

METHOD AND DEVICE AT A TRANSMITTER AND RECEIVER UNIT IN A
MOBILE TELEPHONE SYSTEM

5 The present invention relates to a method pertaining to a
transmitter and receiver unit in a mobile telephone system. The
invention also relates to an arrangement for carrying out the
method.

10 More specifically, the invention relates to a method and to an
arrangement for mobile telephone systems in large buildings,
and particularly in very tall buildings such as so-called
skyscrapers. The mobile telephone system may be any known
wireless mobile system, for instance a GSM system. The
invention is described below with reference to a GSM system,
15 although it will be understood that the invention is not
restricted to this particular type of system. For instance, the
system may be a PABX system or a wireless-LAN-system. The
present invention can also be applied in fully internal
wireless mobile telephone systems in large buildings, where the
20 internal system is connected to the outside world via an
existing telephone network.

The use of a mobile system in large buildings, and then
particularly in skyscrapers, presents serious problems unless
25 measures are taken in the buildings concerned. This is due to
several reasons. One reason is the actual building itself,
since a skyscraper will normally include a significant number
of reinforcement bars, steel beams, etc., which tend to screen
the building magnetically from the outside world. The metal
30 coated panes of facade glass with which such buildings are
normally covered to a large extent also have this affect. It is
also necessary in a high building to install a large number of
base stations which communicate with the mobile telephones and
which are able to cover the whole of the building area. This

can present a system problem with respect to the base station with which a given mobile telephone shall communicate.

Another problem is one of providing effective radio coverage within large buildings. When ground-mounted base stations are used, this is due to attenuation of the radio signals caused by the building, and consequently coverage will become poorer further into a building. By ground-mounted base stations is meant base stations that are placed outdoors.

A further problem resides in the requirement of a high network capacity in large buildings, owing to the large number of users in such buildings. For instance, if a high building has good radio contact with ground base stations the users in said building will take a large part of the capacity of such base stations, therewith reducing the base station capacity for users outside the building. Furthermore, there will often be interference between different base stations covering the building, resulting in poor speech quality and, at times, in lost connections.

Consequently, mutually separate internal mobile telephone systems are often installed in large and high buildings.

Skyscrapers and large buildings have been mentioned in the foregoing. By large buildings is also meant large public complexes or buildings, such as airport buildings, railroad stations, restaurants, office buildings, and so on.

The present invention is not restricted to any particular type of building, but can be applied in all manner of buildings which due to their size and/or configuration necessitate the installation of separate systems that include comprehensive cabling, a large number of antennas, etc., when practicing

known techniques, in order to obtain satisfactory mobile telephone traffic with good coverage within the building concerned. What is strived for is higher speech quality, better coverage and greater capacity.

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Such separate installations include a local transceiver unit which is connected to the fixed part of a mobile telephone network installed in the building. The transceiver unit is a base transceiver station that corresponds to a typical base station in a GSM network. Cables are drawn from the transceiver unit to different stories or floors in the building, where one or more antennas are placed on each storey.

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According to one embodiment, coaxial cables are drawn from the transceiver unit to passive antennas in the building, via so-called splitters. This solution is primarily intended for smaller buildings. It is not as effective in larger buildings, due to the high losses experienced in the coaxial cables, among other things.

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Consequently, fibre optic cables are used in larger buildings between the transceiver unit and an active antenna unit at each storey, for instance. The active antenna unit converts light in the fibre optic cable to an RF-signal and vice versa, in addition to including a transceiver antenna. An installation of this nature may also be supplemented with a facility in which the active antenna unit also supplies passive antennas via splitters.

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It is obvious that the known solutions to the problem of implementing mobile telephone systems in large buildings requires a large amount of coaxial cables and fibre optic cables to be laid in the building, and that a large number of splitters, combiners, antenna units and antennas must be

installed. Such installation is very laborious and cost-demanding.

5 The present invention solves the aforesaid problems in a very simple and relatively very inexpensive manner.

10 The present invention thus relates to a method pertaining to a transceiver unit in a mobile telephone system in which the transceiver unit is installed in a building that includes a ventilation system for use for mobile telephone traffic within the building, said method being characterised by installing one or more antennas in one or more of the air ducts belonging to the building ventilation system and connecting said antennas to said transceiver unit.

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The invention also relates to an arrangement that has essentially the characteristic features set forth in Claim 7.

20 The invention will now be described in more detail with reference to an exemplifying embodiment of the invention and also with reference to the accompanying drawing, in which

- Figure 1 is a schematic illustration of a skyscraper building;
- Figure 2 is a schematic illustration of a ventilation system
- 25 in the form of an air-conditioning system, and is a sectional view of the stories of a skyscraper building;
- Figure 3 is a schematic, diagrammatic illustration of an installation in a building; and
- Figures 4-6 show alternative antenna installations.

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The invention is described below with reference to a skyscraper, although it will be understood that the invention can be applied equally as well in other types of building, as mentioned earlier.

Figure 1 illustrates a typical skyscraper 1. Three particular stories 2, 3, 4 are marked in Figure 1. These stories are used for an air-conditioning plant, and the supply of electric
5 current and water. With respect to the air-conditioning system, an air-conditioning plant installed on such a storey, or floor, will normally serve a number of building stories, or floors, above and below the air-conditioning plant, as illustrated by the arrows 5, 6, 7. An air-conditioning plant may, for
10 instance, serve six stories below the plant and six stories above the storey on which the plant is installed.

Instead of an air-conditioning plant, the system concerned may be a general ventilation system or a ventilation system for
15 ventilation on the one hand and for heating the building on the other hand.

Figure 2 is a schematic illustration of an air-conditioning plant 8 which distributes supply air and exhaust air to and
20 from the various stories or floors via main air ducts 9, 10. Provided on each storey is a secondary air duct 11, 12 which is connected to the main air duct 9, 10 and which distribute air to respective stories.

25 An air conditioning system includes a duct system 12, 10 which delivers air to different parts of the building, and a duct system 11, 9 which sucks air from different parts of said building. A blower 13 blows air into the air supply ducts. Exhaust air normally passes through a filter 14, before being
30 released. The direction in which the air flows is arrowed in Figure 2. A cooling and/or heating coil 15 is connected to the unit 8, for adjusting the temperature of the supply air. The design of an air-conditioning plant will, of course, vary in

accordance with the size and geographical location of the building.

The various spaces, rooms, in the building will include openings through which air can enter and leave the space concerned. In an air-conditioned building, the openings are normally positioned to achieve a uniform air flow throughout the entire building. Such openings are normally placed in all rooms and in other spaces in the building.

The present invention relates to a method pertaining to a transceiver unit in a mobile telephone system in which the transceiver unit 16 is installed in a building for use in mobile telephone traffic within the building, and in which the building is provided with a ventilation system of known kind.

The transceiver unit 16 is of a known kind, such as a so-called base transceiver station, and is connected to the mobile telephone network concerned, normally via a fixed communications network. The transceiver unit 16 can be placed anywhere in the building, and more than one transceiver unit may be placed in the building.

According to the present invention, one or more antennas 17, 18 is/are installed in one or more of the air ducts 9, 10 of the building ventilation system, such as an air-conditioning system. The antenna/antennas 17, 18 is/are connected to the transceiver unit 16, this connection between antenna and transceiver unit being shown schematically by the chain line 19 in Figure 2.

The antennas are, for instance, of the kind used for mobile telephones, i.e. omnidirectional antennas. It will be understood, however, that other antennas may be used when

applying the present invention. For instance, antennas that have a directional effect may alternatively be used. For example, an antenna is installed by providing in the air duct a hole through which the antenna can be inserted. Alternatively,
5 an antenna is installed in the air duct and held in place by means of an appropriate fastener.

In one preferred embodiment of the invention, at least one antenna is installed in a main air duct 9, 10, as illustrated
10 with the antennas 17, 18 in Figure 2. The main air ducts communicate with a number of smaller or secondary air ducts 11, 12 which open into different rooms in the building. The grating normally located adjacent the orifice of respective air ducts 11, 12 in a room or some other space in the building shall be
15 designed to allow the radio signals concerned to pass freely through said orifice. This requirement is satisfied by using plastic gratings.

The antennas have, for instance, a transmission power of only
20 0.5 W at a transmission frequency of 1800 MHz. Trials with such antennas and conventional GSM telephones have shown that extremely effective contact is obtained between the antennas and mobile telephones in a building in which the present invention has been applied in the aforescribed manner.

25 However, the person skilled in this art will realise that frequency and output power can be chosen in accordance with the radio system to be used.

30 Because the antennas are placed centrally in the air-conditioning system, a signal sent by the transceiver unit via the antennas will propagate generally equally throughout that part of the building to which the main air ducts concerned extend. Similarly, a signal sent by a mobile telephone will be

conducted via an orifice of said kind in a building space into a smaller air duct 11, 12 and through said duct to a main air duct 9, 10 and therewith to an antenna 17, 18.

5 In one embodiment of the invention, at least one antenna is installed in each section 5, 6, 7 of the air ducts 9, 10 of the air-conditioning system, where each of said sections serves a given number of stories, or floors, in the building. One such section may conveniently include from 12 to 24 stories of a
10 skyscraper, although it will be understood that the number of stories served will depend on the design of the air-conditioning system.

When many stories are served by one and the same main air duct,
15 it is highly beneficial to install one or more additional antennas in each section of the air ducts 9, 10 of the air-conditioning system, where each of the sections serves different parts of the building. This is illustrated in Figure 2 with the additional antennas 20, 21.

20 According to one preferred embodiment, one or more antennas are installed in the supply air ducts 10 and one or more antennas are installed in the exhaust air ducts 9. Because the orifices of the supply air system and the exhaust air system
25 respectively in the various spaces of the building are often positioned at different places in said spaces, this embodiment provides effective and uniform radio coverage.

In one embodiment, the antennas 17, 18, 20, 21 are passive
30 antennas and are connected to the transceiver unit 16 via coaxial cables 22, 23, as illustrated in Figure 3.

Alternatively, the antennas 24, 25 are active antennas which are connected to the transceiver unit 16 via fibre optic cables

26, 27. In this case, the active antennas include a device 28, 29 which converts light in the fiber optic cable to an RF-signal and vice versa, in addition to including a transmitting and receiving antenna.

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Figures 4, 5 and 6 illustrate alternative antenna installations in air ducts 9, 10.

Figure 4 shows an antenna 30 which is housed in a metallic housing 31. An opening has been made in the duct and covered with a non-metallic cover 32, for instance a plastic cover. The cover 32 and the housing 31 are secured in the duct 9, 10 by means of a screw joint 33, 34. The antenna 30 may be a directional antenna or some other suitable type.

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Figure 5 shows an antenna 35 which is carried by a plate 36 that covers an opening in the air duct. The antenna is suitably an omnidirectional antenna.

Figure 6 shows an antenna arrangement in which the antenna 37 projects into the air duct. The antenna 37 may be a dipole antenna or some other suitable type.

Both active and passive antennas may be used in one and the same system and placed at mutually different positions.

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The person skilled in this art will have no trouble in determining the number of antennas required and their positions in the air ducts in obtaining the desired radio coverage.

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It will be obvious that the present invention requires a minimum of installations in a building in comparison with the installations required when applying the aforescribed known

technology, by virtue of the fact that the existing air duct infrastructure of a building is used as wave guides, .

5 The present invention thus provides a significant advance in enabling highly effective radio coverage for mobile telephony to be obtained in a building quickly and inexpensively, and also to provide very high speech quality and high capacity.

10 Although the invention has been described with reference to a number of embodiments and with reference to only one section of an air-conditioning system, it will be understood that the invention can be varied in different ways to achieve the radio coverage desired. Instead of placing antennas in air-conditioning duct sections that lie at different heights above
15 each other, the antennas may equally as well be placed in different sections of air-conditioning ducts that are located horizontally one after the other, as in a large, elongated air terminal building.

20 The present invention shall not therefore be considered as limited to the aforescribed exemplifying embodiment, since variations can be made within the scope of the accompanying Claims.

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CLAIMS

1. A method relating to a transceiver unit in a mobile telephone system wherein the transceiver unit is installed in a building and used for mobile telephone traffic within the building, and wherein the building includes a ventilation system, characterised by installing one or more antennas (17, 18, 20, 21) in one or more of the air ducts (9, 10) belonging to the ventilation system of said building, and connecting said antenna or antennas (17, 18, 20, 21) to the transceiver unit (16).
2. A method according to Claim 1, characterised by installing at least one antenna (17, 18, 20, 21) in a main air duct (9, 10) that communicates with a plurality of smaller or secondary air ducts (11, 12) which open into rooms and spaces in the building.
3. A method according to Claim 1 or 2, characterised by installing one or more antennas (17, 18, 20, 21) in each section of the air ducts (9, 10) of said ventilation system where each of said sections serves respective different parts of the building.
4. A method according to Claim 1, 2 or 3, characterised by installing one or more antennas (18, 21) in air ducts (10) that deliver supply air to the building and installing one or more antennas (17, 20) in exhaust air ducts (9).
5. A method according to Claim 1, 2, 3 or 4, characterised in that said one or more antennas (17, 18, 20, 21) are passive antennas connected to the transceiver unit (16) via coaxial cables (22, 23).

6. A method according to Claim 1, 2, 3 or 4, characterised in that said one or more antennas (28, 29) are active antennas connected to the transceiver unit via fiber optic cables (26, 27).

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7. An arrangement relating to a transceiver unit in a mobile telephone system in which said transceiver unit is installed in a building and used for mobile telephone traffic within said building, and wherein the building includes a ventilation system, characterised in that one or more antennas (17, 18, 20, 21) is/are installed in one or more of the air ducts (9, 10) belonging to the ventilation system of said building and connected to the transceiver unit (16).

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8. An arrangement according to Claim 7, characterised in that at least one antenna (17, 18, 20, 21) is installed in a main air duct (9, 10) that communicates with a number of smaller or secondary air ducts (11, 12) which open into different rooms and spaces in the building.

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9. An arrangement according to Claim 7 or 8, characterised in that one or more antennas (17, 18, 20, 21) are installed in each section of the air ducts (9, 10) of said ventilation system, where each of said sections is intended to serve different parts of the building.

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10. An arrangement according to Claim 7, 8, or 9, characterised in that one or more antennas (18, 21) are installed in air supply ducts (9) for delivering supply air to the building; and in that one or more antennas (17, 20) are installed in exhaust air ducts (10).

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11. An arrangement according to Claim 7, 8, 9 or 10, characterised in that the antennas (17, 18, 20, 21) are passive



antennas connected to the transceiver unit (16) via coaxial cables (22, 23).

12. An arrangement according to Claim 7, 8, 9 or 10,
5 characterised in that the antennas (24, 25) are active antennas connected to the transceiver unit (16) via fiber optic cables (26, 27).



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