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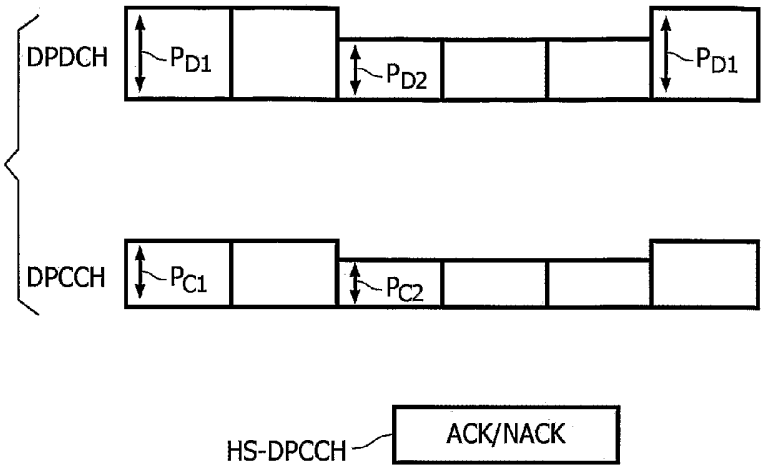
[Continued on next page]

(54) Title: POWER MANAGEMENT IN MOBILE TERMINALS TO ALLOW TRANSMISSION OF ACK/NACK SIGNALS



(57) Abstract: A communication system, for example UMTS (Universal Mobile Telecommunication System), comprises a base station and a plurality of mobile stations. In normal operation the mobile station continuously makes uplink transmissions on certain spread spectrum channels (DPDCH, DPCCH). The maximum allowed power (Pmax) for these uplink transmissions is specified. However there are occasions when for example receiving packet data from the base station, the receiving mobile station has to transmit an acknowledgement (ACK) or a Non-acknowledgement (NACK) at a power level specified by the base station. In order to keep the transmit power of the mobile station within the maximum allowed power, the total power required to transmit an ACK or NACK in parallel with the continuous uplink signals is determined and if this exceeds Pmax then at least the power DPDCH and DPCCH channels are scaled to allow sufficient power for the transmission of an ACK or NACK. The power scaling is carried-out based on the power required for whichever one of ACK or NACK requires the most power. This avoids reducing the amount of time available to a mobile whether an ACK or NACK should be transmitted.

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Declaration under Rule 4.17:

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DESCRIPTION

POWER MANAGEMENT IN MOBILE TERMINALS TO ALLOW TRANSMISSION OF ACK/NACK SIGNALS

The present invention relates to a communication system, to a station for use in a communication system, and to a method of operating a communication system. The present invention has particular, but not exclusive, application to spread spectrum systems such as UMTS (Universal Mobile Telecommunication System).

Terminals in mobile communication systems usually have a maximum transmit power limit, which may be set by physical constraints or in response to an instruction received from a controller.

In a communication system while a terminal is transmitting a first signal, it is sometimes necessary to transmit simultaneously additional signals which would require the terminal's maximum transmit power limit to be exceeded. In such cases, a variety of approaches may be taken, including reducing the transmit power of the first signal in order to allow sufficient power for the additional signal(s) to be transmitted without breaching the maximum power limit or switching-off part or all of the first signal in order to allow the additional signal(s) to be transmitted.

In some systems, it is only possible to execute the reduction in transmit power of the first signal at particular time instants, such as a frame- or timeslot-boundary. These time instants may not correspond to the times at which the transmission of the additional signal(s) must commence. A method of overcoming this problem is to execute a reduction in transmit power in advance of the transmission of the additional signal(s).

In such situations, the exact nature of the additional signal(s) may not yet be known at the time when the reduction in transmit power of the first signal has to be executed because, for example, there is insufficient time for the terminal to evaluate a critical feature, such as a CRC (cyclic redundancy

check) in a received signal. Different types of additional signal may have different transmit power requirements.

An object of the present invention is to be able to transmit an additional signal in a timely manner whilst not exceeding a predetermined maximum power limit.

According to a first aspect of the present invention there is provided a method of operating a communication system comprising a first station and a second station, the first and second stations each having transceiving means, the second station transmitting a first signal to the first station, the power of the transmitted first signal not exceeding a predetermined maximum level, wherein in response to the second station wishing to transmit any one of a set of possible additional signals, the transmit power of the first signal is scaled by an amount which takes into account the greater (or greatest) power requirement of all of the set of the possible additional signals to be transmitted subsequently.

According to a second aspect of the present invention there is provided a communication system comprising a first station and a second station, the first station and second stations having transceiving means, the second station having power control means for controlling the transmitted power level of a first signal to be transmitted to the first station, wherein the power control means is adapted, in response to determining that the second station wishes to transmit any one of a set of possible additional signals simultaneously with the first signals, to scale the transmit power of the first signal by an amount which takes into account the greater (or greatest) power requirement of all of the set of the possible additional signals to be transmitted subsequently.

According to a third aspect of the present invention there is provided a second station for use in a communication system comprising a first station and a second station, the second station including transceiving means for communication with the first station, and power control means for controlling the transmitted power level of a first signal to be transmitted to the first station, wherein the power control means is adapted, in response to

determining that the second station wishes to transmit any one of a set of possible additional signals simultaneously with the first signals, to scale the transmit power of the first signal by an amount which takes into account the greater (or greatest) power requirement of all of the set of the possible additional signals to be transmitted subsequently.

The method in accordance with the present invention avoids setting a requirement on the terminal to make an earlier decision about which type of additional signal is to be transmitted, or to make a reduction in power of the first signal at some time other than the most convenient or required instant.

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a block schematic diagram of an UMTS communication system,

Figure 2 is a simplified block schematic diagram illustrating the downlink and uplink signals,

Figure 3 is a timing diagram showing individually the uplink signals,

Figure 4 is a timing diagram showing the combination of the uplink signals, and

Figure 5 is a flow chart illustrating an embodiment of the method in accordance with the present invention.

In the drawings the same reference numbers have been used to indicate corresponding features.

The UMTS communication system comprises at least one base station BS and a plurality of mobile stations MS, one of which is shown in Figure 1. The mobile stations are able to roam within the radio coverage of the base station(s) and maintain radio communication by way of spread spectrum signalling on downlinks from the base station(s) and uplinks from the mobile stations. As is customary with spread spectrum signalling several signals can be transmitted simultaneously each signal having its own signature or spreading code selected from a set of signatures. Additionally power control

has to be effected to prevent weaker signals being swamped by more powerful signals. Accordingly a base station can specify the maximum power at which a mobile station can transmit on the uplink.

Referring to Figure 1, the base station BS is controlled by a controller 10 which carries out the many functions involved in the maintenance of the system and the sending and receiving of signals. A transceiver 12 is coupled to an antenna 14 for the transmission and reception of spread spectrum signals. An external source of data 16 is coupled to a base band stage 18 in which data is formatted into packets. The data packets are prepared for transmission by multiplying them in a multiplier 20 with a signature, for example a pseudo random code, obtained from a code store 22 under the control of the controller 10. The spread spectrum signal is passed to the transceiver for modulation and transmission.

In the case of a signal received at the antenna it is demodulated and despread by multiplying the demodulated signal with the appropriate signature. Thereafter the despread signal is passed to the base band stage 18.

The mobile station MS is controlled by a controller 30 which carries out the many functions involved in the operation of the mobile station, including the sending and receiving of signals. For convenience of illustration and to facilitate an understanding of the present invention the controller 30 is shown as comprising a microprocessor 32, a transmit power controller 34 and a power scaler 36. A transceiver 38 is coupled to an antenna 40 for the transmission and reception of spread spectrum signals from the base station BS. A man/machine interface 42, which includes a base band data formatting and deformatting stage, means for inputting data and means for outputting data, is coupled to a multiplier 44 to which is supplied a signature, for example a pseudo random code, obtained from a code store 46 under the control of the microprocessor 32. A signal to be transmitted on the uplink is spread and is passed to the transceiver 38 for modulation and transmission.

In the case of a downlink signal received at the antenna 40 it is demodulated and despread by multiplying the demodulated signal with the

appropriate signature. Thereafter the despread signal is passed to the man/machine interface 42.

In the case of UMTS the operating standard requires each mobile station to transmit spread spectrum uplink signals substantially continuously. These signals are formatted into successive frames or time slots whose duration is specified by the system. Two signals are often transmitted continuously and these are a dedicated physical data channel DPDCH and dedicated physical control channel DPCCH, these signals are shown in Figure 1. Only DPCCH is transmitted when there is no data. The relative transmission power levels P_D and P_C of the DPDCH and DPCCH channels are regulated so as to maintain a fixed power ratio for a given data type and their combined powers are controlled so as not to exceed an allowable maximum power level P_{max}. Further while maintaining the fixed power ratio, the power level P_C of the DPCCH is adjusted periodically by a closed-loop power control mechanism.

Referring to Figure 2, which is a simplified version of Figure 1, from time to time the base station BS uses the downlink to transmit packet data to an identified mobile station using High-Speed Downlink Packet Access HSDPA. Under the UMTS standard, the mobile station MS must transmit a positive (ACK) or negative (NACK) acknowledgement for each HSDPA packet received, depending for example on the outcome of a cyclic redundancy check (CRC) evaluation.

Referring to Figure 3 the ACKs and NACKs are transmitted as spread spectrum signals on a so-called High-Speed Dedicated Physical Control Channel (HS-DPCCH), whose time slots are not aligned with the time slots on the other uplink channels carrying the continuous uplink signals DPDCH and DPCCH. The relative transmit powers of the ACKs and NACKs are different and the respective transmit powers are determined by the base station BS and notified to the mobile station MS.

If the transmission of an ACK or NACK in parallel with the continuous uplink signals would require more transmit power than is allowed, the transmit power must be reduced. If the adjustment of the respective signal powers is delayed until the CRC in the HSDPA packet is evaluated, in the case of a large

packet it would be difficult, if not impossible, to make the adjustment at a DPCCH slot boundary as specified in the UMTS standard.

To avoid this problem the method in accordance with the present invention causes the transmit power of the other uplink channels , that is , the DPDCH and DPCCH, to be reduced at the timeslot boundary immediately preceding the start of the ACK or NACK transmission. However, as mentioned above, the transmit power for ACKs is required to be different from the transmit power for NACKs. Consequently, if the mobile station MS was to know by how much to reduce the power of the continuous signals DPDCH and DPCCH in time for the slot boundary prior to the start of the ACK or NACK transmission, it would need to complete the CRC evaluation process more quickly than the time allowed by the timing of the ACK/NACK transmission. Since this is not possible, the mobile station MS reduces the transmit power at the time slot prior to the start of the ACK/NACK transmission by an amount corresponding to whichever of ACK or NACK has the higher power requirement P_A or P_N, respectively. In this way, the mobile station MS can ensure that enough transmit power is available for the ACK/NACK transmission regardless of the final outcome of the CRC evaluation process.

The principle is illustrated in Figures 3 and 4. In Figure 3 the mobile station MS is initially transmitting at its maximum allowed power, $P_{max} = P_{C1} + P_{D1}$.

Suppose that P_A is defined to be $2P_C$ and P_N is defined to be equal to P_C.

Then the powers of the DPDCH and DPCCH must be reduced to P_{D2} and P_{C2} , respectively, such that

$P_{C2} + P_{D2} + P_A = P_{max}$

That is, $P_{C2} + P_{D2} + 2P_{C2} = P_{max}$.

The power ratio between the control and data channels is maintained, such that $P_{D2}/P_{C2} = P_{D1}/P_{C1}$.

Thus $$P_{C2} = \frac{P_{C1} + P_{D1} - P_A}{1 + P_{D1}/P_{C1}} \quad \text{or} \quad P_{C2} = \frac{P_{C1} + P_{D1}}{3 + P_{D1}/P_{C1}}$$

and $P_{D2} = \frac{P_{C1} + P_{D1} - P_A}{1 + P_{C1}/P_{D1}}$ or $P_{D2} = \frac{P_{C1} + P_{D1}}{1 + 3P_{C1}/P_{D1}}$.

In Figure 4 the broken horizontal line illustrates the maximum allowed transmit power P_{max}. When there is not ACK or NACK to be transmitted then the combined maximum amplitudes of P_{D1} and P_{C1} equal P_{max}. However at the boundary of the frame or time slot immediately preceding the sending of an ACK or NACK, these amplitudes are adjusted by for example reducing DPCCH whilst maintaining the power ratio P_D / P_C constant. Thus capacity is left for the transmission of the higher power one of ACK or NACK, even though the lower power one may be transmitted thereby making the combined transmit power lower than P_{max}.

The flow chart shown in Figure 5 summarises the operations carried out by the secondary station in implementing the method in accordance with the present invention. Block 50 relates to the mobile station MS continuously transmitting the DPDCH and DPCCH signals at a combined transmit power level equal to or less than the maximum allowable power level P_{max}. Block 52 relates to the mobile station receiving packet data in a downlink HSDPA packet data signal. Block 54 denotes the mobile station determining the power levels for the ACK or NACK signal and the greater one of the two levels. Block 56 denotes checking if P_{max} would be exceeded by an uplink signal comprising DPDCH, DPCCH and the higher power of the ACK or NACK signals. If the answer is yes (Y) then in block 58 the scaling stage 36 (Figure 1) of the mobile station scales the power of at least the DPCCH channel so that P_{max} will not be exceeded. The flow chart proceeds to block 60. If the answer in the block 56 is no (N) the flow chart proceeds to the block 60. The block 60 denotes the power control stage 34 (Figure 1) of the mobile station reducing the power of the DPDCH and DPCCH channels at the frame or time slot boundary preceding the transmission of the ACK or NACK. Block 62 relates to the mobile station MS transmitting the ACK or NACK.

When implementing the method in accordance with the present invention the scaling of the DPCCH power may coincide with a requested

power increase, for example due to a closed loop power control process or a change in data format on the DPDCH. In this case, the result of the scaling process in accordance with the present invention may in fact be to increase the DPCCH (+ DPDCH) transmit power, but by a smaller amount than was requested by the closed loop power control process and/or change in DPDCH data format. This situation may arise where the sum of P_{C1} and P_{D1} is less than P_{max}, but the sum of P_{C2} + P_{D2} + the greater of P_A and P_N would be greater than P_{max} if the scaling were not applied.

In another embodiment, the additional signals may carry information other than ACK/NACK signalling; for example, they may carry packet data (as in the proposed enhanced uplink in UMTS) or other signalling information.

In a further non-illustrated embodiment the base station may be required to implement the method in accordance with the present invention rather than the mobile station.

Although the method in accordance with the present invention has been described with reference to a spread spectrum communication system, its teachings may be applied to other systems having transmitter power control.

In the present specification and claims the word “a” or “an” preceding an element does not exclude the presence of a plurality of such elements. Further, the word “comprising” does not exclude the presence of other elements or steps than those listed.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the design, manufacture and use of telecommunication systems and component parts therefor and which may be used instead of or in addition to features already described herein.

CLAIMS

1. A method of operating a communication system comprising a first station (BS) and a second station (MS), the first and second stations each having transceiving means (12, 38), the second station transmitting a first signal (DPCCH) to the first station, the power of the transmitted first signal not exceeding a predetermined maximum level (P_{max}), wherein in response to the second station wishing to transmit any one of a set of possible additional signals, the transmit power of the first signal is scaled by an amount which takes into account the greater (or greatest) power requirement of all of the set of the possible additional signals to be transmitted subsequently.

2. A method as claimed in claim 1, characterised in that the set of the possible additional signals comprise a positive acknowledgement signal (ACK) and a negative acknowledgement signal (NACK), in that one of the ACK and NACK is transmitted at a mutually different power level than the other, and in that the scaling in the transmitted power of the first signal assumes that the higher power one of the ACK or NACK is to be transmitted.

3. A method as claimed in claim 1 or 2, wherein the first signal is transmitted in first frames or time slots and the additional signals are transmitted in second frames or time slots, wherein the boundaries between the first frames or time slots are not coincident with the boundaries between the second frames or time slots, characterised in that the transmit power of the first signal is scaled at the frame or time slot boundary immediately preceding the transmission of the additional signal.

4. A method as claimed in claim 1, characterised by the second station transmitting the first signals substantially continuously in successive first frames or time slots, by the first station transmitting to the second station a data packet requiring a response consisting of at least a selected one of the set of possible additional signals, in that the first station requires the response

to be transmitted in a second frame or time slot whose boundaries are different from the boundaries of the first frames or time slots, and in that the power level of at least the first signal is scaled at the boundary of the first frame or time slot immediately preceding the occurrence of the second time slot.

5. A method as claimed in any one of claims 1 to 4, characterised in that the second station determines if the combined power requirement of the first signal and all of the set of possible additional signals exceeds the predetermined maximum level, and, if so, it scales the power requirement of the first signal.

6. A method as claimed in any one of claims 1 to 5, characterised in that the scaling results in a power reduction.

7. A method as claimed in any one of claims 1 to 5, characterised in that in response to the scaling occurring coincidentally with a requirement to increase the power of the first signal, the scaling results in a smaller increase than the requirement.

8. A method as claimed in claim 7, characterised in that the requirement to increase power is due to a regular power control process.

9. A method as claimed in claim 8, characterised in that the regular power control process is a closed loop process and in that the second station receives commands to change power from the first station.

10. A method as claimed in claim 7 or 8, characterised in that the requirement to increase power is due at least in part to a change in parameters or in format of a data signal transmitted from the second station.

11. A method as claimed in any one of claims 1 to 10, characterised in that the first signal and the possible additional signals are transmitted as spread spectrum signals.

12. A communication system comprising a first station (BS) and a second station (MS), the first station and second stations having transceiving means (12, 38), the second station having power control means (34) for controlling the transmitted power level of a first signal (DPCCH) to be transmitted to the first station, wherein the power control means is adapted, in response to determining that the second station wishes to transmit any one of a set of possible additional signals simultaneously with the first signals, to scale the transmit power of the first signal by an amount which takes into account the greater (or greatest) power requirement of all of the set of the possible additional signals to be transmitted subsequently.

13. A system as claimed in claim 12, characterised by the second station having power scaling means (36) which is adapted, in response to the power control means determining that the combined power requirement of the first signal and the set of possible additional signals exceeding the predetermined maximum level, to scale the power requirements of the first signal.

14. A system as claimed in claim 12 or 13, characterised in that the power scaling means is adapted, in response to the scaling occurring coincidentally with a requirement to increase the power of the first signal, to effect a smaller increase in the scaling than the requirement.

15. A system as claimed in claim 14, characterised by power control means in the first station for effecting a closed loop power control process with the second station and by means in the first station for generating commands instructing the second station to change power.

16. A system as claimed in claim 15, characterised in that power control means in the first station is adapted to generate a command to increase power due at least in part to a change in parameters or in format of a data signal transmitted from the second station.

17. A system as claimed in any one of claims 12 to 16, characterised in that the transceiving means are spread spectrum transceiving means.

18. A second station (MS) for use in a communication system comprising a first station and a second station, the second station including transceiving means (38) for communication with the first station, and power control means (34) for controlling the transmitted power level of a first signal (DPCCH) to be transmitted to the first station, wherein the power control means is adapted, in response to determining that the second station wishes to transmit any one of a set of possible additional signals (ACK or NACK) simultaneously with the first signals, to scale the transmit power of the first signal by an amount which takes into account the greater (or greatest) power requirement of all of the set of the possible additional signals to be transmitted subsequently.

19. A second station as claimed in claim 18, characterised by power scaling means (36) which is adapted, in response to the power control means determining that the combined power requirement of the first signal and the set of possible additional signals exceeding the predetermined maximum level, to scale the power requirements of the first signal.

20. A second station as claimed in claim 19, characterised in that the power scaling means is adapted, in response to the scaling occurring coincidentally with a requirement to increase the power of the first signal, to effect a smaller increase in the scaling than the requirement.

21. A second station as claimed in claim 20, characterised in that power control means in the second station is responsive to commands generated by the first station for effecting a change in power.

22. A second station as claimed in any one of claims 18 or 21, characterised in that the transceiving means is a spread spectrum transceiving means.

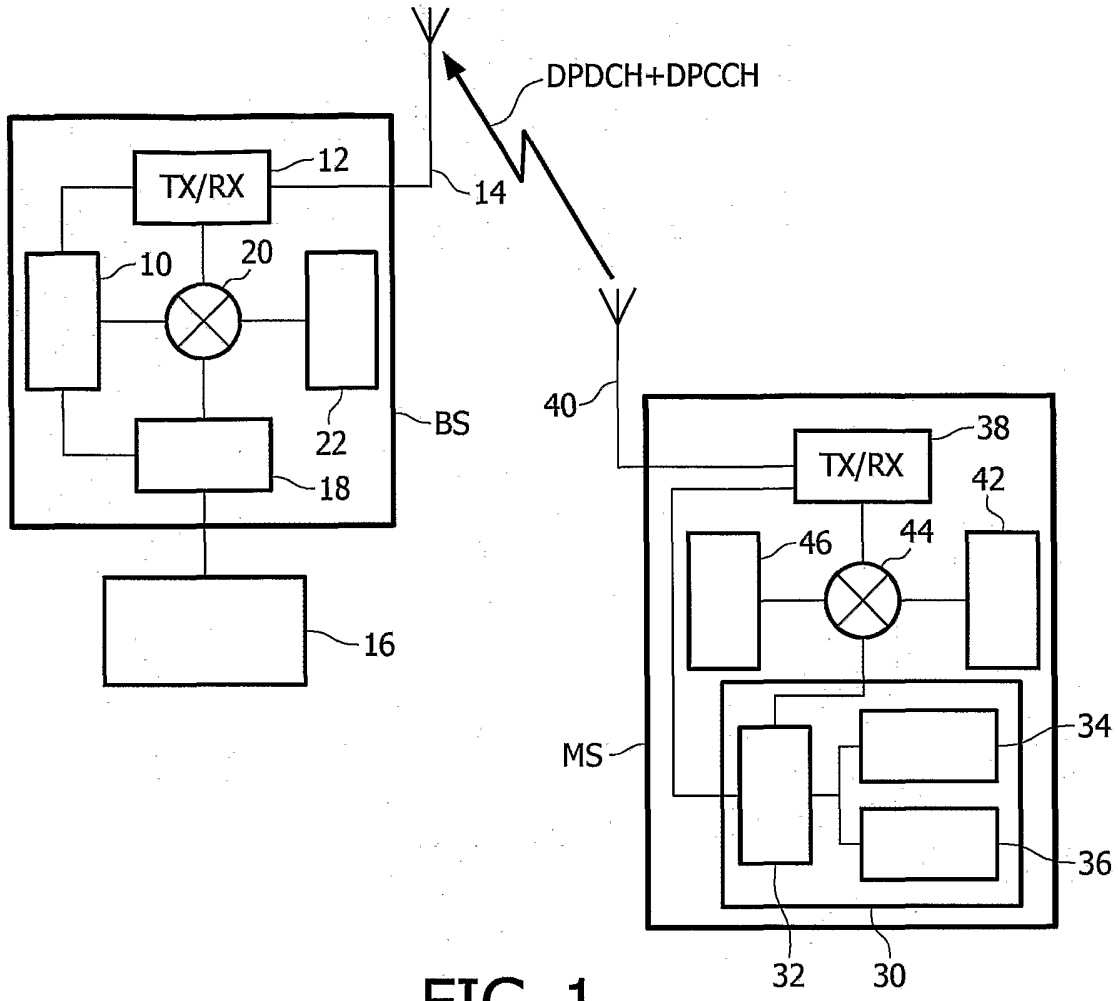
DPDCH+DPCCH
TX/RX
12
14
10
20
22
18
BS
16
40
TX/RX
38
42
46
44
MS
34
36
32
30

FIG. 1

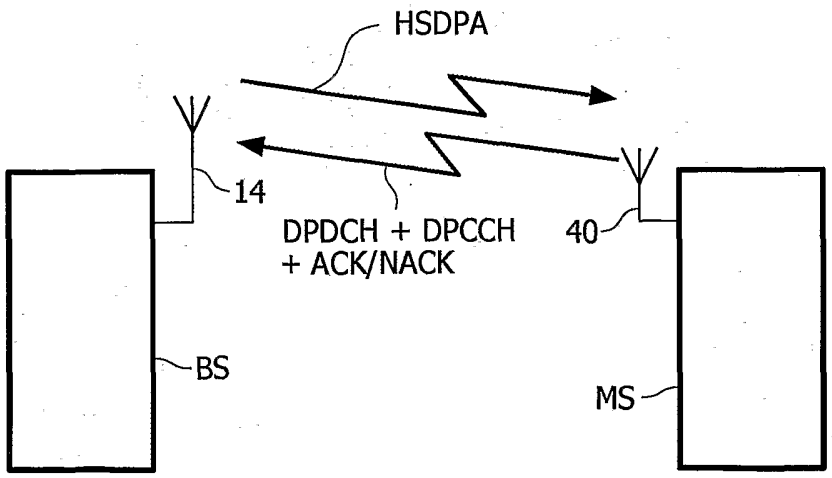
HSDPA
14
DPDCH + DPCCH
+ ACK/NACK
40
BS
MS

FIG. 2

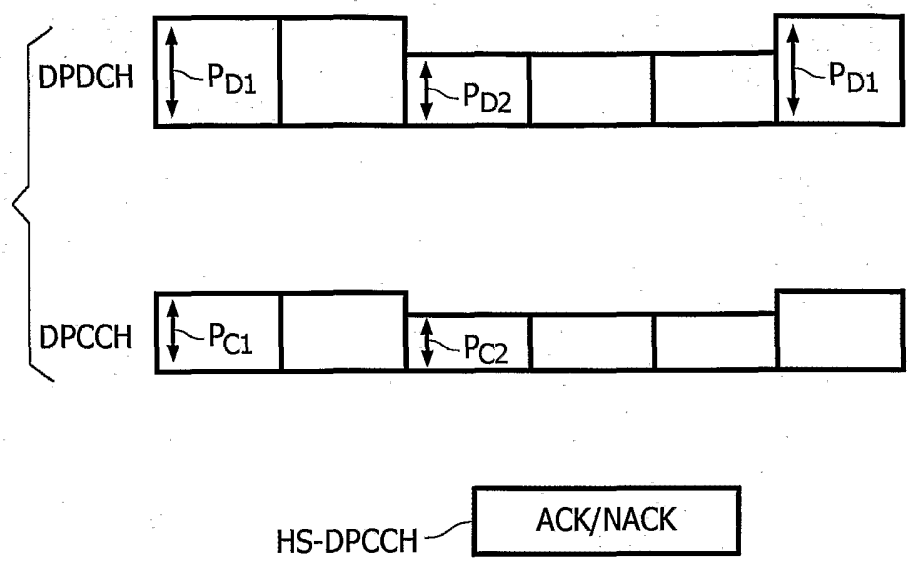
DPDCH
P_{D1}
P_{D2}
P_{D1}
DPCCH
P_{C1}
P_{C2}
HS-DPCCH
ACK/NACK

FIG. 3

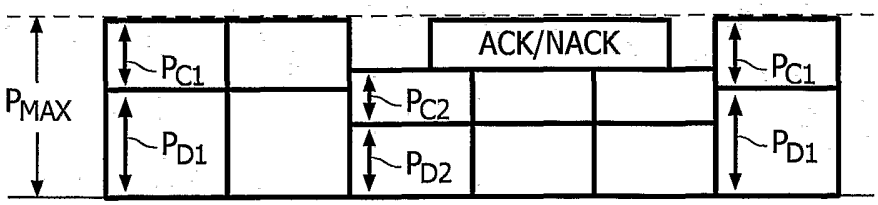
P_{MAX}
P_{C1}
P_{D1}
ACK/NACK
P_{C2}
P_{D2}
P_{C1}
P_{D1}

FIG. 4

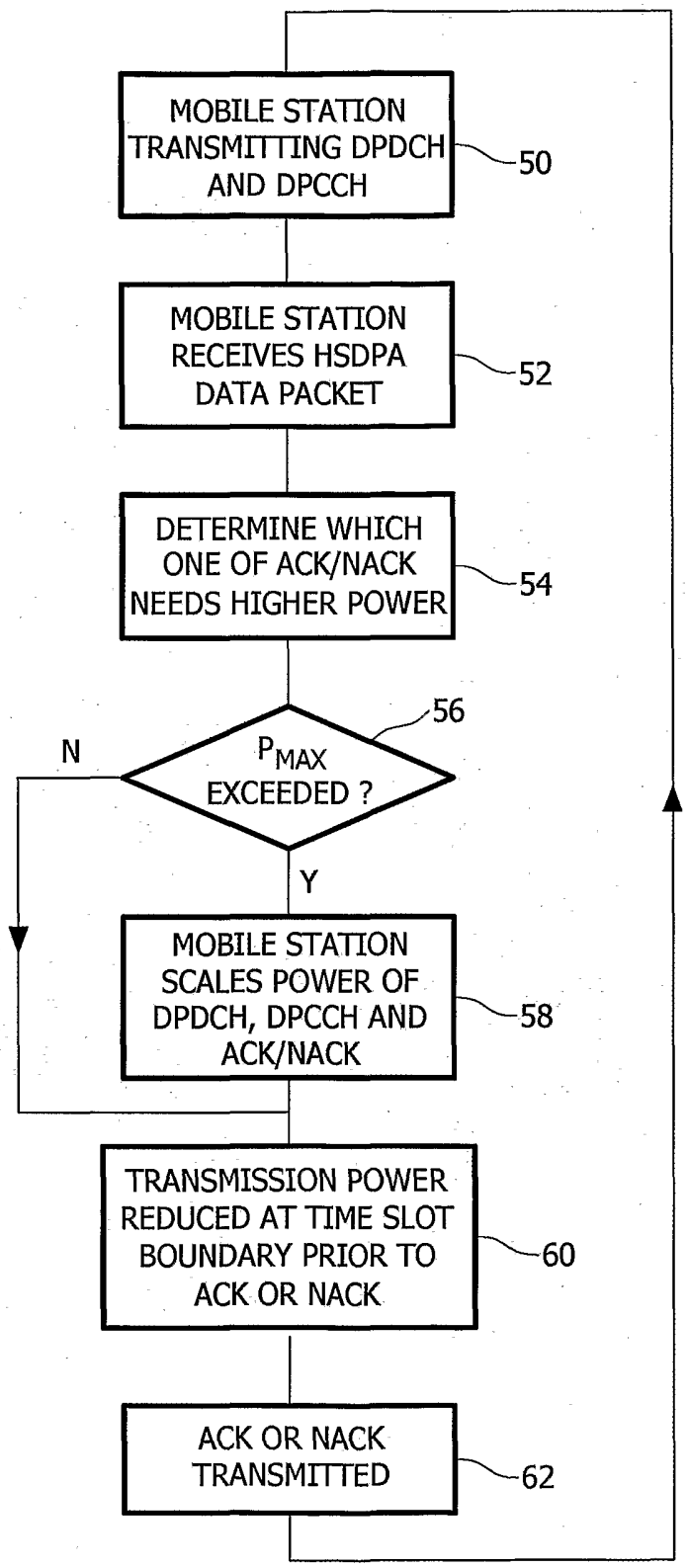
MOBILE STATION TRANSMITTING DPDCH AND DPCCH
50
MOBILE STATION RECEIVES HSDPA DATA PACKET
52
DETERMINE WHICH ONE OF ACK/NACK NEEDS HIGHER POWER
54
56
N
P_{MAX} EXCEEDED ?
Y
MOBILE STATION SCALES POWER OF DPDCH, DPCCH AND ACK/NACK
58
TRANSMISSION POWER REDUCED AT TIME SLOT BOUNDARY PRIOR TO ACK OR NACK
60
ACK OR NACK TRANSMITTED
62

FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/002630

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/005

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 H04B 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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00/62442 A (AIRNET COMMUNICATIONS CORP) 19 October 2000 (2000-10-19) abstract claims 1-3,6,7,10	1-22
X	US 2002/118729 A1 (KOWALSKI JOHN ET AL) 29 August 2002 (2002-08-29) claims 1-3	1-22
X	EP 0 887 947 A (NIPPON ELECTRIC CO) 30 December 1998 (1998-12-30) abstract figure 6 page 2, line 32 - line 45	1-22

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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10 November 2004	19/11/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Mier, A

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PCT/IB2004/002630

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 6 064 659 A (AHMED MANSOOR ET AL) 16 May 2000 (2000-05-16) abstract figures 2-4 claims 1-14	1-22
A	US 5 794 129 A (KOMATSU MASAHIRO) 11 August 1998 (1998-08-11) abstract figure 4 claims 1-9	1-22

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB2004/002630

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0062442 A	19-10-2000	AU 4461500 A	14-11-2000
		WO 0062442 A1	19-10-2000
		US 6262981 B1	17-07-2001
US 2002118729 A1	29-08-2002	US 2001015998 A1	23-08-2001
		US 5991329 A	23-11-1999
		US 2002118722 A1	29-08-2002
		US 2002118653 A1	29-08-2002
		AP 681 A	14-09-1998
		AP 682 A	14-09-1998
		AT 275780 T	15-09-2004
		AT 225993 T	15-10-2002
		AT 209834 T	15-12-2001
		AT 216826 T	15-05-2002
		AU 6342996 A	05-02-1997
		AU 6401396 A	05-02-1997
		AU 6401596 A	05-02-1997
		CA 2224706 A1	23-01-1997
		CA 2365087 A1	23-01-1997
		CA 2376313 A1	23-01-1997
		CA 2376319 A1	23-01-1997
		CA 2376321 A1	23-01-1997
		CA 2378873 A1	23-01-1997
		CA 2378885 A1	23-01-1997
		CN 1192304 A ,B	02-09-1998
		DE 1156593 T1	02-10-2002
		DE 1213854 T1	28-11-2002
		DE 02005245 T1	15-04-2004
		DE 1213845 T1	28-11-2002
		DE 1213846 T1	28-11-2002
		DE 69617429 D1	10-01-2002
		DE 69617429 T2	08-08-2002
		DE 69620884 D1	29-05-2002
		DE 69620884 T2	07-11-2002
		DE 69624242 D1	14-11-2002
		DE 69624242 T2	26-06-2003
		DE 69633351 D1	14-10-2004
		DE 835593 T1	04-05-2000
		DE 986186 T1	09-11-2000
		DE 984577 T1	09-11-2000
		DE 986187 T1	09-11-2000
		DE 986188 T1	09-11-2000
		DE 996239 T1	09-11-2000
		DE 991205 T1	09-11-2000
		DK 836770 T3	10-02-2003
		DK 835568 T3	18-03-2002
		EP 1158702 A2	28-11-2001
		EP 1156593 A2	21-11-2001
		EP 1213854 A2	12-06-2002
		EP 1237293 A2	04-09-2002
		EP 1213845 A2	12-06-2002
		EP 1213846 A2	12-06-2002
		EP 0836770 A2	22-04-1998
		EP 0835568 A2	15-04-1998
EP 0887947 A	30-12-1998	BR 9802565 A	03-11-1999
		CN 1344076 A ,B	10-04-2002
		CN 1206263 A ,B	27-01-1999

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB2004/002630

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0887947 A		EP 0887947 A2	30-12-1998
		JP 3129285 B2	29-01-2001
		JP 11074834 A	16-03-1999
		KR 268145 B1	16-10-2000
		US 6393005 B1	21-05-2002
US 6064659 A	16-05-2000	BR 9911957 A	27-03-2001
		CA 2336947 A1	20-01-2000
		CN 1312975 T	12-09-2001
		EP 1097518 A1	09-05-2001
		JP 2002520939 T	09-07-2002
		WO 0003487 A1	20-01-2000
US 5794129 A	11-08-1998	JP 2798012 B2	17-09-1998
		JP 9036801 A	07-02-1997