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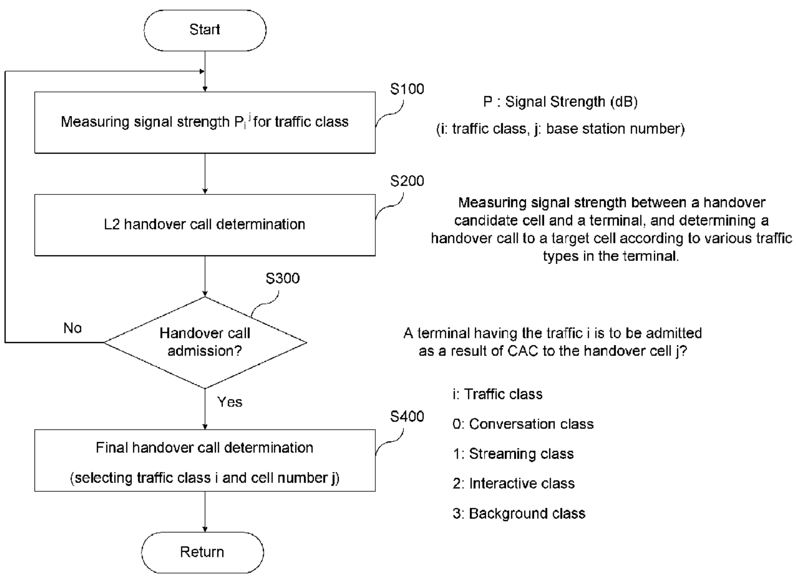
(54) **Title:** L2 HANDOVER METHOD ACCORDING TO TRAFFIC TYPES



(57) **Abstract:** The present invention relates to an L2 handover method having respective handover determination threshold values according to traffic types in a mobile communication system supporting multi-services. In the L2 handover method satisfying quality of service (QoS) requirements in the mobile communication system supporting multi-services according to the exemplary embodiment of the present invention, a) a signal strength for each traffic class is measured, b) respective handover determination reference values according to traffic class types are applied and an L2 handover call is determined, and c) resources are allocated to services that are sensitive to delay before services that are insensitive to delay so as to satisfy the QoS requirements for the determined handover calls.

WO 2006/062306 A1

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Description

L2 HANDOVER METHOD ACCORDING TO TRAFFIC TYPES

Technical Field

[1] The present invention relates to a layer 2 (L2) handover method according to traffic types, and more specifically, to an L2 handover method having respective handover determination threshold value values according to traffic types in a mobile communication system supporting multi-services.

Background Art

[2] In a next generation mobile communication system, handover frequently occurs due to a high capacity micro-cell and a terminal moving at a high speed. Therefore, studies on methods for securely providing quality of service (QoS) at handover have been actively pursued.

[3] In general, a handover (or handoff) is performed by switching a communication channel to another channel of a new cell in order to maintain communication when a mobile station moves from a base station (or a sector) to another base station. The handover is classified as a hard handover and a soft handover. The hard handover results in a radio connection being broken between the network and the mobile station before a new radio connection is established with the network in a target cell, while the soft handover is a handover procedure in which radio links are added and abandoned in such a manner that the mobile station always maintains at least one radio link established with the base station.

[4] In addition, the handover in a mobile communication system is classified as a layer 3 (L3) handover in an IP layer and a layer 2 (L2) handover in layers below the IP layer. Hereinafter, layer 2 (L2) will be referred to as a data link layer, and layer 3 (L3) will be referred to as a network layer.

[5] As to the prior art, Korean Patent Application No. 2003-15882 (filed on March 13, 2003) discloses an invention entitled “Apparatus for handover of base station in broadband wireless access communication system and method thereof”.

[6] This patent relates to a handover method for allocating a call to a processor having minimum available resources among processors having more resources than required by a mobile station, and an apparatus using the handover method. In this patent, a call access rate may be increased since the handover to base stations having a carrier to interference noise ratio (CINR) satisfying requirements that are provided based on handover determination reference information is notified to a service base station when at least one CINR satisfies the requirements, and accordingly, a call drop rate may be reduced.

[7] As to another prior art, Korean Patent Application No. 2002-83731 (filed on December 24, 2002) discloses an invention entitled "Method of handover in next generation mobile telecommunication system".

[8] This patent relates to a handover method for preventing data loss by minimizing a handover delay time in a mobile communication network while supporting mobility on IP-based networks.

[9] In the above handover method for providing mobility in a next generation mobile communication system, an IP address is reallocated according to a process of mobile IPs to perform a location registration process when a terminal is in an idle state, data loss may be prevented by using a retransmission function of a radio link control (RLC) layer since the mobile terminal sends traffic to a new access station (AS) rather than performing an IP address registration process, and a network load may be reduced since some processes for IP allocation are omitted.

[10] In general, non-real-time traffic such as World Wide Web (WWW) traffic and email are not sensitive to packet delay but are sensitive to packet loss. Accordingly, the packet loss may be reduced since the non-real-time traffic stores packets transmitted during handover in a packet retransmission method or a buffering method, and transmits the stored packets after layer 2 (L2) handover is finished. Therefore, QoS deterioration may be also reduced.

[11] However, real-time traffic such as a voice over Internet protocol (VoIP) service and a video streaming service are less sensitive to the packet loss compared to the non-real-time traffic, but are sensitive to the communication delay. Accordingly, there is a problem in realizing a service that satisfies QoS requirements even though a packet transmission time and an IP registration time are reduced in layer 3 (L3).

[12] That is, there is a problem in that the QoS is deteriorated when real-time voice and video streaming services that are sensitive to delay are provided, since characteristics of multi-class services having respective QoS requirements are not considered in the L2 handover method according to the prior art.

[13] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention, and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

Disclosure of Invention

Technical Problem

[14] The present invention has been made in an effort to provide a layer 2 (L2) handover method that satisfies quality of service (QoS) requirements and has respective handover determination threshold values according to traffic types in a mobile com-

munication system supporting multi-services, and to provide a layer 2 (L2) handover method for respectively providing differentiated services according to sensitiveness to delay and minimizing call drop between a mobile terminal and a base station which is caused by a handover in the layer 2 (L2).

Technical Solution

[15] In an exemplary layer 2 (L2) handover method satisfying quality of service (QoS) requirements in a mobile communication system supporting multi-traffic class services according to an embodiment of the present invention, a) a signal strength for each traffic class is measured, b) respective handover determination reference values according to traffic class types are applied and an L2 handover call is determined, and c) resources are allocated to services that are sensitive to delay before services that are insensitive to delay so as to satisfy the QoS requirements for the determined handover calls.

[16] While a call according to the traffic class continues, a) to c) are repeatedly performed to satisfy the QoS requirements and to use the minimum number of resources.

[17] In b), different reference values for respective services are established according to characteristics of multi-services having different QoS requirements, a high reference value is provided to high priority services, and a low reference value is provided to the low priority services.

[18] In b), a handover region is varied according to multi-traffic class services having different priorities from each other.

[19] The high priority traffic class service among the multi-traffic class services has a wide handover region so as to preferentially perform the handover since it has a high handover threshold value.

Advantageous Effects

[20] According to the exemplary embodiment of the present invention, resources are effectively allocated since the QoS criteria for handover failure rate and packet loss rate required for each traffic class are satisfied in the multi-class service environment, and service drops between the mobile terminal and the base station caused by the handover in the layer 2 (L2) are minimized since the differentiated services are respectively provided according to the sensitiveness to delay.

Brief Description of the Drawings

[21] FIG. 1 shows a flowchart for representing a layer 2 (L2) handover according to traffic type according to an exemplary embodiment of the present invention.

[22] FIG. 2 shows a detailed flowchart for representing an L2 handover call determination process according to the exemplary embodiment of the present invention.

[23] FIG. 3 shows a diagram for representing parameters used when a handover call is determined in a multi-traffic class service environment according to the exemplary embodiment of the present invention.

[24] FIG. 4 shows a schematic diagram for representing a handover region of the multi-traffic class service having various priorities according to the exemplary embodiment of the present invention.

Best Mode for Carrying Out the Invention

[25] An exemplary embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

[26] Hereinafter, a layer 2 (L2) handover method according to traffic type according to an exemplary embodiment of the present invention will be described with reference to the figures.

[27] Firstly, the L2 handover method will be described by using one of four service classes recommended in a universal mobile telecommunications system (UMTS) as follows.

[28] Class 1 is a conversational class for voice or video conference traffic, Class 2 is a streaming class for real-time video streaming, Class 3 is an interactive class for World Wide Web (WWW) or data access, and Class 4 is a background class for email or downloading.

[29] Class 1 and Class 2 correspond to real-time services and Class 3 and Class 4 correspond to non-real-time services.

[30] FIG. 1 shows a flowchart for representing a layer 2 (L2) handover operation according to traffic type according to an exemplary embodiment of the present invention. The L2 handover operation includes handover call determination processes (S100 and S200) and a call admission control process (S300).

[31] As shown in FIG. 1, in an L2 handover method satisfying quality of service (QoS) requirements in a mobile communication system supporting multi-services, a signal strength P_i^j for each traffic class is measured in step S100. Here, i of P_i^j denotes a traffic class and j thereof denotes a base station number.

[32] Subsequently, an L2 handover call is determined in step S200 by using a handover determination reference value varied according to a traffic class type. That is, after signal strength between a handover candidate cell and a terminal is measured, a handover call to a target cell is determined by using the handover determination reference value varied according to the traffic class type of a corresponding terminal.

[33] Subsequently, a call admission control process is performed, in which resources are preferentially allocated to services that are sensitive to delay before services that are in-sensitive to delay so as to satisfy the QoS requirements for the determined handover

calls. That is, the handover call handed over to the target cell requests resource allocation, and it is determined whether resources for the required handover call are allocated in various call admission control methods in step S300. At this time, it is determined whether a terminal having an i traffic class is admitted as a result of the call admission control to the handover cell.

[34] In general, the handover call determined in step S200 performs the call admission control process before the resource allocation requested by a new call is performed. When the handover call is not admitted in the call admission process in step S300, the steps S100 to 300 are repeatedly performed.

[35] For example, a reconfiguration method is used for the call admission control in step S300. The reconfiguration method is a representative method among conventional call admission control methods of a mobile communication system. In the reconfiguration method, minimum and maximum bandwidths satisfying the QoS requirements in the traffic classes are previously allocated. The bandwidth of various services may be varied from a maximum value to a minimum value by using the reconfiguration method. That is, an operation obtaining bandwidth from services having low priority or lending bandwidth to a service having high priority is performed according to resource usages at an arbitrary moment.

[36] As an example, a new service continues at a minimum bandwidth when the new service does not obtain a maximum bandwidth in an arbitrary base station cell. As another example, when the high priority service does not obtain the minimum bandwidth from an arbitrary base station cell, the high priority service deprives bandwidth by reducing the bandwidth of the service having lower priority to a minimum quality level of bandwidth.

[37] Subsequently, when the handover call is admitted, a final handover call is determined in step S400. At this time, the traffic class i and the base station cell number j are selected.

[38] Accordingly, the handover operation according to the traffic type is finished.

[39] FIG. 2 shows a detailed flowchart for representing the L2 handover call determination process corresponding to step S200 shown in FIG. 1 according to the exemplary embodiment of the present invention. The L2 handover call determination process shown in FIG. 2 is based on appropriate handover parameter establishment for performing the handover operation.

[40] Handover parameters used in the exemplary embodiment of the present invention will be described as follows.

[41] P_i denotes a signal strength for the traffic class i, and the signal strength includes a signal to noise ratio (SNR) which is presented in □m.

[42] H_i denotes a handover threshold value for the traffic class i. The signal strength

indicates that the mobile terminal enters a handover region when the signal strength is less than a corresponding handover threshold value H_i.

[43] Q_i denotes a quality threshold value for the traffic class i. The quality threshold value indicates an acceptable minimum quality value during an active call period. Therefore, the signal strength indicates that the mobile terminal leaves the handover region when the signal strength is less than a corresponding quality reference Q_i.

[44] D_i denotes a determination value for the traffic class i. When the signal strength corresponds to the handover threshold value H_i, a distance α_i between the mobile terminal and the base station is calculated (at this time, the distance α_i corresponds to a time of the mobile terminal moving to the handover region). When the signal strength corresponds to quality threshold value Q_i, a distance β_i between the mobile terminal and the base station is calculated (at this time, the distance β_i corresponds to a time of the mobile terminal leaving the handover region). Therefore, the handover determination threshold value D_i is appropriately determined between β_i and α_i.

[45] The L2 handover call determination process according to the exemplary embodiment of the present invention will be described with reference to FIG. 2.

[46] Firstly, initialization is performed by establishing the traffic class i as 0 in step S210, and the traffic class i is increased by 1 in step S202.

[47] Subsequently, it is determined whether the signal strength P_i for the traffic class i is less than a corresponding handover threshold value H_i in step S203, and the handover is started in step S204 at the distance α_i between the mobile terminal and the base station since the mobile terminal enters the handover region when the signal strength P_i for the traffic class i is less than the handover threshold value H_i. When the signal strength P_i for the traffic class i is not less than the handover threshold value H_i, the traffic class i is increased by 1 in step S202.

[48] Then, it is determined whether the signal strength P_i for the traffic class i is less than the handover determination threshold value D_i for the traffic class i in step S205, and the handover is determined in step S206 where the distance between the mobile terminal and the base station reaches D_i when the signal strength P_i for the traffic class i is less than handover determination threshold value D_i for the traffic class i. When the signal strength P_i for the traffic class i is not less than the handover determination threshold value D_i for the traffic class i, the traffic class i is increased by 1 in step S202.

[49] Finally, it is determined whether the signal strength P_i for the traffic class i is less than a corresponding quality threshold value Q_i in step S207, the handover is finished at the distance β_i where the mobile station leaves the handover region when the signal strength P_i for the traffic class i is less than the corresponding quality threshold value Q_i, and a call admission for the handover call is requested to perform the handover in the

target cell in step S208. When the signal strength P_i for the traffic class i is not less than the quality threshold value Q_i, the traffic class i is increased by 1 in step S202.

[50] Accordingly, the handover call to the target cell is determined by using the handover determination reference value that is varied according to various traffic types including class 1 to class 4.

[51] FIG. 3 shows a diagram for representing parameters used when the handover call is determined in a multi-traffic class service environment according to the exemplary embodiment of the present invention, and it shows various handover determination parameters according to the traffic classes in the multi-traffic class environment.

[52] Referring to FIG. 3, the handover threshold values H_0 and H_1 and the handover determination threshold values D_0 and D_1 for the traffic classes 0 and 1 may be found according to the signal strength P_i^j and the distance between the mobile terminal and the base station as described above, and 1) a handover access point of the traffic class 0, 2) a handover access point of the traffic class 1, 3) a handover determination point of the traffic class 0, 4) a handover determination point of the traffic class 1, 5) a handover exit point of the traffic class 0, and 6) a handover exit point of the traffic class 1 may be found according to the handover threshold values H_0 and H_1 and the handover determination threshold values D_0 and D_1, and handover margins for the traffic classes 0 and 1 according to 1), 2), 3), 4), 5), and 6) may be found.

[53] That is, with a high handover threshold value H_0, a high priority traffic service among the multi-class services (i.e., the traffic class 0 in FIG. 3) has a wide handover region so as to preferentially perform the handover.

[54] In addition, with a low handover threshold value H_1, low priority service traffic (i.e., the traffic class 1 in FIG. 3) has a narrow handover region so as to perform the handover strictly.

[55] Therefore, handover failures may be reduced since the services of the high priority traffic class (i.e., services sensitive to delay) are determined as a handover call prior to the services of the low priority traffic class (i.e., services insensitive to delay).

[56] In general, the signal strength between the handover candidate cell and the mobile terminal is measured as described above, and the services that are sensitive to delay receive resources before the services that are insensitive to delay in order to effectively use the resources and to satisfy the QoS requirements in the call admission control method (e.g., the reconfiguration method) after the handover call to the target cell is determined.

[57] Accordingly, since the call admission process is performed as in step S300, the handover is preferentially performed for the services of the high priority traffic class, and therefore QoS requirements for the delay are satisfied and the handover failure rate is also reduced.

[58] FIG. 4 shows a schematic diagram for representing the handover region of the multi-traffic class service having various priorities according to the exemplary embodiment of the present invention, and the handover region is determined by the parameters shown in FIG. 3.

[59] As shown in FIG. 4, in the call admission control method for a handover call in the mobile communication system supporting the various service classes, the resources are basically allocated to the high priority service class that is sensitive to delay before the low priority service class that is insensitive to delay.

[60] Therefore, in the L2 handover method according to the traffic types according to the exemplary embodiment of the present invention, since the high handover threshold value is applied to the service class that is sensitive to delay so as to increase the effect of the call admission control, the handover region become wide as shown in FIG. 4. Accordingly, more service classes that are sensitive to delay are registered in a handover candidate list than the service classes that are insensitive to delay and are easily included in a call admission control list, which supports a basic policy of the call admission control.

[61] As described in FIG. 2, FIG. 3, and FIG. 4, it is useful to control the handover determination threshold value according to the traffic classes in order to use the minimum number of resources while satisfying the required QoS parameters (e.g., the handover failure rate and a packet loss rate) when the mobile communication system is designed.

[62] According to the exemplary embodiment of the present invention, a high threshold value is provided to the high priority services and a low threshold value is provided to the low priority services, since the threshold values are respectively established for the respective service classes according to characteristics of the multi-services having respective QoS requirements in the multi-service environment, and a low call drop rate is maintained since a service interruption caused by deterioration of the QoS between the mobile terminal and the base station is prevented while the handover is performed. Accordingly, no resources are wasted since the various traffic classes satisfy the QoS requirements according to the exemplary embodiment of the present invention.

[63] According to the exemplary embodiment of the present invention, the resources may be effectively allocated since the QoS criteria including the handover failure rate and the packet loss rate respectively required for the respective traffic classes in the multi-class service environment are satisfied.

[64] In addition, according to the exemplary embodiment of the present invention, since different resources for the service that is sensitive to delay and the service that is insensitive to delay are provided, connection drops caused by the handover in layer 2 between the mobile terminal and the base station may be minimized.

[65] While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

[66]

[67]

Claims

[1] A layer 2 (L2) handover method satisfying quality of service (QoS) requirements in a mobile communication system supporting multi-traffic class services, the L2 handover method comprising:
a) measuring a signal strength for each traffic class;
b) applying respective handover determination threshold values according to traffic class types and determining an L2 handover call; and
c) allocating resources to services that are sensitive to delay before services that are insensitive to delay so as to satisfy the QoS requirements for the determined handover calls.

[2] The L2 handover method of claim 1, wherein
a) to c) are repeatedly performed to satisfy the QoS requirements and to use the minimum resources while a call according to the traffic class continues.

[3] The L2 handover method of claim 1, wherein
in b),
different threshold values for respective service classes are established according to characteristics of multi-traffic class services having different QoS requirements, and
a high threshold value is provided to high priority services, and a low threshold value is provided to low priority services.

[4] The L2 handover method of claim 1, wherein
in b),
a handover region is varied according to the multi-traffic class services having respective priorities.

[5] The L2 handover method of claim 4, wherein
the high priority traffic service among the multi-traffic class services has a wide handover region so as to preferentially perform the handover since it has a high handover threshold value.

[6] The L2 handover method of claim 4, wherein
the low priority service traffic among the multi-traffic class services has a narrow handover region so as to perform the handover strictly since it has a low handover threshold value.

[7] The L2 handover method of claim 1, wherein
in c), the high priority services sensitive to delay are registered more than the low priority services that are insensitive to delay.

[8] The L2 handover method of claim 1, wherein
in b), a parameter for determining the handover call is selected from among a

signal strength P_i for the traffic class i, a handover threshold value H_i for the traffic class i, a quality threshold value Q_i for the traffic class i, and a determination value D_i for the traffic class i.

[9] The L2 handover method of claim 8, wherein
the signal strength P_i for the traffic class i is represented in a signal to noise ratio (SNR) which is presented in □m.

[10] The L2 handover method of claim 8, wherein
when the signal strength is less than a corresponding handover threshold value H_i, the signal strength indicates that the mobile terminal enters a handover region.

[11] The L2 handover method of claim 8, wherein
the quality threshold value Q_i indicates an acceptable minimum quality value during an active call period.

[12] The L2 handover method of claim 11, wherein
the signal strength indicates that the mobile terminal leaves the handover region when the signal strength is less than a corresponding quality reference Q_i.

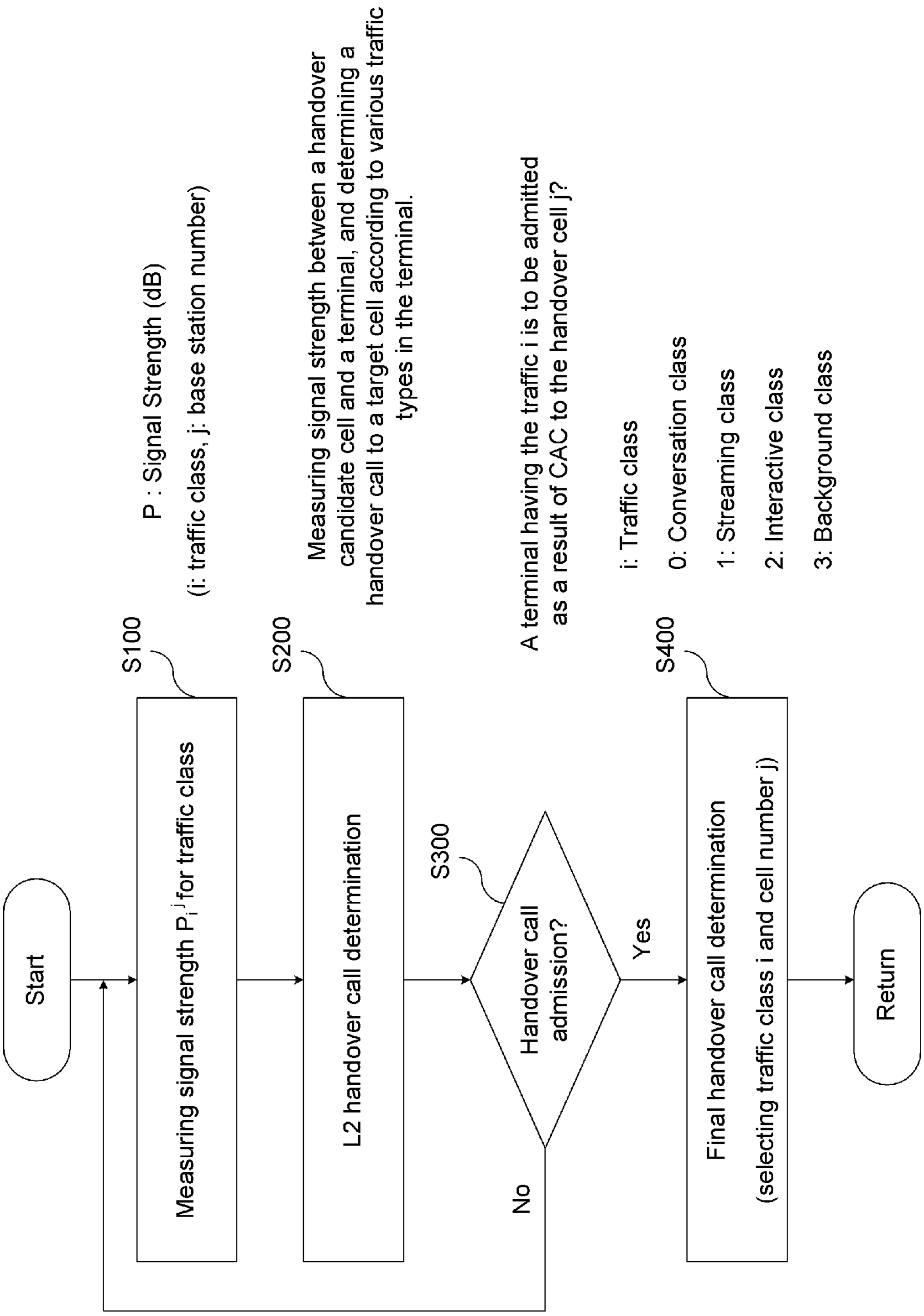
[13] The L2 handover method of claim 8, wherein
a distance α_i between a mobile terminal and a base station is calculated (at this time, the distance α_i corresponds to a time of the mobile terminal moving to the handover region) when the signal strength corresponds to the handover threshold value H_i, and a distance β_i between the mobile terminal and the base station is calculated (at this time, the distance β_i corresponds to a time of the mobile terminal leaving the handover region) when the signal strength corresponds to the quality threshold value Q_i.

[14] The L2 handover method of claim 13, wherein
the handover determination threshold value D_i is appropriately determined between the distance β_i and the distance α_i.

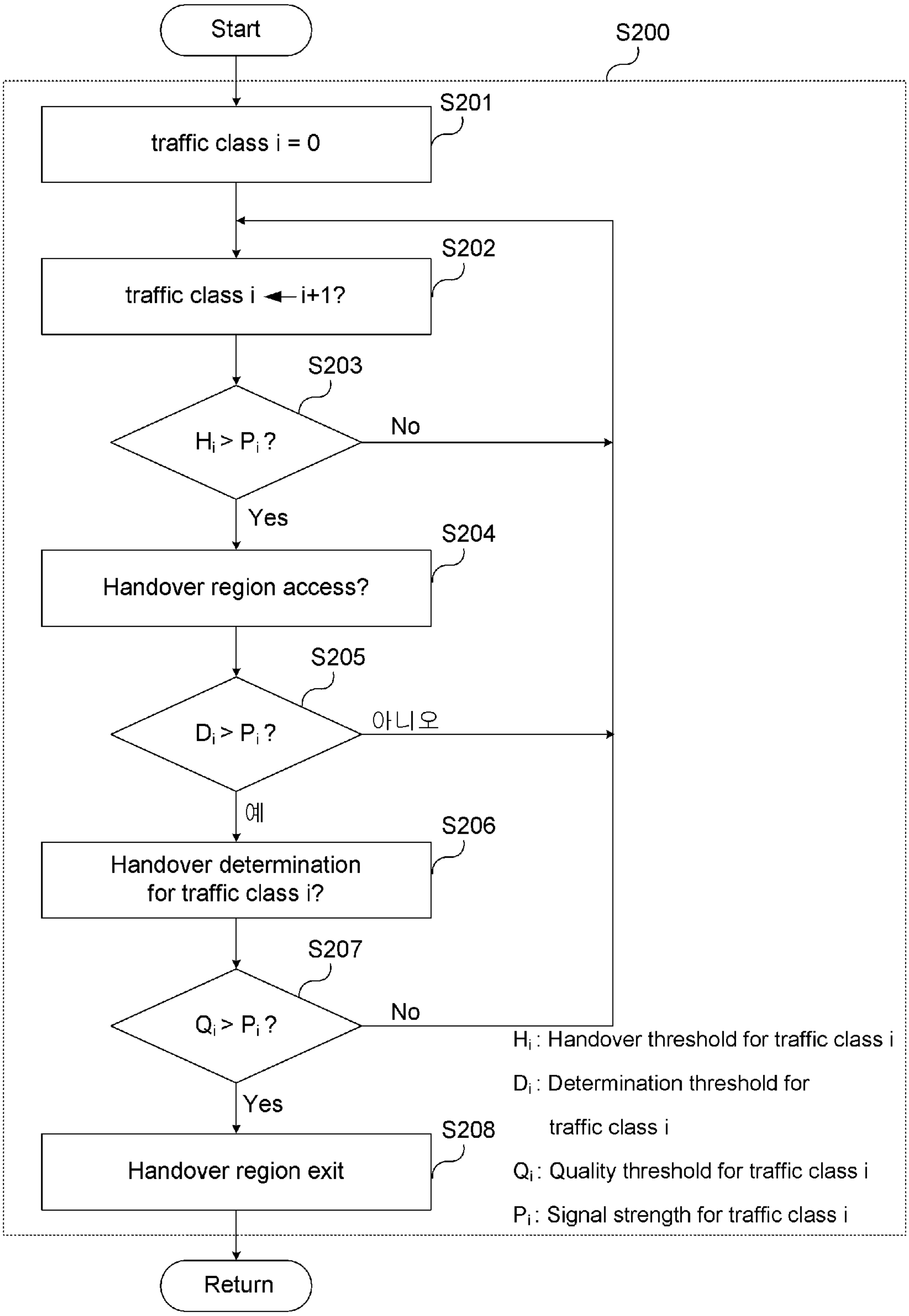
[15] The L2 handover method of claim 8, wherein b) comprises:
b-1) establishing the traffic class i to 0 for initialization and increasing the traffic class i by 1;
b-2) determining whether the signal strength P_i for the traffic class i is less than a corresponding handover threshold value H_i;
b-3) starting the handover at the distance α_i between the mobile terminal and the base station since the mobile terminal enters the handover region when the signal strength P_i for the traffic class i is less than the handover threshold value H_i;
b-4) determining whether the signal strength P_i for the traffic class i is less than the handover determination threshold value D_i for the traffic class i;
b-5) determining the handover where the distance between the mobile terminal and the base station reaches D_i when the signal strength P_i for the traffic class i is

less than the handover determination threshold value D_i for the traffic class i;
b-6) determining whether the signal strength P_i for the traffic class i is less than a corresponding quality threshold value Q_i; and
b-7) requesting a call admission for the handover call so that the handover at the distance β_i at which the mobile station leaves the handover region may be finished and another handover may be performed in the target cell, when the signal strength P_i for the traffic class i is less than the corresponding quality threshold value Q_i.

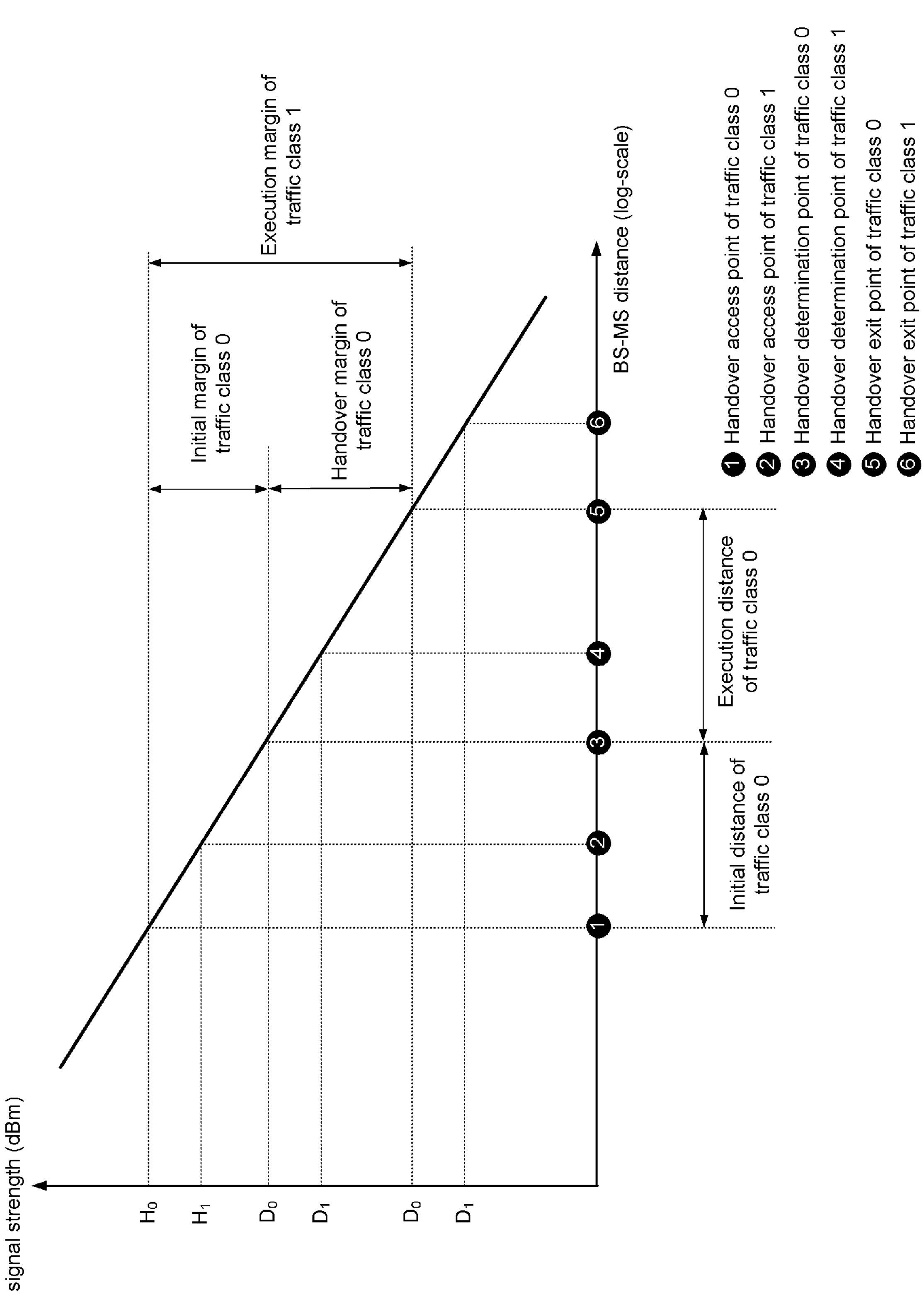
[Fig. 1]


Start
Measuring signal strength P_i^j for traffic class
S100
P : Signal Strength (dB)
(i: traffic class, j: base station number)
L2 handover call determination
S200
Measuring signal strength between a handover candidate cell and a terminal, and determining a handover call to a target cell according to various traffic types in the terminal.
S300
Handover call admission?
A terminal having the traffic i is to be admitted as a result of CAC to the handover cell j?
No
Yes
Final handover call determination
(selecting traffic class i and cell number j)
S400
i: Traffic class
0: Conversation class
1: Streaming class
2: Interactive class
3: Background class
Return

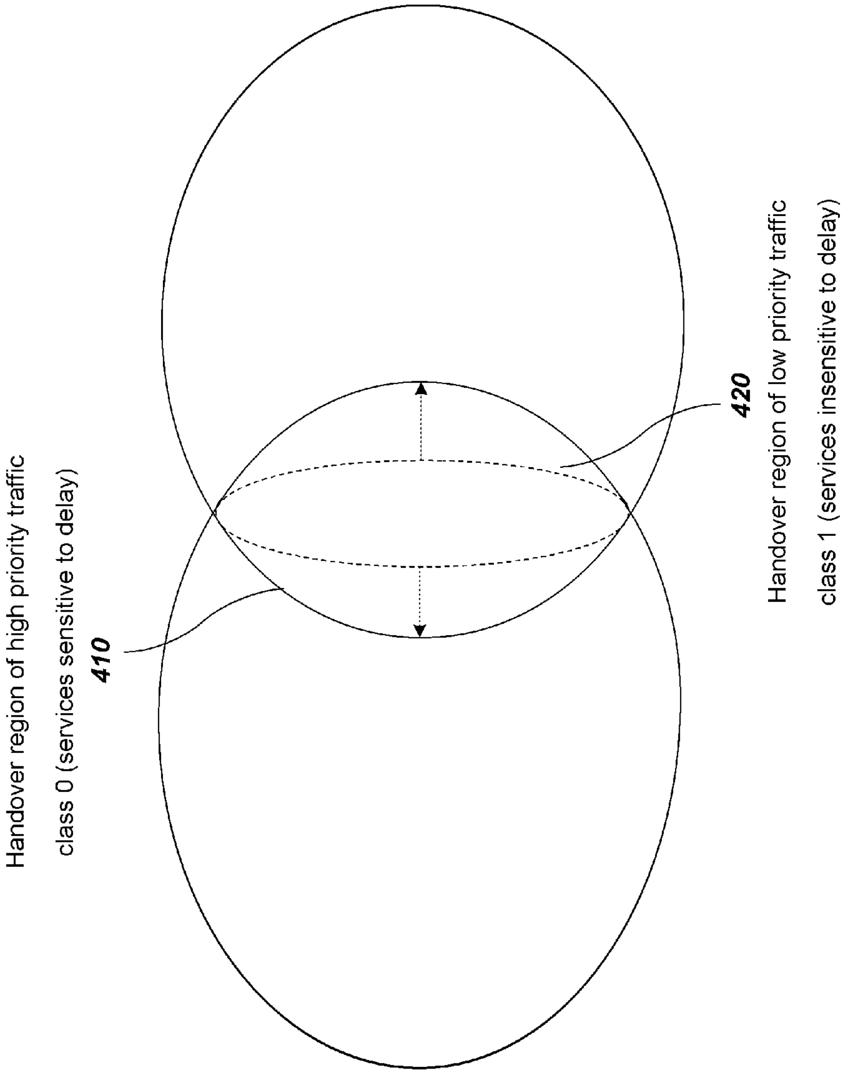
[Fig. 2]


Start
S200
S201
traffic class i = 0
S202
traffic class i ← i+1?
S203
$H_i > P_i$?
No
Yes
S204
Handover region access?
S205
$D_i > P_i$?
아니오
예
S206
Handover determination
for traffic class i?
S207
$Q_i > P_i$?
No
Yes
S208
Handover region exit
H_i : Handover threshold for traffic class i
D_i : Determination threshold for
traffic class i
Q_i : Quality threshold for traffic class i
P_i : Signal strength for traffic class i
Return

[Fig. 3]


signal strength (dBm)
H0
H1
D0
D1
D0
D1
BS-MS distance (log-scale)
Execution margin of traffic class 1
Initial margin of traffic class 0
Handover margin of traffic class 0
Initial distance of traffic class 0
Execution distance of traffic class 0
1
2
3
4
5
6
1 Handover access point of traffic class 0
2 Handover access point of traffic class 1
3 Handover determination point of traffic class 0
4 Handover determination point of traffic class 1
5 Handover exit point of traffic class 0
6 Handover exit point of traffic class 1

[Fig. 4]


Handover region of high priority traffic
class 0 (services sensitive to delay)
410
420
Handover region of low priority traffic
class 1 (services insensitive to delay)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 2005/004021

A. CLASSIFICATION OF SUBJECT MATTER
IPC[8]: ***H04Q 7/38*** (2006.01)
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[8]: H04Q 7/38

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 practicable, search terms used)
EPODOC, PAJ, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 313 258 A (MOTOROLA LIMITED) 19 November 1997 (19.11.1997) *abstract, claims, figures 1, 2, 3, 6.* --	1
A	US 6 556 834 B1 (S. KOBAYASHI et al.) 29 April 2003 (29.04.2003) *abstract, column 2, line 39 to column 4, line 64, claims, figures 1, 2, 3.* --	1
A	US 6 385 451 B1 (J. KALLIOKULJU et al.) 7 May 2002 (07.05.2002) *abstract, claims, figure 1.* --	1

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
24 March 2006 (24.03.2006)	26 April 2006 (26.04.2006)

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/0046879 A1 (P. SCHRAMM et al.) 29 November 2001 (29.11.2001) *abstract, claims, figures 1-5.*	1
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A	US 6 269 087 B1 (T. NAKAMURA et al.) 31 July 2001 (31.07.2001) *abstract, claims, figure 3.*	1
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A	US 5 509 051 A (C. A. BARNETT et al.) 16 April 1996 (16.04.1996) *abstract, claims, figure 3.*	1

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR 2005/004021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB A 2313258		none	
US A 20010046879		none	
US A 5509051		none	
US A 6269087		none	
US A 6385451		none	
US A 6556834		none	