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Handover in a cellular communication system

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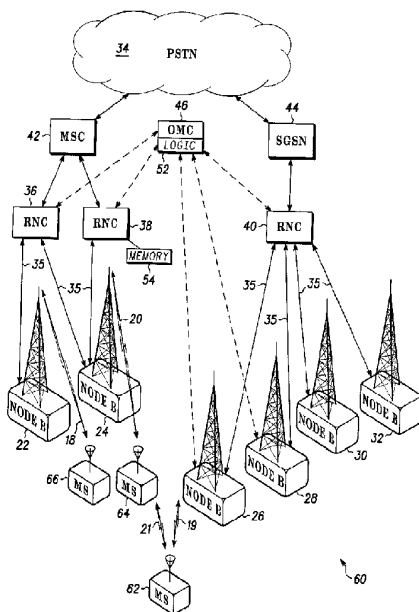
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(54) Title: HANDOVER IN A CELLULAR COMMUNICATION SYSTEM

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(57) Abstract: An arrangement and method wherein handover is improved for a lower data rate user (62) assigned to a lower data rate channel alternative that does not support soft handover. If handover is to be required, the user is re-assigned to a higher data rate dedicated traffic channel that does support soft handover. Soft handover is then implemented. After handover is completed, the lower data rate user (62) may be re-assigned to a lower data rate channel alternative. One example of a lower data rate channel alternative, employed in a Universal Mobile Telephone Standard (UMTS) system (60), is a RACH/FACH combination bearer.



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HANDOVER IN A CELLULAR COMMUNICATION SYSTEM

Field of the Invention

5 This invention relates to handover in cellular communication systems that support both soft handover and hard handover. The present invention is applicable to, but not limited to, Universal Mobile Telephone Standard (UMTS) cellular communication systems.

10

Background of the Invention

In the field of this invention it is known that handover between radio facilities, e.g. cells of a cellular communication system, provides on-going quality of service. Typically, in order to provide continuous, uninterrupted service a call or session that is in progress for a user can be continued while the user's radio quality varies through the use of handover. This handover can either be hard (break before make) or soft (make before break).

In some cellular communication systems, for example UMTS, a user can be assigned a given radio bearer according to his or her specific request for service. The data rate, also termed bandwidth, provided can be lower or higher depending on the service or usage being requested. Thus, for example, in UMTS higher data rate users may be assigned to a dedicated traffic channel, whereas lower data rate users may be assigned to an inferior channel alternative, for example a combination of Random Access

Channel (RACH) and Forward Link Access Channel (FACH), hereinafter referred to as a RACH/FACH combination.

5 However, many such inferior channel alternatives, including the above mentioned RACH/FACH combination, only support hard handover, i.e. they do not support soft handover. This is disadvantageous when soft handover is required for a low data rate user.

10 Thus, there exists a need in the field of the present invention to provide an arrangement wherein handover is improved for a low data rate user assigned to an above mentioned inferior channel alternative that does not support soft handover.

The discussion of the background to the invention herein is included to explain the context of the invention. This is not to be taken as an admission that any of the material referred to was published, known or part of the common general knowledge in Australia as at the priority date of any of the claims.

Statement of Invention

20 According to one aspect of the present invention there is provided a method of operating a cellular communication system, comprising including:

assigning higher data rate users to higher data rate dedicated traffic channels that support soft handover;

assigning lower data rate users to lower data rate channel alternatives that support only hard handover;

25 determining, for a lower data rate user assigned to a lower data channel alternative, that handover is to be required;

re-assigning the lower data rate user to a higher data rate dedicated traffic channel; and

30 performing a soft handover of there-assigned lower data rate user.

According to a further aspect of the present invention there is provided apparatus for use in a cellular communication system, comprising including:

means for assigning higher data rate users to higher data rate dedicated traffic channels that support soft handover;

35 means for assigning lower data rate users to lower data rate channel alternatives that support only hard handover;

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means for determining, for a lower data rate user assigned to a lower data channel alternative, that handover is to be required;

means for re-assigning the lower data rate user to a higher data rate dedicated traffic channel; and

5 means for performing a soft handover of the reassigned lower data rate user.

10 According to a still further aspect of the present invention there is provided a communication unit, for example a switching node, base station, base site controller, Radio Network Controller, RNC, or a Serving GPRS Support Node, SGSN, of a cellular communication system, including the apparatus as described above.

According to a still further aspect of the present invention there is provided a cellular communication system including the apparatus as described above.

In a fifth aspect, the present invention provides a communication unit, as claimed in claim 15.

5 In a sixth aspect, the present invention provides a storage medium storing processor-implementable instructions, as claimed in claim 16.

Further aspects are as claimed in the dependent claims.

10 In order to provide soft handover for the user, the radio bearer can be changed from the low radio access bearer to a higher one using a dedicated channel (DCH) to allow for a soft handover between cells. Optionally, after the handover is completed and the user is firmly within the
15 new area, the radio bearer may be reverted back to the original bearer attributes.

Brief Description of the Drawings

20 Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a schematic illustration of a UMTS cellular
25 communication system; and

FIG. 2 is a flowchart showing process steps carried out in an embodiment of the invention.

Description of Preferred Embodiment

In the preferred embodiment, the invention is applied to a UMTS cellular communication system, but it is to be appreciated the invention can be applied to any system with lower data rate bearers and higher data rate dedicated traffic channels.

FIG. 1 shows a UMTS cellular communication system 60.

A plurality of subscriber terminals (also known as mobile stations and hereinafter referred to as MS's) 62-66 communicate over radio links 18-21 with a plurality of base stations, referred to under UMTS terminology as Node-B's, 22-32. For clarity purposes, only a limited number of MS's 62-66 and Node-B's 22-32 are shown.

The Node-B's 22-32 are connected to external networks, for example, the public-switched telephone network (PSTN) or the Internet, 34 through Radio Network Controller stations (RNC) (in UMTS terminology) 36-40 and plural mobile switching centres (MSC's), such as MSC 42 (the others are, for clarity, not shown) and Serving GPRS Support Nodes (SGSN) 44.

Each Node-B 22-32 contains one or more transceiver units and communicates with the rest of the cell-based system infrastructure via the I_{ub} interface 35 as defined in the UMTS specification.

Each RNC 36-40 may control one or more Node-B's 22-32.
Each MSC 42 provides a gateway to the external network
34, whilst the SGSN 44 links to external packet networks.

- 5 The Operations and Management Centre (OMC) 46 is operably
connected to RNC's 36-40 and Node-B's 22-32 (shown only
with respect to Node-B 26 and Node-B 28 for clarity), and
administers and manages the parts of the cellular
telephone communication system 60, as will be understood
10 by those skilled in the art.

In this embodiment, the RNC's 36, 38, 40 have been
adapted, by provision of a handover improvement module,
to offer, and provide for, improved handover from one
15 radio link to another for low data rate users, as will be
described in more detail below.

However, this adaptation may be implemented in any
suitable manner to provide suitable apparatus. The module
20 may consist of a single discrete entity added to a
conventional RNC, or may alternatively be formed by
adapting existing parts of a conventional RNC, for
example by reprogramming of a one or more processors
therein. As such the required adaptation may be
25 implemented in the form of processor-implementable
instructions stored on a storage medium, such as a floppy
disk, hard disk, PROM, RAM or any combination of these or
other storage media. Furthermore, whether a separate
entity or an adaptation of existing parts or a
30 combination of these, the module may be implemented in

the form of hardware, firmware, software, or any combination of these.

- It is also within the contemplation of the invention that
- 5 such adaptation of transmission characteristics may alternatively be controlled, implemented in full or implemented in part by a module added to or formed by adaptation of any other suitable part of the communication system 60. For example, this may be
- 10 implemented instead at the node-B's 22-32 when the node-B's 22-32 are combined base station controllers-base transceiver stations, and as such serve more than one cell, or in MSC 42.
- 15 Further, in the case of other network infrastructures, implementation may be at any appropriate switching node such as any other appropriate type of base station, base station controller etc. Alternatively the various steps involved in determining and carrying out such adaptation
- 20 (as will be described in more detail below) can be carried out by various components distributed at different locations or entities within any suitable network or system.
- 25 In the system 60, the RNCs 36, 38, 40 assign low data rate users to RACH/FACH combinations. The RACH/FACH combination bearers only support hard handover (break before make), i.e. they do not support soft handover (make before break). The RNCs 36, 38, 40 assign higher
- 30 data rate users to dedicated traffic channels (TCH). The

dedicated traffic channels support both soft handover and hard handover.

Let us assume that MS 62 is currently receiving service
5 from Node-B 24 over radio link 21, and that MS 62 is a
low data rate user that has therefore been assigned to a
RACH/FACH combination. This embodiment will now be
further described for the situation when the MS 62 moves
such that it will leave the area (cell) serviced by the
10 Node-B 24 and into the area (cell) serviced by the Node-B
26 and will therefore need to be handed over to a new
radio link 19 provided by the Node-B 26.

FIG. 2 is a flowchart illustrating the process steps
15 carried out by the handover improvement module, located
in this example in the RNC 38, in this embodiment in
order to implement the above described handover.

At step s2, the handover improvement module determines
20 whether the MS 62 has been assigned to the RACH/FACH
combination bearer. In this case the answer is in the
affirmative, so at step s4 the handover improvement
module monitors handover parameters of the MS 62 on the
RACH/FACH combination.

25 At step s6 the handover improvement module determines,
from the monitored parameters, whether the MS 62 is
approaching the border of the current cell
(alternatively, or additionally, signal strength may be
30 monitored and analysed as to whether it is decreasing
toward a handover threshold level).

If the answer is in the affirmative, at step s8 the handover improvement module re-assigns (this may itself be termed handover) the MS 62 to a dedicated traffic
5 channel.

At step s10 the handover improvement module again monitors the handover parameters.

10 At step s12 the handover improvement module determines, from the monitored parameters, whether the MS 62 is still approaching the border of the current cell (or when signal strength is the criteria, whether the signal strength is still decreasing toward the handover
15 threshold level).

If the answer is still in the affirmative, at step s14 the handover improvement module performs a soft handover of the MS 62 from the radio link 21 provided by the Node-
20 B 24 to the new radio link 19 provided by the Node-B 26. Service is thus continued from Node-B 26 on a dedicated traffic channel.

This represents the completion of one example of the
25 preferred embodiment. The above process may be performed entirely by the handover improvement module located at RNC 38.

However, optionally, the process may be continued by
30 implementation of step s18, in which, once handover has been completed, e.g. the call is safely or adequately

contained in the new cell, the MS 62 is re-assigned to a RACH/FACH combination. This part of the process may be performed by a further handover improvement module located at the RNC 40, as this RNC is responsible for the new serving Node-B 26. Another possibility is that the overall process containing steps s2 to s18 may be performed by a single handover improvement module that operates as a distributed function among different entities in the system 60.

10

The above described handover based on re-assigning from RACH/FACH to a dedicated channel tends to provide a higher quality of service for low bandwidth data users by providing a seamless transition between cells or areas of coverage.

15

In the above embodiment, the MS 62 is a mobile telephone, but MS 62 may include or consist of any other appropriate form of radio receiving apparatus, for example a personal computer with a radio modem, an electronic organiser, a video and/or audio player, etc.

20

The present invention finds particular application in wireless communication systems such as UMTS systems. However, the inventive concepts contained herein are equally applicable to alternative wireless communications systems. Whilst the specific, and preferred, implementations of the present invention are described above, it is clear that variations and modifications of such inventive concepts could be readily applied by one skilled in the art.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of operating a cellular communication system, including:
 assigning higher data rate users to higher data rate dedicated traffic channels
 5 that support soft handover;
 assigning lower data rate users to lower data rate channel alternatives that
 support only hard handover;
 determining, for a lower data rate user assigned to a lower data channel
 alternative, that handover is to be required;
 10 re-assigning the lower data rate user to a higher data rate dedicated traffic
 channel; and
 performing a soft handover of there-assigned lower data rate user.
2. A method according to claim 1, further comprising:
 15 re-assigning the lower data rate user to a lower data rate channel alternative
 after the soft handover is completed.
3. A method according to claim 1 or 2, wherein the step of determining that
 handover is to be required comprises determining that the user is approaching a border
 20 of a cell area served by the user's current cell.
4. A method according to claim 1 or 2, wherein the step of determining that
 handover is to be required comprises determining that handover is to be required
 because of decreasing signal strength.
 25
5. A method according to any one of the preceding claims, wherein the cellular
 communication system is a Universal Mobile Telephone Standard, UMTS, system.
6. A method according to claim 5, wherein the lower data rate channel alternative
 30 is a bearer provided by a combination of Random Access Channel, RACH, and
 Forward Link Access Channel, FACH.
7. Apparatus for use in a cellular communication system, including:
 means for assigning higher data rate users to higher data rate dedicated traffic
 35 channels that support soft handover;
 means for assigning lower data rate users to lower data rate channel
 alternatives that support only hard handover;

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means for determining, for a lower data rate user assigned to a lower data channel alternative, that handover is to be required;

means for re-assigning the lower data rate user to a higher data rate dedicated traffic channel; and

5 means for performing a soft handover of the reassigned lower data rate user.

8. Apparatus according to claim 7, further comprising:

re-assigning the lower data rate user to a lower data rate channel alternative after the soft handover is completed.

10

9. Apparatus according to claim 7 or 8, wherein the means for determining that handover is to be required comprises determining that the user is approaching a border of a cell area served by the user's current cell.

15

10. Apparatus according to claim 7 or 8, wherein the means for determining that handover is to be required comprises determining that handover is to be required because of decreasing signal strength.

20

11. Apparatus according to any one of claims 7 to 10, wherein the cellular communication system is a Universal Mobile Telephone Standard, UMTS, system.

12. Apparatus according to claim 11, wherein the lower data rate channel alternative is a bearer provided by a combination of Random Access Channel, RACH, and Forward Link Access Channel, FACH.

25

13. A communication unit, for example a switching node, base station, base site controller, Radio Network Controller, RNC, or a Serving GPRS Support Node, SGSN, of a cellular communication system, including the apparatus according to any one of claims 7 to 12.

30

14. A cellular communication system including the apparatus according to any one of claims 7 to 12.

15. A communication unit operable to perform the steps of any one of claims 1 to 6.

35

16. A storage medium storing processor-implementable instructions for controlling a processor to carry out the method of any one of claims 1 to 6.

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17. A method of operating a communication system substantially as hereinbefore described with reference to the accompanying Figures.

5 18. A communication system substantially as hereinbefore described with reference to the accompanying Figures.

19. Apparatus for a communication system substantially as hereinbefore described with reference to the accompanying Figures.

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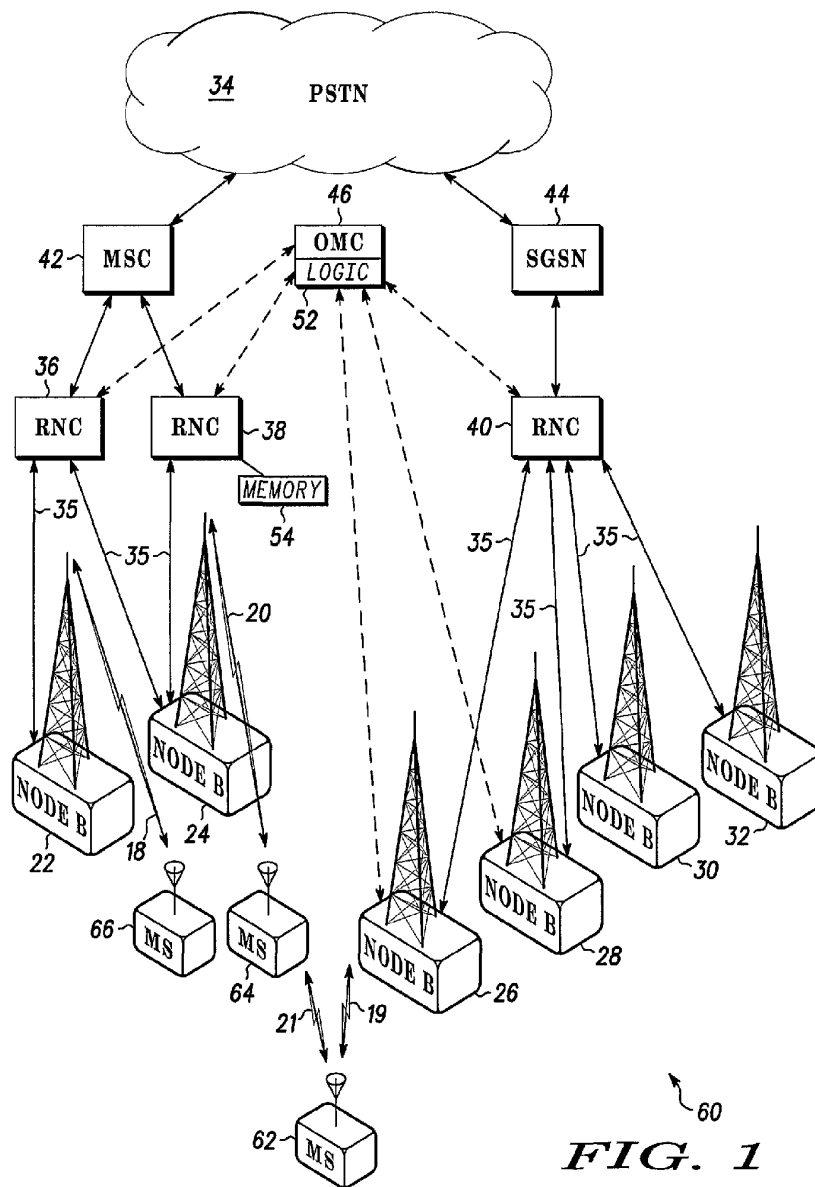
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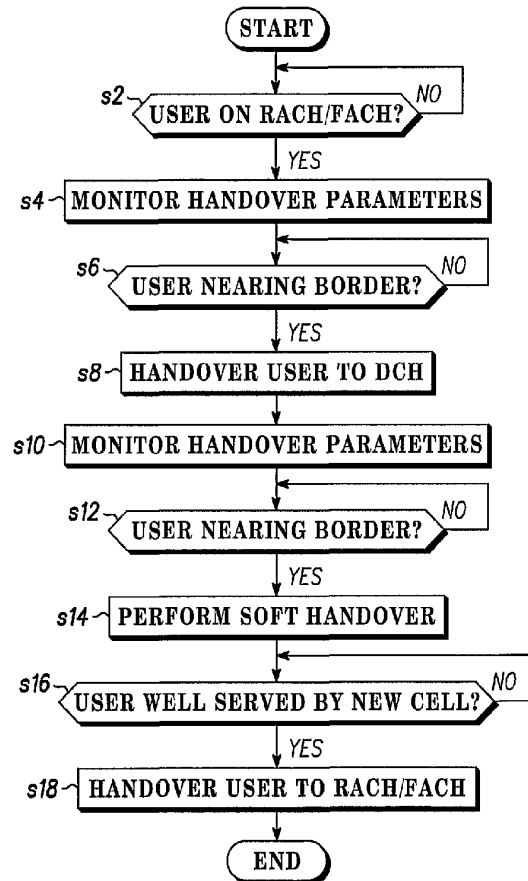
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**FIG. 1**

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*FIG. 2*