

13. An antenna (2-10) according to claim 11 or 12, characterized in that the second metal plane layer (6-6) is a ground layer (1-3, 3-6, 4-6, 5-6, 6-6) arranged to a mobile device (1-1).

14. A subscriber identity module (1-4, 2-1) comprising one or more contacts for connecting to a mobile device, characterized in that it comprises an antenna (2-10, 6-10) according to any one of the previous claims 1 to 13, the antenna further comprising a first metal plane layer (6-5) as the receiving means, which is at least partly between the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) and the second dielectric layer (2-

4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) the first metal plane layer being adapted to be coupled with a second metal plane layer (6-6) of the subscriber identity module whereby a resonator (6-5, 6-6) is formed between the first metal layer (6-5) and the second metal layer (6-6).

5 15. A module (2-1) according to claim 14, characterized in that the resonator (6-5, 6-6) is capacitive, inductive, dielectric and/or non-radiating.

16. A module (2-1) according to claim 14 or 15, characterized in that second metal plane layer (6-6) is a ground layer.

10 17. A module (2-1) according to claims 14 to 16, characterized in that the distance (6-9) between the metal plane layers (6-5, 6-6) is adapted on the basis of the frequency to be received.

18. A subscriber identity module (2-1) according to claims 14 to 17, characterized in that comprises means for determining positioning data at least partly based on the signal.

19. A subscriber identity module (2-1) according to claims 14 to 18, characterized in that it comprises means for conveying the signal from a satellite positioning system and/or the positioning data via one or more contacts (2-2).

20. An antenna arrangement (6-10) for receiving a signal from a satellite positioning system, characterized in that it comprises an antenna (2-10, 6-10) according to any one of the previous claims 1 to 7, the antenna further comprising a first metal plane layer (6-5) as the receiving means, which is at least partly between the first dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) and/or the second dielectric layer (2-4a, 2-4b, 3-2, 3-3, 5-2, 4-3, 5-2, 5-3, 6-4, 6-15) the first metal plane layer (6-5) being adapted to be coupled with a second metal plane layer (6-6) of a mobile device, whereby a resonator (6-5, 6-6) is formed between the first metal plane layer (6-5) and the second metal plane layer (6-6) when the antenna arrangement is installed in the mobile device.

21. An arrangement (2-10) according to claim 20, characterized in that the resonator (6-5, 6-6) is capacitive, inductive, dielectric and/or non-radiating.

22. An arrangement (2-10) according to claim 20 or 21, characterized in that second metal plane layer (6-6) is a ground layer.

23. An arrangement (2-10) according to claims 20 to 22, c h a r a c t e r i z e d in that the effect of the variation of the distance between the first metal layer (6-5) and the second metal layer (6-6) is controlled on the basis of the dielectric constant of the dielectric material for minimizing the detuning
5 effect .

24. A mobile device (1-1) comprising a first antenna for receiving a signal from a mobile communications system, c h a r a c t e r i z e d by further comprising a second antenna (2-10, 6-10) according to any one of the claims 1
10 to 13, a subscriber identity module (6-1) according to any one of the claims 14 to 19 or an antenna arrangement (6-10) of the claims 20 to 23 for receiving a signal from a satellite positioning system.

25. An antenna arrangement (6-10) for receiving a signal from a satellite positioning system, c h a r a c t e r i z e d in that the antenna ar-
15 rangement comprises

- receiving means (7-1, 8-6) adapted to receive the signal the receiving means (7-1, 8-6) being a ground (7-1) of a mobile device;
- resonator means (7-4) being adapted to the frequency
20 of the signal; and
- filtering means (7-2) adapted to pass frequencies below the frequency of the signal.

26. An antenna arrangement (6-10) according to claim 25, c h a r a c t e r i z e d in that resonator means (7-4) and filtering means (7-2) are coupled to the receiving means (7-1, 8-6).

27. An antenna arrangement (6-10) according to claims 25 or 26, c h a r a c t e r i z e d in that resonator means (7-4) and filtering means (7-2) are
30 coupled together.

28. An antenna arrangement (6-10) according to any one of the previous claims 25 or 27, c h a r a c t e r i z e d in that resonator means (7-4) and filtering means (7-2) are coupled to a subscriber identity module.

29. An arrangement according to any one of the previous claims 25

or 28, characterized in that the resonator (7-4) comprises one or more of a dielectric component and/or one or more of a resistor and/or one or more of a capacitor and/or one or more of an inductor.

30. An arrangement according to any one of the previous claims 25
5 to 29, characterized in that the filtering means (7-2) comprises one or more of a dielectric component and/or one or more of a resistor and/or one or more of a capacitor and/or one or more of an inductor and/or one or more of a transistor.

31. An arrangement (2-10) according to any one of the previous
10 claims 20 to 23, characterized in that the distance between the resonator (6-5, 7-4) and the ground plane (6-6, 7-1) is adapted on the basis of the frequency to be received.

32. A module according to any one of the previous claims 14 to 19,
15 characterized in that the effect of the variation of the distance (6-9) between the first metal layer (6-5) and the second metal layer (6-6) is controlled on the basis of the dielectric constant of the dielectric material (6-4) for minimizing the detuning effect.