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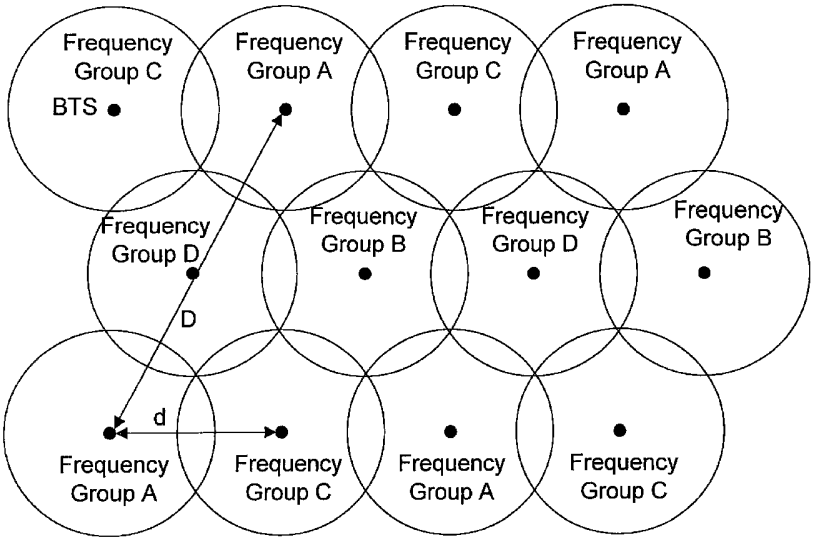
(54) **Title:** A CELLULAR MOBILE TELEPHONE NETWORK AND A PROCEDURE TO OPTIMIZE IT



(57) **Abstract:** The present invention relates to a procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network, in which the base station (BS) of/for each cell is allocated a number of carrier frequencies (f_1, ..., f_n), where n is an integer, from the frequency band for the mobile telephone network to transmit the information to mobile stations within the cell. In the cellular mobile telephone network, carrier frequencies (f_1, ..., f_n) of a cell recur in another cell according to a predefined frequency reusing factor. The procedure includes the steps: to allocate to the pilot channel (f_x _pilot channel) of a carrier frequency (f_x), where x is an integer and $1 \leq x \leq n$, a very high share of the for the carrier frequency (f_x) available power; and to allocate to the pilot channels of different carrier frequencies (f_1, ..., f_n) different power.

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A CELLULAR MOBILE TELEPHONE NETWORK AND A PROCEDURE TO OPTIMIZE IT

Technical field

The present invention relates according to a first aspect to a cellular mobile telephone network.

According to a second aspect the present invention relates to a procedure to optimize a cellular mobile telephone network.

According to a third aspect the present invention relates to at least one computer program product to optimize a cellular mobile telephone network.

Prior art

At the issuance of permits for UMTS-licenses the authorities of some countries have demanded that the licensee shall fulfill a criterion for the signal strength of the UMTS pilot channel. The demand means that the signal strength with certain probability, in excess of the promised coverage area, must not be lower than a certain predefined signal level. The problem is, at fulfillment of above mentioned criterion, to build a UMTS-network in an optimal way with regard to, among other things, traffic routing possibilities and the spectrum efficiency.

Document WO-A1-96/37082 describes a cellular mobile telephone network, in which each cell is allocated specific frequencies which differ from those of adjacent cells in such a way that the same frequencies are reused in other cells according to a frequency reusing factor. The document also describes that at least one of the carrier frequencies is transmitted with lower power. On can for each cell create a number of frequency groups with different power - in the extreme case as many as the number of carrier frequencies. The aim of the solution according to this document is to increase the capacity in the cellular mobile

telephone network without extending the frequency band. This solution, however, does not solve the above presented problem.

Document WO-A1-00/07318 describes a procedure and a system to allocate power to channels in a requirement based system for the transceiver system of the base station. The aim of the power control is to keep the power of a carrier frequency on a described power. Available power on a carrier frequency is allocated between active channels.

The document US-5,901,145 describes handover for a mobile station between a communication system with distributed/spread spectrum and a frequency division/ spacing communication system. This solution uses a pilot channel which is not controlled by the base station.

None of the above mentioned documents addresses or presents a solution to the above mentioned problem.

Summary of the invention

The present invention intends to solve the above mentioned problems. This is achieved according to a first aspect with a cellular mobile telephone network according to the patent claim 1. The base station for each cell is allocated a number of carrier frequencies ($f_1, \ldots, f_n$), where n is an integer, from the frequency band for the mobile telephone network to transmit information to mobile stations within the cell. Carrier frequencies ($f_1, \ldots, f_n$) at/of a cell recur in another cell according to a predefined frequency reusing factor. In/for the cellular mobile telephone network applies that the pilot channel (f_x-pilot-channel) of a carrier frequency (f_x), where x is an integer and $1 \leq x \leq n$, is allocated a very high share of the for the carrier frequency (f_x) available power. Besides, the pilot channels of different carrier frequencies ($f_1, \ldots, f_n$) are allocated different power. By this solution, a cellular mobile telephone network is obtained which on the one hand fulfils the demand that

the signal strength with a certain probability, in excess of the promised coverage area, does not fall below a certain predefined signal level, and on the other hand is optimal with regard to traffic routing possibilities and spectrum efficiency.

Another advantage in this connection is obtained if the f_x-pilot-channel is allocated at least 70% of the for the carrier frequency (f_x) available power.

In this connection it is also an advantage if the f_x-pilot-channel is allocated at least 80% of the for the carrier frequency (f_x) available power.

Another advantage in this connection is obtained if the f_x-pilot-channel is allocated at least 90% of the for the carrier frequency (f_x) available power.

In this connection it is also an advantage if the f_x-pilot-channel is allocated 100% of the for the carrier frequency (f_x) available power.

Another advantage in this connection is obtained if the f_x-pilot-channel is blocked for traffic.

In this connection it is also an advantage if the f_x-pilot-channel is transmitted by means of a simple transmitter.

An advantageous variant in this connection is obtained if the traffic is routed/directed away from the carrier frequency (f_x), the pilot channel of which has high power, to other carrier frequencies (f_i), where $1 \leq i \leq n$ and $i \neq x$, by means of inter-frequency handover and/or cell reselection.

Another advantage in this connection is obtained if cells on the carrier frequency (f_x), the pilot channel of which has high power, do not exist in lists over adjacent cells which are distributed to mobile stations in the mobile telephone network.

In this connection it is also an advantage if there at cell-search is added an offset on the (f_x)-pilot-channel so that the mobile stations land up on

the carrier frequency (f_x) only within the range where the traffic channel on the carrier frequency (f_x) has service.

Another object of the present invention is to make a procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network, in which the base station (BS) for each cell is allocated a number of carrier frequencies ($f_1,\ldots,f_n$), where n is an integer, from the frequency band for/of the mobile telephone network to transmit the information to mobile stations within the cell, and in which carrier frequencies ($f_1,\ldots,f_n$) of a cell recur in another cell according to a predefined frequency reusing factor. The procedure includes the steps:

- to allocate to the pilot channel (f_x-pilot-channel) of a carrier frequency (f_x), where x is an integer and $1 \leq x \leq n$, a very high share of the for the carrier frequency (f_x) available power; and
- to allocate to the pilot channels of different carrier frequencies ($f_1,\ldots,f_n$) different power.

By this procedure a cellular mobile telephone network is obtained which on the one hand fulfils the demand that the signal strength with a certain probability, in excess of the promised coverage area, does not fall below a certain predefined signal level, and on the other hand is optimal with regard to traffic routing possibilities and spectrum efficiency.

Another advantage in this connection is obtained if the f_x-pilot-channel is allocated at least 70% of the for the carrier frequency (f_x) available power.

In this connection it is also an advantage if the f_x-pilot-channel is allocated at least 80% of the for the carrier frequency (f_x) available power.

Another advantage in this connection is obtained if the f_x-pilot-channel is allocated at least 90% of the for the carrier frequency (f_x) available power.

In this connection it is also an advantage if the f_x-pilot-channel is allocated 100% of the for the carrier frequency (f_x) available power.

Another advantage in this connection is obtained if the procedure also includes the step:

- to block the carrier frequency (f_x) for traffic.

In this connection it is also an advantage if the procedure also includes the step:

- to transmit the f_x-pilot-channel by means of a simple transmitter.

An advantageous variant in this connection is obtained if the procedure also includes the step:

- to route/direct away the traffic from the carrier frequency (f_x), the pilot channel of which has high power, to other carrier frequencies (f_i), where $1 \leq i \leq n$ and $i \neq x$, by means of inter-frequency handover and/or cell reselection.

Another advantage in this connection is obtained if the procedure also includes the step :

- not allowing that cells on the carrier frequency (f_x), the pilot channel of which has high power, exist in lists over adjacent cells which are distributed to mobile stations in the mobile telephone network.

In this connection it is also an advantage if the procedure also includes the step:

- to, at cell-search, add an offset on the f_x-pilot-channel so that the mobile stations land up on the carrier frequency (f_x) only within the range where the traffic channel on the carrier frequency (f_x) has service.

Another purpose of the present invention is to make a computer program product which can directly be loaded down into the internal memory of at least one digital computer. The at least one computer program product includes software code parts to execute the steps according to the procedure according to the present invention when said product/products is/are executed/run on said at least one computer. By this computer program product a cellular mobile telephone network is obtained which on the one hand fulfils the demand that the signal strength with a certain probability, in excess of the promised coverage area, does not fall below a certain predefined signal level, and on the other hand is optimal with regard to traffic routing possibilities and spectrum efficiency.

I should be observed that when the term "includes/ including" is used in this description it should be regarded to indicate the existence of appointed qualities, steps or components, but does not exclude the existence of one or more other qualities, parts, steps, components or groups of them.

The embodiment of the invention now will be described with reference to the enclosed drawings, where:

Brief description of the drawings

Figure 1 schematically shows the cells of a cellular mobile telephone network and their frequency groups when the frequency reusing factor is 4;

Figure 2 shows a flow chart of a procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network;

Figure 3 shows a flow chart over further steps in the procedure according to Figure 2 according to a first embodiment.

Figure 4 shows a flow chart over some further steps in the procedure according to Figure 2 according to a second embodiment.

Figure 5 shows a flow chart over a further step in the procedure according to Figure 2 according to a third embodiment.

Figure 6 shows a schematic picture over some computer program products according to the present invention.

Detailed description of embodiments

In Figure 1 a schematic representation of a geographic area covered by the cells of a cellular mobile telephone network is shown. In order to facilitate the description it is assumed that the cells are of the same size and that they can be represented by circles which have the same radii; the base stations BTS indicated by black circles are located in the center of a cell. The distance from a base station BTS to another one is d. It is assumed that the frequency reusing factor is 4, from which follows the known fact that four frequency groups are needed. The four frequency groups in Figure 1 are frequency group A, frequency group B, frequency group C and frequency group D. The same frequency group consequently can be reused in such a way that a cell of another frequency group is located between cells of the same frequency group, for instance in the in Figure 1 shown way. The carrier frequency consequently is reused with a distance D. Assume that two carrier frequencies exist for one cell, i.e. that each frequency group includes two carrier frequencies, at which the total number of carrier frequencies consequently is 8, and assume that one carrier frequency requires a band of 200 kHz such as in the GSM-system. Consequently the in Figure 1 shown system would require a frequency band of 1,6 MHz.

According to one embodiment of a cellular mobile telephone network according to the present invention the base station (BS) of each cell is allocated a number of carrier frequencies ($f_1,\ldots,f_n$), where n is an integer, from the frequency band for the mobile telephone network to transmit information to mobile stations within the cell. The carrier frequencies ($f_1,\ldots,f_n$) of a cell recur in another cell according to a predefined frequency reusing factor. The cellular mobile telephone network is characterized in that the pilot channel (f_x-pilot-channel) of a carrier frequency (f_x), where x is an integer and $1\leq x\leq n$, is allocated a very high share of the for the carrier frequency (f_x) available power. In addition, the cellular mobile telephone network is characterized in that the pilot channels of different carrier frequencies ($f_1,\ldots,f_n$) are allocated different power.

Expressed in a different way one may say that the cellular mobile telephone network is built in such a way that the f_x-pilot-channel of each cell fulfils the license requirement, i.e. the criterion for the signal strength of the UMTS pilot channel. The pilot channels of other carrier frequencies are from a power point of view dimensioned according to the requirements of the market in customary way.

According to one advantageous embodiment of the cellular mobile telephone network, the f_x-pilot-channel is allocated at least 70% of the for the carrier frequency (f_x) available power.

According to another advantageous embodiment of the cellular mobile telephone network, the f_x-pilot-channel is allocated at least 80% of the for the carrier frequency (f_x) available power.

According to yet another advantageous embodiment of the cellular mobile telephone network, the f_x-pilot-

channel is allocated at least 90% of the for the carrier frequency (f_x) available power.

According to yet another advantageous embodiment of the cellular mobile telephone network, the f_x-pilot channel is allocated 100% of the for the carrier frequency (f_x) available power. In this case the carrier frequency (f_x) can be blocked for traffic. Then there will be no need to direct/route the traffic to other carrier frequencies in the cell, or to punish the f_x-pilot-channel at cell search. Yet another advantage then also is obtained by using a simple, cheap transmitter for the f_x-pilot-channel. This implies lower demands on linearity of the transmitter, and no power control.

In the cases when the f_x-pilot-channel is allocated less than 100% of the for the carrier frequency (f_x) available power, the traffic is routed/directed away from the carrier frequency (f_x), the pilot channel of which has high power, to other carrier frequencies (f_i), where $1 \leq i \leq n$ and $i \neq x$ by means of inter-frequency handover and/or cell reselection. This routing/directing of mobile stations is allowed in the message/report "Physical Channel Reconfiguration", in which UARFCN for the new carrier frequency can be specified. If the message/report is transmitted to a mobile station in the condition CELL_DHC it initiates an inter-frequency handover. If the message/report on the other hand is transmitted to a mobile station in the condition CELL-FACH an inter-frequency cell reselection is initiated.

According to one preferred embodiment of the cellular mobile telephone network according to the present invention, cells on the carrier frequency (f_x) the pilot channel of which has high power do not exist in lists of adjacent cells which are distributed to mobile stations in the mobile telephone network. This

prevents already active mobile stations from making handovers/cell reselections to the carrier frequency (f_x). This applies to/for the lists of adjacent cells which are in (i) the system information on BCH and (ii) in dedicated "Measurement Control"-messages, if any, to specific mobile stations.

According to another preferred embodiment of the cellular mobile telephone network according to the present invention, is at cell-search an offset added on the f_x-pilot-channel so that the mobile channels land up on the carrier frequency (f_x) only within the range where the traffic channel on the carrier frequency (f_x) has service. This can be achieved by parameter setting via system information on BCH.

In Figure 2 a flow chart is shown of a procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network. In the cellular mobile telephone network, the base station (BS) for each cell is allocated a number of carrier frequencies ($f_1,\ldots,f_n$), where n is an integer, from the frequency band of the mobile telephone network to transmit information to mobile stations within the cell. In the cellular mobile telephone network, carrier frequencies ($f_1,\ldots,f_n$) of/at a cell recur in another cell according to a predefined frequency reusing factor. The procedure starts at the block 10. The procedure then continues, at the block 12, with the step: To allocate to the pilot channel (f_x-pilot-channel) of a carrier frequency (f_x), where x is an integer $1 \leq x \leq n$, a very high share of the for the carrier frequency (f_x) available power. After that, the procedure continues, at the block 14, with the step: To allocate to pilot channels of different carrier frequencies ($f_1,\ldots,f_n$) different power. The procedure then is finished at the block 16.

According to one advantageous embodiment of the procedure according to the present invention, at least 70% of the for the carrier frequency (f_x) available power is allocated to the f_x-pilot-channel.

According to another advantageous embodiment of the procedure according to the present invention, at least 80% of the for the carrier frequency (f_x) available power is allocated to the f_x-pilot-channel.

According to yet another advantageous embodiment of the procedure according to the present invention, at least 90% of the for the carrier frequency available power is allocated to f_x-pilot-channel.

According to yet another embodiment of the procedure, 100% of the for the carrier frequency available power is allocated to the f_x-pilot-channel.

In Figure 3 a flow chart of some further steps of the procedure according to Figure 2 according to a first embodiment is shown. The procedure starts at the block 20. The procedure then continues, at the block 22, with the step: To block the carrier frequency (f_x) for traffic. After that, the procedure continues, at the block 24, with the step: To transmit the f_x-pilot-channel by means of a simple transmitter. The procedure then is finished at the block 26.

In Figure 4 a flow chart of some further steps of the procedure according to Figure 2 according to a second embodiment are shown. The procedure starts at the block 30. The procedure then continues, at the block 32, with the step: To route/direct away the traffic from the carrier frequency ($f_{x,}$) the pilot channel of which has high power, to other carrier frequencies (f_i), where $1 \leq i \leq n$ and $i \neq x$ by means of inter-frequency handover and/or cell reselection. After that, the procedure continues, at the block 34, with the step: Not allowing that cells on the carrier frequency (f_x), the pilot channel of which has high

power, exist in lists for/of adjacent cells which are distributed to mobile stations in the mobile telephone network. The procedure then is finished at the block 36.

In Figure 5 a flow chart is shown of yet another step in the procedure according to Figure 2 according to a third embodiment. The procedure starts at the block 40. The procedure then continues, at the block 42, with the step: To, at cell-search, add an offset on/to the f_x pilot channel so that the mobile stations land up on the carrier frequency (f_x) only within the range where the traffic channel on the carrier frequency (f_x) has service.

In Figure 6 a schematic drawing of some computer program products according to the present invention is shown. In Figure 6, n pc. computer products $102_{1,...,}$ 102_n, where n is an integer, are shown. The computer program products $102_{1,...,}$ 102_n can be loaded directly into the internal memory of at least one digital computer $100_{1,...,}$ 100_n. In Figure 6, n computers are also shown. Each computer program product $102_{1,...,}$ 102_n includes software code parts to execute a part of, or all, the steps according to Figure 2 when the program product/products $102_{1,...,}$ 102_n are run on the computer/computers $100_{1,...,}$ 100_n. The computer program products $102_{1,...,}$ 102_n can, for instance, be in form of diskettes, RAM-disks, magnetic tape, optomagnetic disks or any other suitable products.

The invention is not limited to the above described embodiments. It will be obvious that a lot of different modifications are possible within the scope of the enclosed patent claims.

PATENT CLAIMS

1. A cellular mobile telephone network, in which the base station (BS) for each cell is allocated a number of carrier frequencies ($f_1,\ldots,f_n$), where n is an integer, from the frequency band for the mobile telephone network to transmit information to mobile stations within the cell, and in which carrier frequency ($f_1,\ldots,f_n$) of a cell recurs in another cell according to a predefined frequency reusing factor, c h a r a c t e r i z e d in that the pilot channel (f_x-pilot-channel) of a carrier frequency (f_x), where x is an integer and $1\leq x\leq n$, is allocated a very high share of the for the carrier frequency (f_x) available power, and in that the pilot channels of different carrier frequencies ($f_1,\ldots,f_n$) are allocated different power, in routing/directing away the traffic from the carrier frequency (f_x), the pilot channel of which has high power, to other carrier frequencies (f_i) where $1\leq i\leq n$ and $i\neq x$, by means of inter-frequency handover and/or cell reselection.

2. A cellular mobile telephone network as claimed in patent claim 1, c h a r a c t e r i z e d in that the f_x-pilot-channel is allocated at least 70% of the for the carrier frequency (f_x) available power.

3. A cellular mobile telephone network as claimed in any of the patent claims 1-2, c h a r a c t e r i z e d in that the f_x-pilot-channel is allocated at least 80% of the for the carrier frequency (f_x) available power.

4. A cellular mobile telephone network as claimed in any of the patent claims 1-3, c h a r a c t e r i z e d in that the f_x-pilot-channel is allocated at least 90% of the for the carrier frequency (f_x) available power.

5. A cellular mobile telephone network as claimed in any of the patent claims 1-4, c h a r a c t e r i z e d in that the f_x-pilot-channel is allocated 100% of the for the carrier frequency the (f_x) available power.

6. A cellular mobile telephone network as claimed in the patent claim 5, c h a r a c t e r i z e d in that the carrier frequency (f_x) is blocked for traffic.

7. A cellular mobile telephone network as claimed in any of the patent claims 5-6, c h a r a c t e r i z e d in that the f_x-pilot-channel is transmitted by means of a simple transmitter.

8. A cellular mobile telephone network as claimed in the patent claim 1, c h a r a c t e r i z e d in that cells on the carrier frequency (f_x), the pilot channel of which has high power, do not exist in lists for/of adjacent cells which are distributed to mobile stations in the mobile telephone network.

9. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network, in which the base station (BS) for/of each cell is allocated a number of carrier frequencies ($f_1,\ldots,f_n$), where n is an integer, from the frequency band for the mobile telephone network to transmit information to mobile stations within the cell, and in which carrier frequencies ($f_1,\ldots,f_n$) at/of a cell recur in another cell according to a predefined frequency reusing factor, which procedure includes the steps:

- to allocate to the pilot channel (f_x-pilot-channel) of a carrier frequency (f_x), where x is an integer and $1 \leq i \leq n$, a very high share of the for the carrier frequency (f_x) available power;

- to route/direct away the traffic from the carrier frequency (f_x), the pilot channel of which has high power, to other carrier frequencies (f_i), where $1 \leq i \leq n$ and $i \neq n$, by means of inter-frequency handover and/or cell-reselection; and
- to allocate to pilot channels of different carrier frequencies ($f_1, \ldots, f_n$) different power.

10. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in the patent claim 9, c h a r a c t e r i z e d in to allocate at least 70% of the for the carrier frequency (f_x) available power to the f_x-pilot-channel.

11. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in any of the patent claims 9-10, c h a r a c t e r i z e d in to allocate at least 80% of the for the carrier frequency (f_x) available power to the f_x-pilot-channel.

12. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in any of the patent claims 9-11, c h a r a c t e r i z e d in to allocate at least 90% of the for the carrier frequency (f_x) available power to the f_x-pilot-channel.

13. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in any of the patent claims 9-12, c h a r a c t e r i z e d in to allocate 100% of the for the carrier frequency (f_x) available power to the f_x-pilot-channel.

14. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in the patent claim 13, c h a r a c t e r i z e d in that the procedure also includes the step:

- to block the carrier frequency (f_x) for traffic.

15. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in any of the patent claims 13-14, c h a r a c t e r i z e d in that the procedure also includes the step:

- to transmit the f_x-pilot-channel by means of a simple transmitter.

16. A procedure to, from a cost efficiency point of view and with regard to spectrum efficiency, optimize a cellular mobile telephone network as claimed in the patent claim 15, c h a r a c t e r i z e d in that the procedure also includes the step:

- not allowing that cells on the carrier frequency (f_x), the pilot channel of which has high power, exist in lists of/for adjacent cells which are distributed to mobile stations in the mobile telephone network.

17. At least one computer program product ($102_{1,...,}$ 102_n) which can be directly loaded into the internal memory of at least one digital computer ($100_{1,...,}$ 100_n), including software code parts to execute the steps according to the patent claim 11, when said at least one product ($102_{1,...,}$ 102_n) is run on said at least one computer ($100_{1,...,}$ 100_n).

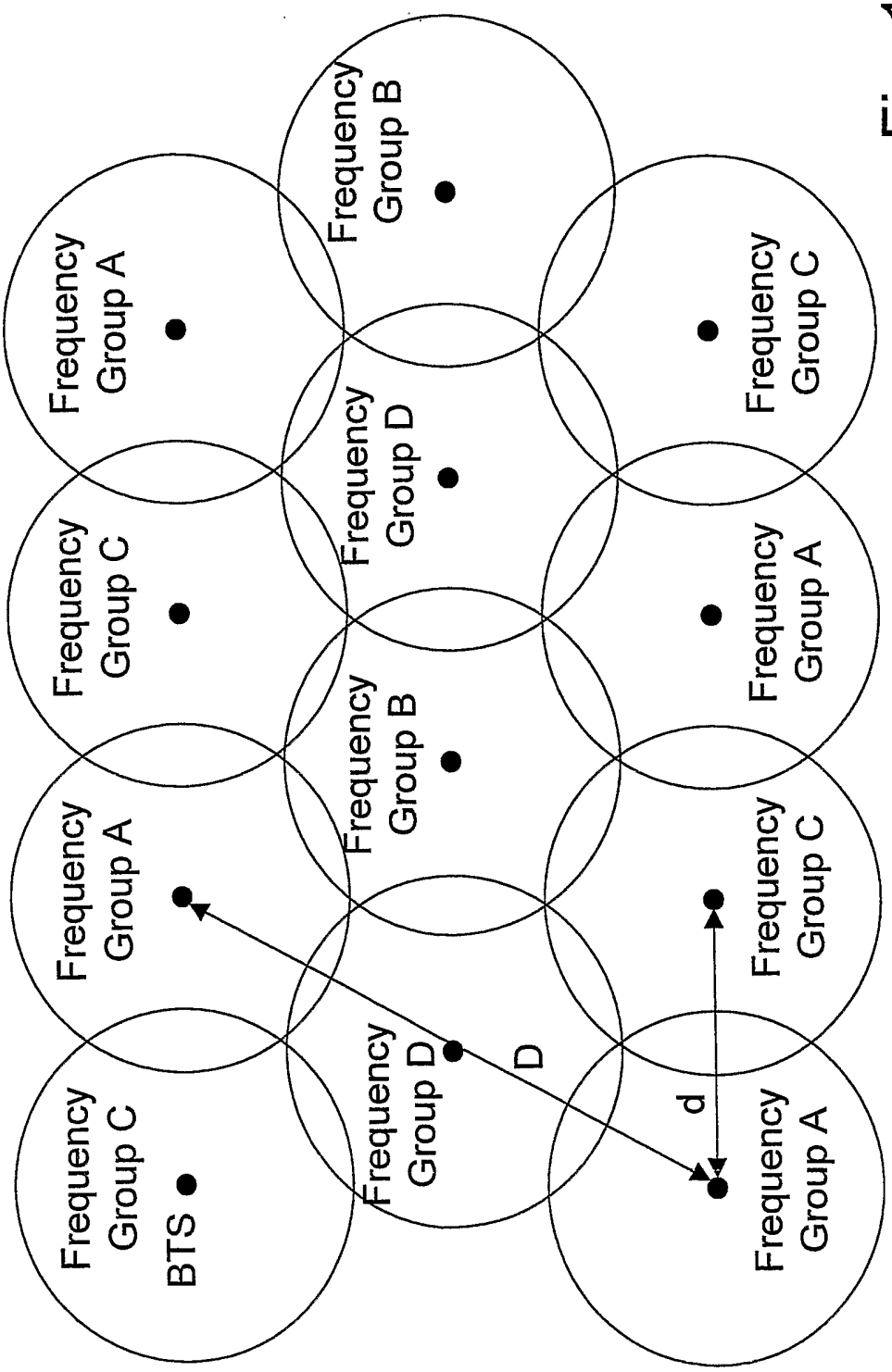
Frequency Group A
Frequency Group B
Frequency Group C
Frequency Group D
Frequency Group C
Frequency Group A
Frequency Group B
Frequency Group D
Frequency Group A
Frequency Group C
Frequency Group C
Frequency Group A
BTS
D
d

Fig. 1

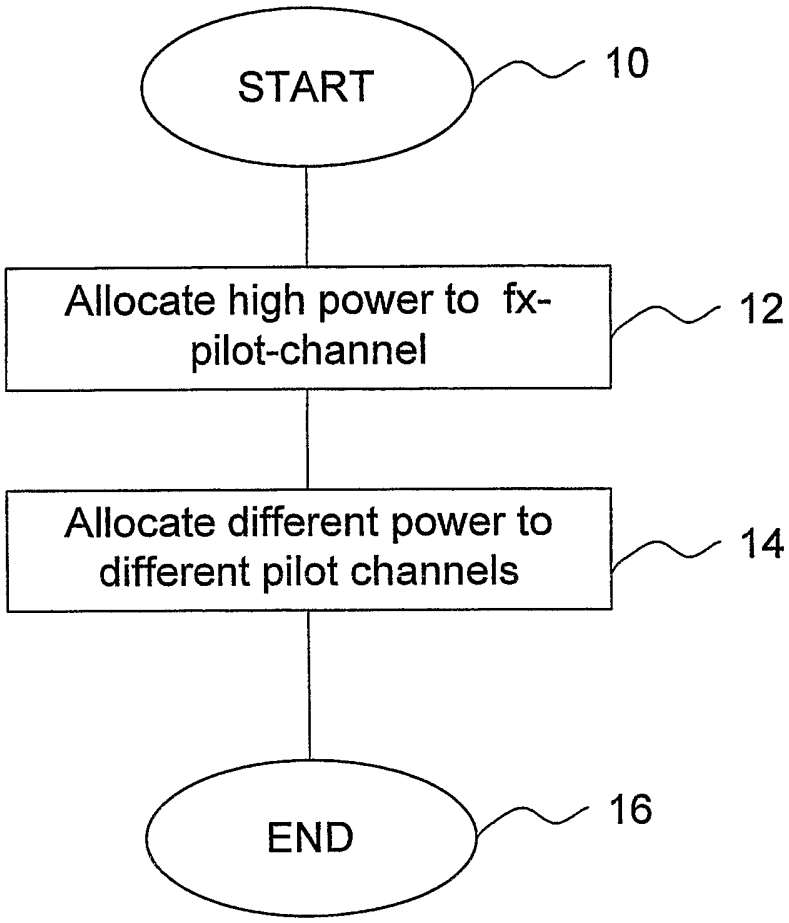
START
10
Allocate high power to fx-pilot-channel
12
Allocate different power to different pilot channels
14
END
16

Fig. 2

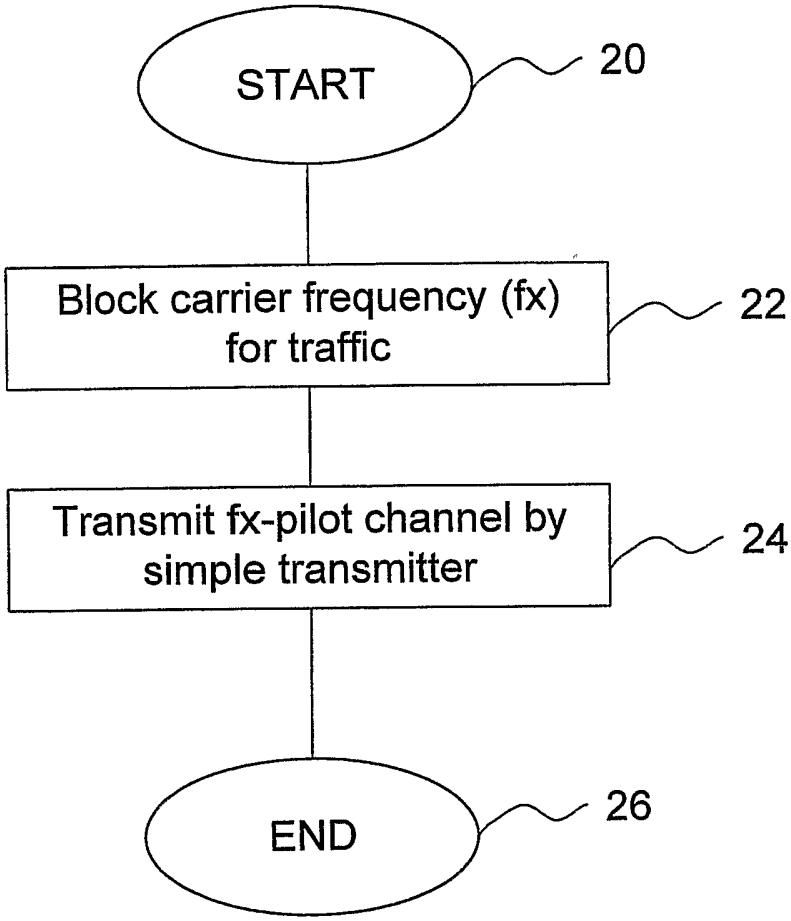
START
20
Block carrier frequency (fx) for traffic
22
Transmit fx-pilot channel by simple transmitter
24
END
26

Fig. 3

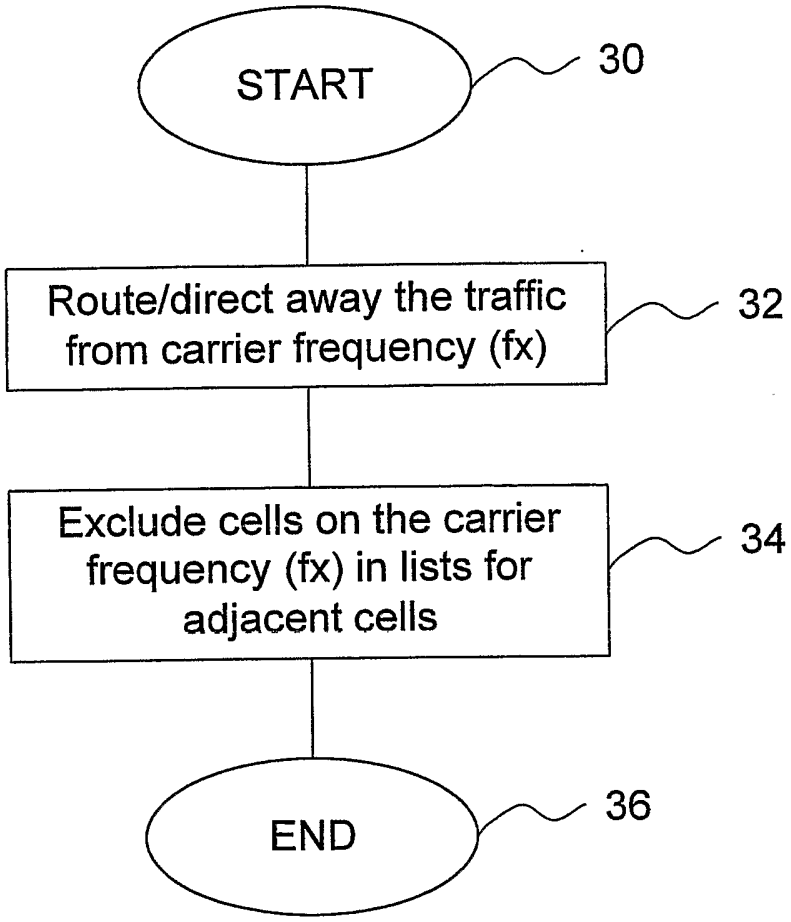
START
30
Route/direct away the traffic from carrier frequency (fx)
32
Exclude cells on the carrier frequency (fx) in lists for adjacent cells
34
END
36

Fig. 4

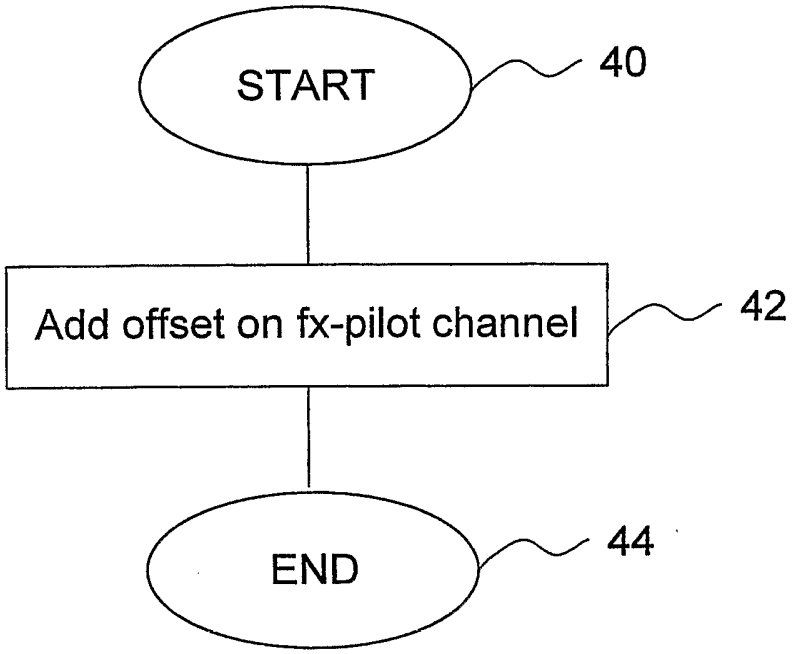

Fig. 5

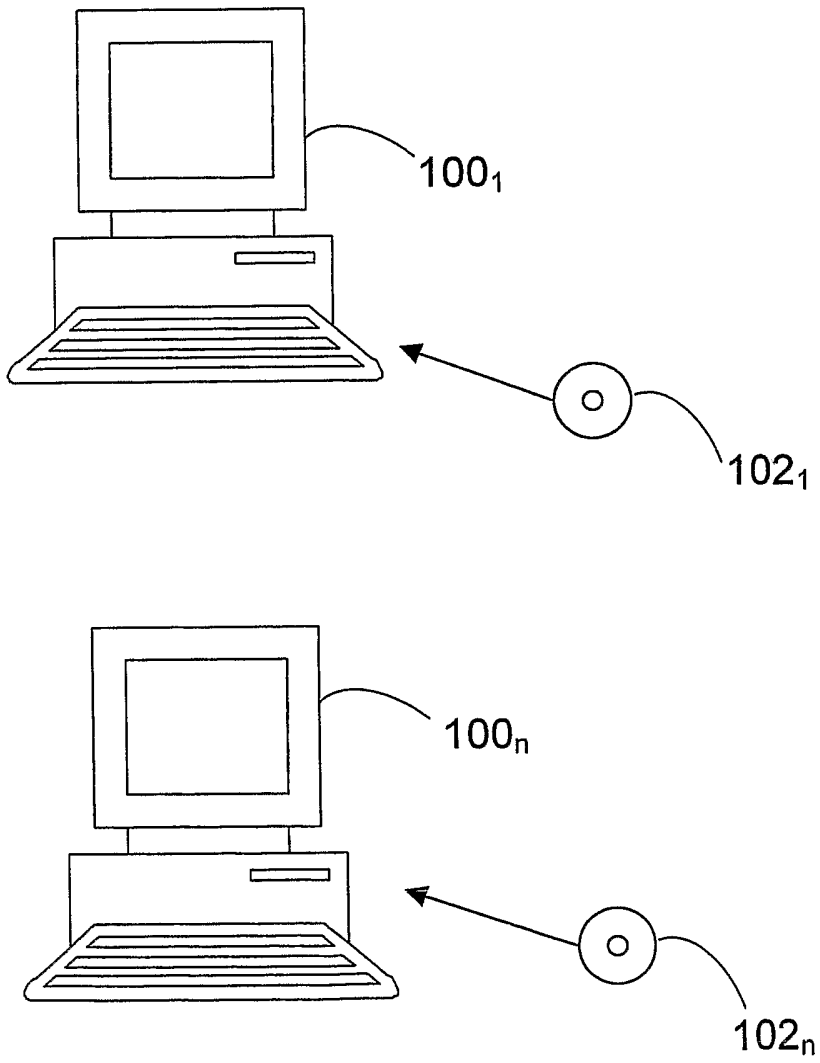

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/00992

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/36
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5758090 A (DONER, J.R.), 26 May 1998 (26.05.98), figure 3, abstract ---	1-17
A	US 5341397 A (GUDMUNDSON, B.), 23 August 1994 (23.08.94), abstract ---	1-17
A	US 6188906 B1 (LIM, Y-S ET AL), 13 February 2001 (13.02.01), column 2, line 60 - column 3, line 25 ---	1-17
A	US 5901145 A (SAWYER, F. ET AL), 4 May 1999 (04.05.99), abstract --- --------	5-7,13-15

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 August 2003	16 -09- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Markus Stålö /OGU Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

26/07/03

International application No.
PCT/SE 03/00992

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