(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 December 2002 (27.12.2002)

PCT

(10) International Publication Number
WO 02/104059 A1

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/EP02/01497

(22) International Filing Date: 11 February 2002 (11.02.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0114664.6 15 June 2001 (15.06.2001) GB

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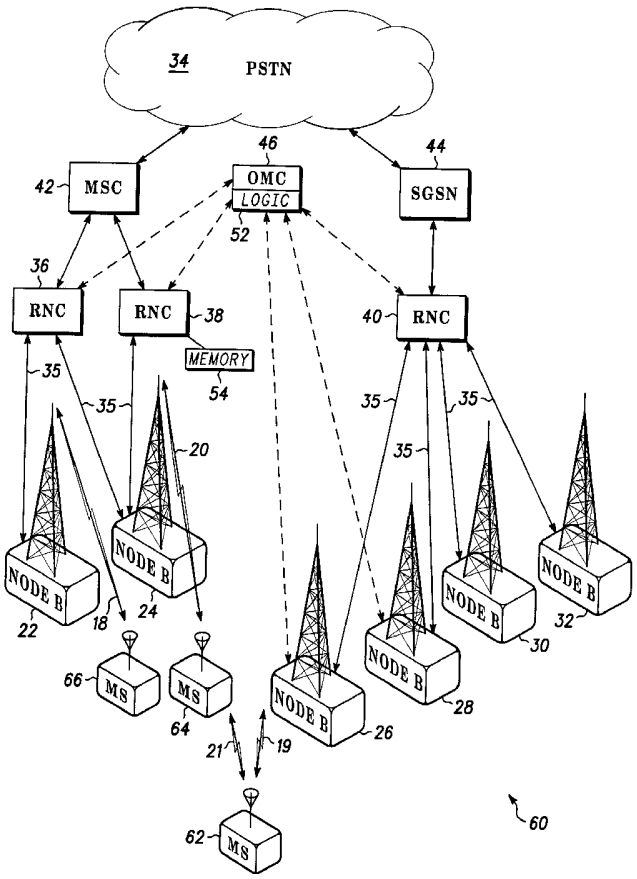
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR,

[Continued on next page]

(54) Title: HANDOVER IN A CELLULAR COMMUNICATION SYSTEM



(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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GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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Published:
— *with international search report*

HANDOVER IN A CELLULAR COMMUNICATION SYSTEM

Field of the Invention

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.

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.

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.

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.

Statement of Invention

In a first aspect, the present invention provides a method of operating a cellular communication system, as claimed in claim 1.

In a second aspect, the present invention provides apparatus for use in a cellular communication system, as claimed in 7.

In a third aspect, the present invention provides a communication unit, as claimed in 13.

In a fourth aspect, the present invention provides a cellular communication system, as claimed in claim 14.

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

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.

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 new area, the radio bearer may be reverted back to the original bearer attributes.

Brief Description of the Drawings

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 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.

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 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 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 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 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 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 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 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.

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 (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.

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 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 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 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 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 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.

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 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 channel.

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

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 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-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 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 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.

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.

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.

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.

Claims

1. A method of operating a cellular communication system, comprising:

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;

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

performing a soft handover of the re-assigned lower data rate user.

2. A method according to claim 1, further comprising:

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 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.

5. A method according to any preceding claim, 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 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, comprising:

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

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

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

means for performing a soft handover of the re-assigned 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.

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.

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.

11. Apparatus according to any 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.

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, comprising the apparatus according to any of claims 7 to 12.

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

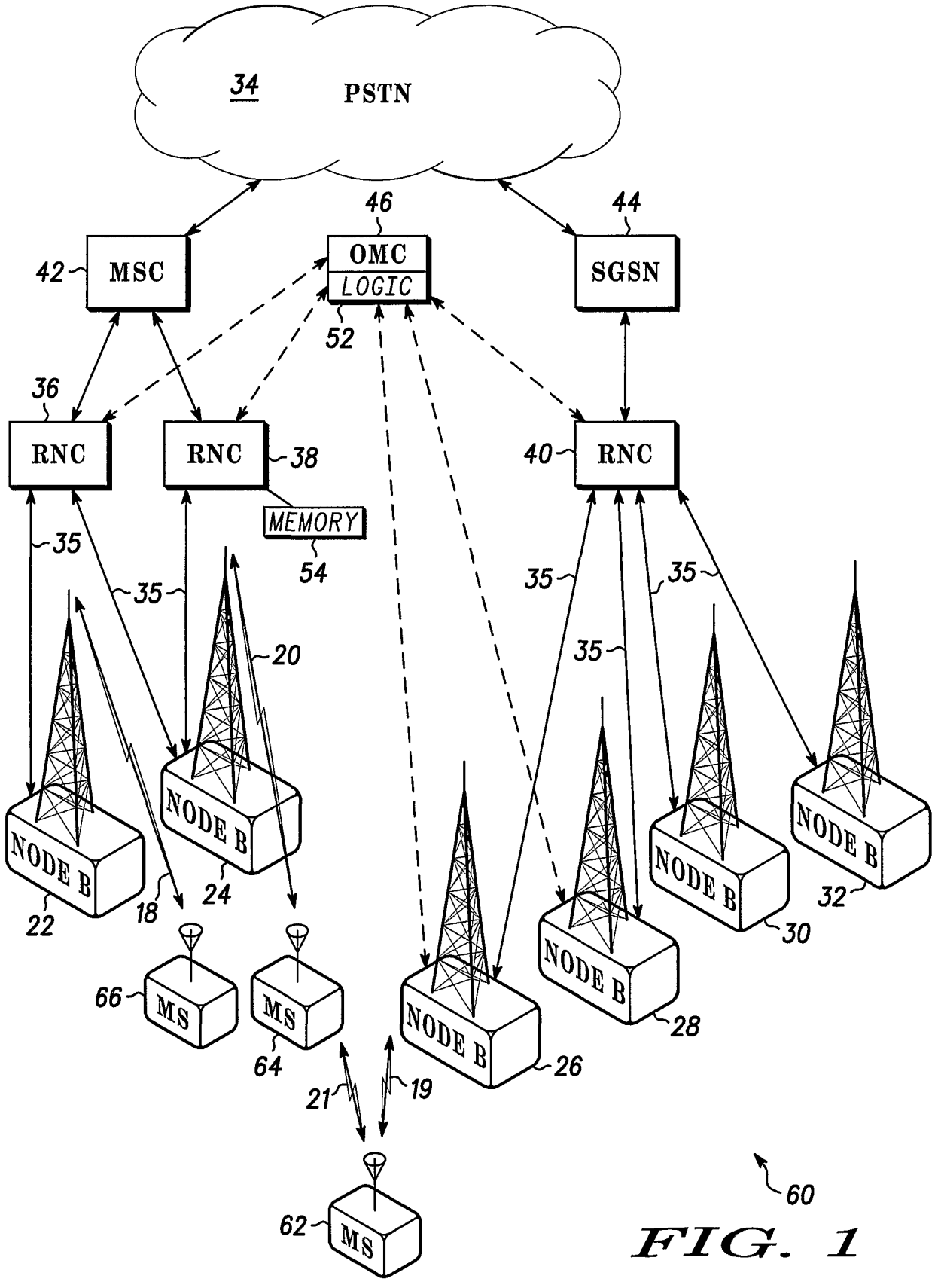
15. A communication unit operable to perform the steps of any of claims 1 to 6.

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

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

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.


34
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44
42
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OMC
LOGIC
SGSN
52
36
RNC
RNC
38
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RNC
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35
35
35
35
20
NODE B
NODE B
NODE B
NODE B
NODE B
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18
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64
NODE B
NODE B
28
26
21
19
62
MS
60

FIG. 1

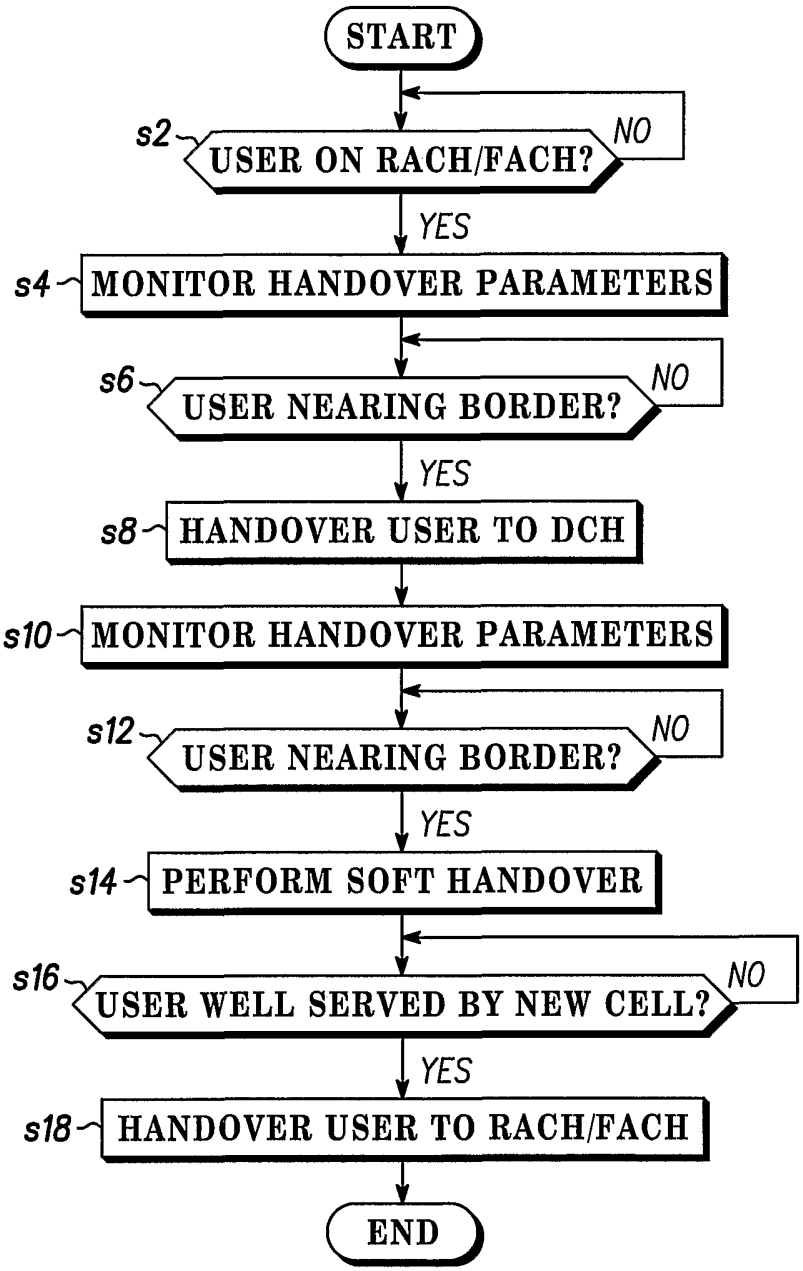
START
s2
USER ON RACH/FACH?
NO
YES
s4
MONITOR HANDOVER PARAMETERS
s6
USER NEARING BORDER?
NO
YES
s8
HANDOVER USER TO DCH
s10
MONITOR HANDOVER PARAMETERS
s12
USER NEARING BORDER?
NO
YES
s14
PERFORM SOFT HANDOVER
s16
USER WELL SERVED BY NEW CELL?
NO
YES
s18
HANDOVER USER TO RACH/FACH
END

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/01497

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

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)
IPC 7 H04Q

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 240 079 B1 (JOKINEN HARRI ET AL) 29 May 2001 (2001-05-29) column 2, line 21 -column 3, line 14 column 5, line 40 - line 65 column 7, line 38 - line 51	1-19
A	WO 01 31948 A (ERICSSON TELEFON AB L M) 3 May 2001 (2001-05-03) page 2, line 8 - line 14 page 18, line 1 - line 12 page 9, line 19 -page 10, line 9	1-19
A	US 5 805 995 A (JIANG HUA ET AL) 8 September 1998 (1998-09-08) column 2, line 15 -column 3, line 18	1-19

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
1 July 2002	08/07/2002

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

ormation on patent family members

Inte ıal Application No
PCT/EP 02/01497

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6240079 B1	29-05-2001	FI 96558 B	29-03-1996
		AU 696802 B2	17-09-1998
		AU 3524095 A	19-04-1996
		CA 2200307 A1	04-04-1996
		EP 0783811 A2	16-07-1997
		FI 971270 A	26-03-1997
		WO 9610305 A2	04-04-1996
		JP 10509566 T	14-09-1998
		US 6072787 A	06-06-2000
WO 0131948 A	03-05-2001	AU 1319501 A	08-05-2001
		WO 0131948 A1	03-05-2001
US 5805995 A	08-09-1998	NONE	