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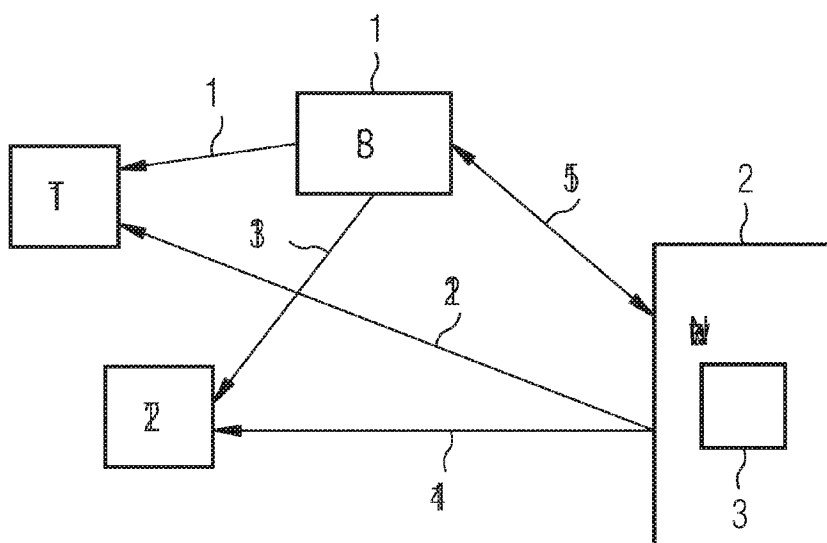
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(54) Title: A METHOD OF SCHEDULING RESOURCES IN A COMMUNICATION SYSTEM



(57) Abstract: A method of scheduling resources in a communication system comprising a terminal, a base station and a network control entity comprises allocating code space for users of a channel controlled by the base station and allocating the same code space for users of a channel controlled by the network control entity. A determination of whether there is ongoing or imminent network controlled communication in each part of the code space is made and for any part of the code space where there is no network controlled communication, that part of the code space is scheduled for base station controlled communication.

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A METHOD OF SCHEDULING RESOURCES IN A COMMUNICATION SYSTEM

This invention relates to a method of scheduling resources in a communication system, in particular for cellular communication systems.

5 This invention is particularly applicable to code division multiple access (CDMA) based cellular radio systems, such as universal terrestrial radio access network (UTRAN) frequency division duplex system (FDD). In Release 6 UTRAN FDD systems, an orthogonal variable spreading factor (OVSF) code space is provided, part of which needs to be reserved for communication with users that are in  
10 CELL\_FACH state and is controlled from a radio network controller (RNC) using a secondary common control physical channel (S-CCPCH). The other part of the OVSF code space may be reserved for communicating with users in CELL\_DCH state, controlled from the Node B using a high speed downlink shared channel (HS-DSCH).

HS-DSCH tends to be code limited, rather than power limited, whereas S-  
15 CCPCH is used relatively infrequently and hence the valuable OVSF code space allocated to S-CCPCH is wasted most of the time.

A proposal has been made in the 3<sup>rd</sup> generation partnership project (3GPP), for the HS-DSCH to be used for carrying a forward access channel (FACH) for users in CELL\_FACH state rather than using the S-CCPCH. However, this approach has  
20 several disadvantages. Channel quality indication (CQI) feedback and no ACK/NACK feedback is not possible. Thus, hybrid automatic repeat request (HARQ) and frequency dependent scheduling, two very important features of high speed downlink packet access (HSDPA), are not possible. Also, as the HS-DSCH has a transmit time interval (TTI) of 2msec and no power control is available, such a short TTI is disadvantageous  
25 as it offers zero time diversity. Furthermore, there is no power control information available for the high speed shared control channel (HS-SCCH), so the signalling overhead will be quite large

In accordance with the present invention, a method of scheduling resources in a communication system comprising a terminal, a base station and a network control  
30 entity comprises allocating code space for users of a channel controlled by the base station and allocating the same code space for users of a channel controlled by the network control entity; determining whether there is ongoing or imminent network controlled communication in each part of the code space and for any part of the code

space where there is no network controlled communication, scheduling that part of the code space for base station controlled communication.

In the present invention the method is applied to a cellular radio system in which two types of channel are present; one controlled by the base station and a second  
5 by a network control entity which is a higher level entity than the base station, whereby the same code space is allocated to both channels and the base station uses the codes, only after checking that they are not being used by the network control entity.

Preferably, at any time, the part of the code space not scheduled for network controlled communication is contiguous with further code space permanently allocated  
10 only for base station controlled communication.

The most efficient arrangement is that the channels controlled by the network control entity are ordered contiguously in the code domain and the network control entity uses the codes in a manner that ensures a contiguous set of codes are available to the base station.

15 Preferably, the terminal is informed via the network controlled channel that the same code space is used by the base station controlled channel, such that the terminal can switch between the network controlled channel and the base station controlled channel without reconfiguration of a physical layer of the terminal.

The terminal may be informed when using the channel controlled from the  
20 network control entity that the same codes are used for the second channel controlled by the base station, in order that it does not need to reconfigure its physical layer if it switches between the two channels

Preferably, the communication system is a code division multiple access based cellular radio system.

25 Preferably, the system comprises a universal terrestrial radio access network frequency division duplex system.

Preferably, the network control entity is a radio network controller.

Preferably, the base station controlled channel comprises a high speed downlink shared channel.

30 Preferably, the network control entity controlled channel comprises a secondary common control physical channel.

The present invention enables a more optimal usage of the code space that does not involve wastage of S-CCPCH codes.

An example of a method of scheduling resources in a communication system will now be described with reference to the accompanying drawings in which:

Fig. 1 is a block diagram of a system to which the method of the present invention can be applied;

5 Fig. 2 illustrates a first example of the arrangement of code space for the method of the present invention; and,

Fig. 3 illustrates a second example of the arrangement of codes space for the method of the present invention.

10 Fig.1 shows a communication system in which one or more terminals T1, T2 are variously controlled by a base station 1, or from a higher level entity than the base station, a network control entity, which is typically part of a network 2. Figs. 2 and 3 illustrate examples of how, in accordance with the present invention, a radio resource controller (RRC) 3 in the network 2 maps a group of orthogonal variable spreading factor (OVSF) codes 4 for both a secondary common control physical channel (S-CCPCH) 12, 14 and a high speed downlink shared channel (HS-DSCH) 11, 13. The group of OVSF codes are split between P-CCPCH and F-DPCH 5, HS-DSCH 6 and S-CCPCH 7. The S-CCPCH codes 7 are further subdivided into smaller code spaces 8, 9, 10.

20 A scheduler in the base station, or node B 1, considers whether there is currently a transmission ongoing on the S-CCPCH 12, 14 for whichever terminal T1, T2 the base station is scheduling (the S-CCPCH has a longer TTI than HS-DSCH, i.e. in the order of 10-40msec), or the scheduler determines whether the RNC has sent forward access channel (FACH) data that is imminently to be transmitted on the S-CCPCH. If the S-CCPCH is in use, or about to be in use, then the codes 8, 9, 10 are not available to used for HS-DSCH. If, however the S-CCPCH is not in use, then the Node B scheduler may schedule and send HS-DSCH data on the associated codes.

The S-CCPCH codes 8, 9, 10 are allocated and used in such a manner that a contiguous set of HS-DSCH codes are available to the Node B scheduler, if some, or all of the S-CCPCH codes are available. This can be seen in Fig.3. In Fig.3, when the RNC 30 3 has data to send on one of the S-CCPCH; then S-CCPCH1 10A is selected in preference to S-CCPCH2 9, or S-CCPCH3 8, in order that the set of codes 6, 8A, 9A, available to the HS-DSCH remains contiguous. Maintenance of a contiguous set of HS-

DSCH codes is useful to the Node B scheduler due to the signalling mechanism used on HS-SCCH.

To reduce re-configuration time, CELL\_FACH users are made aware that the S-CCPCH codes are re-used for HS-DSCH and of any additional HS-DSCH codes. Thus,  
5 switching to CELL\_DCH state does not require a re-configuration of the physical layer receivers in the terminal, or user equipment (UE), T1, T2.

The present invention allows for re-use of the code space between S-CCPCH and HS-DSCH and faster reconfiguration between CELL\_FACH and CELL\_DCH states without incurring the system performance penalties described above, i.e. short  
10 TTI removing time diversity and larger signalling overhead due to lack of power control. If the option for allowing for fast reconfiguration between the states is not considered, then the re-use of the S-CCPCH codes can be implemented in the standard with no impact for existing Release 5 and 6 terminals.

For the purpose of this example, the radio system is UTRAN FDD, the first  
15 channel is the S-CCPCH controlled from the RNC and received by terminals in CELL\_FACH state and the second channel is the HS-DSCH, controlled from the base station and received by users in CELL\_FACH state. However, the names of the channels in use and the specific network control entity may be different in other systems, for example universal terrestrial radio access (UTRA) time division duplex  
20 (TDD), time division-synchronous code division multiple access (TD-SCDMA), or CDMA2000 and the invention is not limited to the specific example described, but is applicable to any communication system operating in a similar manner.

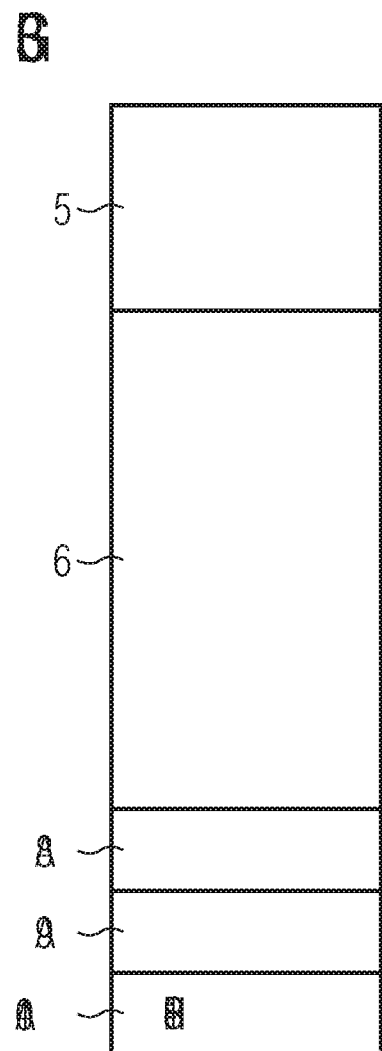
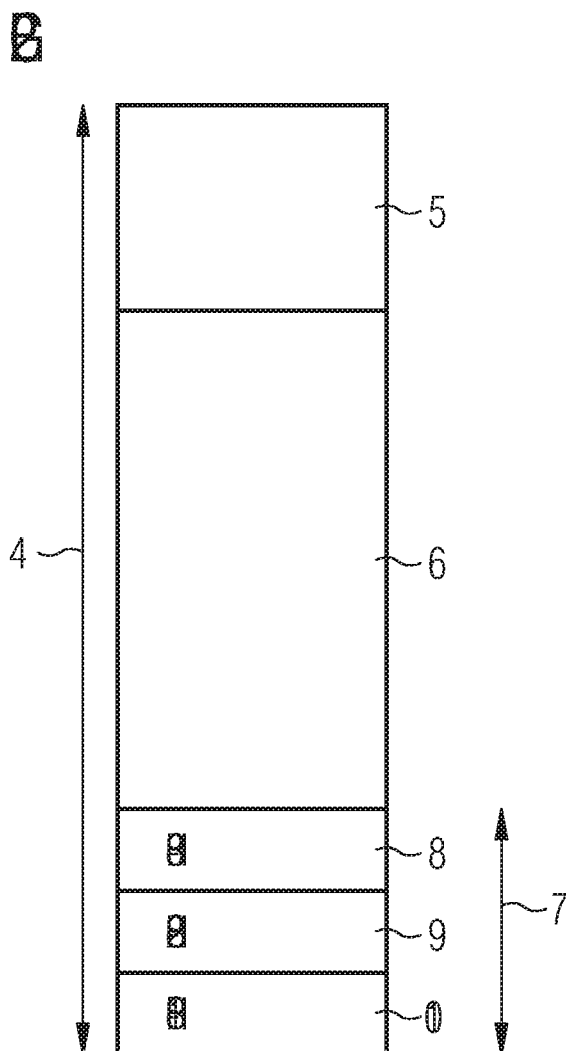
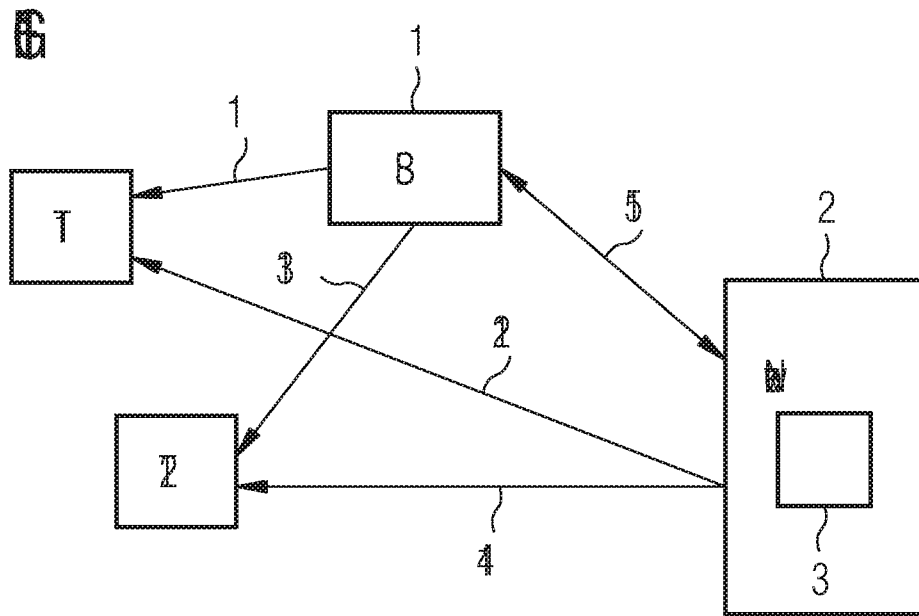
CLAIMS

1. A method of scheduling resources in a communication system comprising a terminal, a base station and a network control entity; the method comprising allocating  
5 code space for users of a channel controlled by the base station and allocating the same code space for users of a channel controlled by the network control entity; determining whether there is ongoing or imminent network controlled communication in each part of the code space and for any part of the code space where there is no network controlled communication, scheduling that part of the code space for base station  
10 controlled communication.
2. A method according to claim 1, wherein at any time, the part of the code space not scheduled for network controlled communication is contiguous with code space permanently allocated only for base station controlled communication.  
15
3. A method according to claim 1 or claim 2, wherein the terminal is informed via the network controlled channel that the same code space is used by the base station controlled channel, such that the terminal can switch between the network controlled channel and the base station controlled channel without reconfiguration of a physical  
20 layer of the terminal.
4. A method according to any preceding claim, wherein the communication system is a code division multiple access based cellular radio system.
- 25 5. A method according to any preceding claim, wherein the system comprises a universal terrestrial radio access network frequency division duplex system.
6. A method according to any preceding claim, wherein the network control entity is a radio network controller.  
30
7. A method according to any preceding claim, wherein the base station controlled channel comprises a high speed downlink shared channel.

6

8. A method according to any preceding claim, wherein the network control entity controlled channel comprises a secondary common control physical channel.

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## INTERNATIONAL SEARCH REPORT

International application No

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**A. CLASSIFICATION OF SUBJECT MATTER**  
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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)  
 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, INSPEC

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 420 938 A (MOTOROLA INC [US]) 7 June 2006 (2006-06-07)	1-6
Y	page 1, line 8 - line 11 page 4, line 24 - line 31 page 5, line 28 - page 10, line 20 page 15, line 11 - line 19 page 17, line 4 - page 21, line 8 figure 1	7,8
Y	----- EP 1 549 098 A (CIT ALCATEL [FR]) 29 June 2005 (2005-06-29) paragraph [0003] paragraph [0010] paragraph [0013] figure 1 ----- -/--	7,8



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents :

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- \*E\* earlier document but published on or after the international filing date
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- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*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
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- \* & \* document member of the same patent family

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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	TSENG Y-C ET AL: "CODE PLACEMENT AND REPLACEMENT STRATEGIES FOR WIDEBAND CDMA OVSF CODE TREE MANAGEMENT" IEEE TRANSACTIONS ON MOBILE COMPUTING, IEEE SERVICE CENTER, LOS ALAMITOS, CA, US, vol. 1, no. 4, October 2002 (2002-10), pages 293-302, XP001171671 ISSN: 1536-1233 the whole document -----	1-8
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Information on patent family members

International application No

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