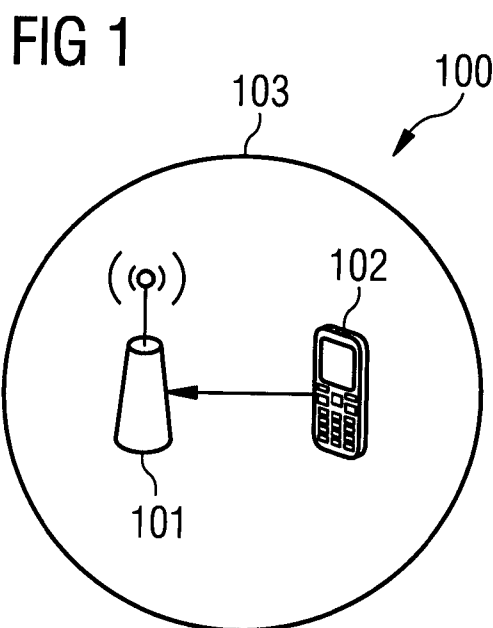




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(54) Title: DEFINING A CONTROL CHANNEL ELEMENT



(57) Abstract: It is described a method for defining a control channel element, which corresponds to a subset of resources within a physical resource block of a control channel, the control channel element to be used for sending downlink control information being responsive for controlling a transmission between a user equipment and a base station via a radio transmission channel, wherein the control channel is part of the radio transmission channel. The method comprises determining parameters, wherein the parameters are used for channelizing downlink control information, the parameters comprising a position of a physical resource block in the frequency domain of the radio transmission channel, a spreading code and a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel, and defining the control channel element based on the determined parameters.



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DEFINING A CONTROL CHANNEL ELEMENT

Field of invention

- 5 The present invention relates to the field of cellular networks, in particular LTE based networks, and in particular to cellular networks using a control channel.

Art Background

10

In cellular network systems, in particular in current 3GPP, different channels are used for controlling the transmissions between base stations and user equipments (UE).

15

LTE downlink physical layer has over the past releases been evolving from being 100% based on common reference signals (CRS) towards using more UE specific reference signals. With the latest release of the LTE specification (release 10) the benefits of demodulation reference signal (DM RS) based transmission might not be fully achieved because the system still relies on cell specific reference signals to demodulate control information. This may lead to an increased control overhead in the system and suboptimal performance.

20

In future releases, there may be focus on bringing the benefits from DM RS based transmission to control channels and maybe at some stage allow for operating without common reference signals at all. However, operation without common reference signals may also provide some problems.

25

There may be a need for an efficient and reliable system and method for providing a control channel being based on DM RS based transmission.

30

Summary of the Invention

This need may be met by the subject matter according to the independent claims. Advantageous embodiments of the present invention are described by the dependent claims.

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According to a first aspect of the invention there is provided a method for defining a control channel element (CCE), which corresponds to a subset of resources within a

physical resource block (PRB) of a control channel, the control channel element to be used for sending downlink control information (DCI) being responsive for controlling a transmission between a user equipment and a base station via a radio transmission channel, wherein the control channel is part of the radio transmission channel. The method
5 comprises determining parameters, wherein the parameters are used for channelizing downlink control information, the parameters comprising a position of a physical resource block in the frequency domain of the radio transmission channel, a spreading code and a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel, and defining the control channel element based on the
10 determined parameters.

This aspect of the invention is based on the idea to make a unique resource identification for a CCE, which or the aggregation of which is used for the transmission of a control channel, in particular an ePDCCH (enhanced physical downlink control channel) based on
15 three parameters: a scrambling id, a spreading code, and a physical resource block (PRB) position or index.

A legacy physical downlink control channel (PDCCH) is using the first 1 to 3 OFDM symbols. The herein described control channel (enhanced physical downlink control channel, E-PDCCH) may be arranged in the same region as the physical downlink shared
20 channel (PDSCH) for transmitting control information.

When designing a control channel for demodulation with UE specific reference signal, the starting assumption is usually that the UE specific reference signal is already present for
25 the data transmission and the main issue is how to integrate the control information into that transmission.

However, there exists a number of control messages which are transmitted without the presence of UE data and thus without UE specific DM RS already available. UE specific
30 DM RS can of course be made available but as the minimal granularity of UE specific reference signals is usually taken as one PRB and control message sizes are usually too small to fill out one PRB simply allocating one PRB including UE specific DM RS for a single control message may lead to resource waste.

35 So the problem is how to on one hand make a UE specific transmission which can be optimized in terms of precoding and frequency diversity and on the other hand achieve a

proper efficiency on the resource utilization when control messages do not require a whole PRB.

The idea of this method is to provide a minimal unit for the allocation of resources within a radio transmission channel (particularly in the mentioned ePDCCH), wherein a whole PRB is allocated and control channels among multiple users or from a single user could be multiplexed in this PRB.

According to the described method, a control channel element (CCE) is defined based on parameters being used for channelizing downlink control information. Channelizing in this context may refer to forming a control channel for the transmission of DCI. The CCE may be mapped to a subset of resources of a PRB. The CCE or the aggregation of CCEs may be allocated dynamically based on the parameters, which may vary for instance based on a selection of the parameters due to interference reduction considerations.

The term "base station" in this context may denote any kind of physical entity being able to hold one or more cells. A base station in this context may be any kind of network device providing the required functionality for the method, it may also be a transceiver node in communication with a centralized entity. The base station may be for example a NodeB or eNB.

The definition of the CCE and the subsequent allocation of CCE may be performed either by the base station or by a centralized entity. For controlling the transmissions within the cells being served by the base station, the base station may send control messages comprising the downlink control information (DCI) to the UEs. The control messages indicate which resources of the radio transmission channel may be used for uplink and/or downlink data transmission by the UE. The control channel may denote the subcarriers (subset of resources of a PRB) or channels of the radio transmission channel which are used for transmitting these control messages or signals.

A physical resource block may denote a specific number of subcarriers which are allocated to a user for a predetermined amount of time. These are referred to as physical resource blocks (PRBs) in the LTE specifications. The position of the physical reference block (PRB) may refer to an index being assigned to the PRB. The index may indicate the position of the subcarriers. Also more than one CCE may be aggregated to transmit the control channel, wherein one CCE is occupying a subset of radio resources within one PRB. Also more than one PRB may be allocated to be used for the control channel.

According to a further embodiment of the invention, the spreading code creates a first sequence of symbols based on a sequence of modulated symbols corresponding to the downlink control information, the scrambling sequence creates a second sequence of symbols based on the first sequence of symbols, and the scrambling identity is assigned to the second sequence of symbols being indicative for the scrambling sequence.

For example, when the spreading factor is 4, the base station may have a group of sequences, represented by a 4x4 matrix, $W1$. Each column in the matrix is a sequence, for instance, $[1 \ 1 \ 1 \ 1]^T$ is the first sequence, $[1 \ -1 \ 1 \ -1]^T$ is the second sequence. There are four sequences in this group. If there are coded bits of control information, modulated with QPSK, there is a sequence of modulated symbols, e.g. $d(1), d(2), \dots, d(n)$. After spreading, the base station sends a sequence, $x(m)$, where $x(m)$ is

$$x(m) = [d(1)W1(1,1), d(1)W1(2,1), d(1)W1(3,1), d(1)W1(4,1), d(2)W1(1,1), d(2)W1(2,1), d(2)W1(3,1), d(2)W1(4,1), \dots, d(n)W1(1,1), d(n)W1(2,1), d(n)W1(3,1), d(n)W1(4,1)].$$

$x(m)$ becomes four times longer than the original modulated symbols $d(n)$. This is known as “spreading”. Codes sequences in the same group are orthogonal to each other, e.g. the first column, $W1(:,1)$ is orthogonal with the second column, $W1(:,2)$.

In addition, a scrambling sequence $s(m)$ (for instance a pseudo-random sequence) may be used to randomize it:

$$y(m) = x(m) * s(m)$$

A seed and/or a phase is used to determine the $s(m)$.

In the above example, a “scrambling id” may be used to identify the scrambling sequence $s(m)$, i.e.:

- A. If two base stations use the same “scrambling id”, they use the same group of sequences. The orthogonality among code sequences within the group can be maintained.
- B. If two base stations use different “scrambling ids”, the scrambling sequences are not the same. The transmissions from the two base stations are not orthogonal, even if orthogonal code sequences are used, but randomized instead.

If two cells want to coordinate interference with each other, they should use the same “scrambling id”. Otherwise, they should use different “scrambling ids”.

- 5 Thus, according to the herein described method, the definition of the CCE may be based on a PRB index (PRB, position of PRB), a code index (w, spreading code index in the matrix), and a scrambling id (sc_id, being used to indicate the scrambling sequence).

- 10 The control channel resource set may be thus a set of triples (sc_id, w, PRB), each identifying a CCE. The UE may be configured with a search space containing multiple CCE or aggregation of CCEs in the set, and to blindly detect the control channel among the search space.

- 15 According to a further embodiment of the invention, the scrambling sequence is a pseudo-random sequence.

The scrambling sequence may be based on a sequence of numbers that approximates the properties of random numbers.

- 20 According to a further embodiment of the invention, the method further comprises allocating a physical resource block for the control channel element.

- 25 The CCE may be mapped to physical resources of the channel, e.g., to a subset of resources of one physical resource block. The subset of resources of the physical resource block may then be allocated for transmissions by the base station in view of control signals to the user equipment.

- 30 According to a further embodiment of the invention, the method further comprises assigning different spreading codes to different control channel elements within one physical resource block for allocating the physical resource block for a plurality of control channels.

- 35 By using different spreading codes in the same sequence group, one PRB may multiplex multiple control channels, for example up to 4 or 8.

According to an embodiment of the invention, a multiplexing scheme for multiplexing different control channel elements within one physical resource block is based on code division multiplexing.

5 Code division multiplexing refers to synchronous CDMA (code division multiple access), which employs spread-spectrum and a special coding scheme (where each transmitter is assigned a code) to allow multiple users to be multiplexed over the same physical channel. In contrast to this, time division multiple access (TDMA) divides access by time, while frequency division multiple access (FDMA) divides it by frequency.

10 This may provide the advantage that multiplexing within one PRB may be supported. The herein described method may occupy the whole PRB for each grant and may allow multiple users multiplex their control information in one PRB/slot via CDM style. This may provide the advantage that multiplexing multiple CCEs within one PRB may be supported, by spreading different CCEs with different spreading codes.

15 According to a further embodiment of the invention, the method further comprises allocating a plurality of physical resource blocks for a distributed control channel, wherein the control channel element corresponding to each physical resource block is based on a position of the physical resource block in the frequency domain of the radio transmission channel being unique for each physical resource block.

20 Some distributed CCE aggregations may be reserved for a distributed control channel. The CCE aggregation of the distributed control channel may contain a few control channel resources with the same or different scrambling id, the same or different spreading code, and different PRB index. It may be used by UEs when they do not have control channel resource set configured yet.

25 It may be possible to allocate one whole PRB_index (i.e. all CCEs multiplexed in the PRB) for a single control channel. In this case, it might not be necessary for UEs to de-spread.

30 According to a further embodiment of the invention, the method further comprises sending control signals for the user equipment in the allocated physical resource block.

35 After allocating the at least one physical resource block, the base station may send control signals to the UE using one CCE or an aggregation of multiple CCEs.

According to a further embodiment of the invention, the method further comprises exchanging, between the base station and a neighboring base station, information on the position of the physical resource block, the spreading code and/or the scrambling sequence being allocated for a control channel.

5

Base stations may exchange information about their control channels and the allocated scrambling identity, the allocated spreading code and the information on the position of the physical resource block. By exchanging this information, the base stations may adapt their parameters when scheduling the control channel to avoid interferences.

10

According to a second aspect of the invention, there is provided a base station for defining a control channel element, which corresponds to a subset of resources within a physical resource block of a control channel, the control channel element to be used for sending downlink control information being responsive for controlling a transmission between a user equipment and the base station via a radio transmission channel, wherein the control channel is part of the radio transmission channel. The base station comprises a determination unit being adapted to determine parameters, wherein the parameters are used for channelizing downlink control information, the parameters comprising a position of a physical resource block in the frequency domain of the radio transmission channel, a spreading code and a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel, and a definition unit being adapted to define the control channel element based on the determined parameters.

15

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The base station may be any type of access point or point of attachment, which is capable of providing a wireless access to a cellular network system. Thereby, the wireless access may be provided for a user equipment or for any other network element, which is capable of communicating in a wireless manner. The base station may be a NodeB, eNB, home NodeB or HeNB, or any other kind of access point. The base station may in particular be used for an LTE or 3GPP cell and communication.

30

The base station may comprise a receiving unit, for example a receiver as known by a skilled person. The base station may also comprise a transmitting or sending unit, for example a transmitter. The receiver and the transmitter may be implemented as one single unit, for example as a transceiver. The transceiver or the receiving unit and the sending unit may be adapted to communicate with the user equipment and/or a further base station via an antenna.

35

The determination unit and the definition unit may be implemented as single units or may be implemented for example as part of a standard control unit, like a CPU or a microcontroller.

- 5 According to a third aspect of the invention, there is provided a user equipment, the user equipment being adapted to communicate with the base station as described above.

The user equipment (UE) may be any type of communication end device, which is capable of connecting with the described base station. The UE may be in particular a cellular
10 mobile phone, a Personal Digital Assistant (PDA), a notebook computer, a printer and/or any other movable communication device.

The user equipment may comprise a receiving unit or receiver which is adapted for receiving signals from the base station. The user equipment may comprise a transmitting
15 unit for transmitting signals. The transmitting unit may be a transmitter as known by a skilled person. The receiver and the transmitting unit may be implemented as one single unit, for example as a transceiver. The transceiver or the receiver and the transmitting unit may be adapted to communicate with the first and the second base station via an antenna.

- 20 According to a fourth aspect of the invention, there is provided a cellular network system. The cellular network system comprises a base station as described above. The cellular network system may further comprise a user equipment as described above.

Generally herein, the method and embodiments of the method according to the first aspect
25 may include performing one or more functions described with regard to the second, third or fourth aspect or an embodiment thereof. Vice versa, the base station, user equipment or cellular network system and embodiments thereof according to the second, third and fourth aspect may include units or devices for performing one or more functions described with regard to the first aspect or an embodiment thereof.

30 According to a fifth aspect of the herein disclosed subject-matter, a computer program for defining a control channel element is provided, the computer program being adapted for, when executed by a data processor assembly, controlling the method as set forth in the first aspect or an embodiment thereof.

35 As used herein, reference to a computer program is intended to be equivalent to a reference to a program element and/or a computer readable medium containing instructions for

controlling a computer system to coordinate the performance of the above described method.

5 The computer program may be implemented as computer readable instruction code by use of any suitable programming language, such as, for example, JAVA, C++, and may be stored on a computer-readable medium (removable disk, volatile or non-volatile memory, embedded memory/processor, etc.). The instruction code is operable to program a computer or any other programmable device to carry out the intended functions. The computer program may be available from a network, such as the World Wide Web, from
10 which it may be downloaded.

The herein disclosed subject matter may be realized by means of a computer program respectively software. However, the herein disclosed subject matter may also be realized by means of one or more specific electronic circuits respectively hardware. Furthermore,
15 the herein disclosed subject matter may also be realized in a hybrid form, i.e. in a combination of software modules and hardware modules.

In the above there have been described and in the following there will be described exemplary embodiments of the subject matter disclosed herein with reference to a cellular
20 network system, a base station, a user equipment and a method of defining a control channel element. It has to be pointed out that of course any combination of features relating to different aspects of the herein disclosed subject matter is also possible. In particular, some embodiments have been described with reference to apparatus type embodiments whereas other embodiments have been described with reference to method
25 type embodiments. However, a person skilled in the art will gather from the above and the following description that, unless otherwise notified, in addition to any combination of features belonging to one aspect also any combination between features relating to different aspects or embodiments, for example even between features of the apparatus type embodiments and features of the method type embodiments is considered to be disclosed
30 with this application.

The aspects and embodiments defined above and further aspects and embodiments of the present invention are apparent from the examples to be described hereinafter and are explained with reference to the drawings, but to which the invention is not limited.

35

Brief Description of the Drawings

Figure 1 shows a cellular network system according to an exemplary embodiment of the present invention.

5

Figure 2 shows an example for a physical resource block.

Figure 3 shows an example for channelization using the parameters.

10 Figure 4 shows a base station and a user equipment within a cellular network system according to an exemplary embodiment of the invention.

It is noted that in different figures, similar or identical elements are provided with the same reference signs.

15

Detailed Description

In the following, embodiments of the herein disclosed subject matter are illustrated with reference to the drawings and reference to aspects of current standards, such as LTE.

20

However, such reference to current standards is only exemplary and should not be considered as limiting the scope of the claims.

Figure 1 shows a cellular network system 100. The cellular network system comprises a cell 103 being provided by a base station 101. A user equipment 102 is served by the base station. The user equipment needs information in which slots or resources it is allowed to transmit and/or to receive. Therefore, the base stations sends control signals via a control channel to the user equipment comprising information about the allocation for uplink and downlink transmission. The base station and the user equipment are communicating via a radio transmission channel.

25

30

Before sending the control signals, channel coding is used for coding signals comprising downlink control information. Based on parameters used for channelizing the control channel, a control channel element (CCE) may be defined. The CCE is then mapped to a subset of resources of a physical resource block (PRB) of the radio transmission channel. The subset of resources of the PRB to which the CCE is mapped may be allocated for a transmission of the control signals. The CCE may be defined based on a position of a

35

physical resource block in the frequency domain of the radio transmission channel, based on a spreading code and based on a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel. The base station then transmits the control signals according to the defined CCE mapped to PRBs.

5

The channelization is based on code division multiplexing as shown in Figure 3. Modulation symbols of coded bits corresponding to the downlink control information are modulated, 301. The spreading code creates a first sequence of spread symbols based on the sequence of modulated symbols corresponding to the downlink control information, 302. The scrambling sequence, which may be a pseudo-random sequence, then creates a second sequence of scrambled symbols based on the first sequence of spread symbols, 303. The scrambling identity is assigned to the second sequence of symbols being indicative for the scrambling sequence. The second sequence of scrambled symbols may then be mapped to a subset of resources of a PRB, 304.

10

15

In the following, the control channel will be referred to as ePDCCH or E-PDCCH.

An example for a physical resource block 201 is shown in Figure 2. The PRB may provide different sections for different spreading factors (SF). Here, spreading factors 1, 2, 4 are shown.

20

One ePDCCH CCE is identified with a triple (sc_id, w, PRB_index). "sc_id" is the scrambling id, to indicate the scrambling sequence. "w" is a spreading code in the sequence group. "PRB_index" is an position of a PRB in the frequency domain. An E-PDCCH resource set is a set of triples (sc_id, w, PRB). DM-RS and modulated symbols for control signalling bits may be spread into one PRB using the same spreading code w.

25

The described method may also be used to provide an ICIC (inter carrier interference control) in code and frequency domain. A TX point (for instance the base station) may negotiate with his neighbours to coordinate interference on the ePDCCH. The following schemes may apply.

30

In code domain, there might be no interference between the two PDCCHs from two TX points, if they have the same sc_id, but different spreading codes "w", on the same PRB, i.e. same PRB_index. In the frequency domain, there might be no interference between the two ePDCCHs from two TX points, if they have different PRB_index. There may be

35

reduced interference between the two ePDCCHs from two TX points, if they have the same PRB_index and spreading code, but different scrambling ids.

TX points can adjust the number of ePDCCHs multiplexed on the same PRB or adjust the TX power to adapt the channel quality of the UEs.

By using UE's specific DM RS, a TX precoding weight vector may be applied for the ePDCCH like in common PDSCH, so the described method for the ePDCCH benefits from precoding gain. After a UE reports CQI, the base station may allocate the ePDCCH on the PRB, which has the best channel quality. When a PRB is used only by one UE, the UE may benefit from the full Tx power as one CCE is spread over the whole PRB.

The signal strength of the described ePDCCH may become stronger when there are fewer UEs scheduled per TTI. When there are very few UEs scheduled in a TTI, multiplexing order per a PRB might be 1 or 2. The total TX power may be shared by 1 or 2 UEs without creating large power imbalance among resource elements within one PRB.

Figure 4 shows a cellular network system 400 according to an exemplary embodiment of the invention. The cellular network system comprises a base station 101 and a user equipment 102 being served by the base station.

The base station 101 comprises a determination unit 402 being adapted to determine parameters. The parameters may be used for channelizing downlink control information. The parameters comprise a position of a physical resource block in the frequency domain of the radio transmission channel, a spreading code and a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel. The base station further comprises a definition unit 403 being adapted to define the CCE based on the determined parameters.

The base station may be any type of access point or point of attachment, which is capable of providing a wireless access to a cellular network system. Thereby, the wireless access may be provided for the user equipment, or for any other network element, which is capable of communicating in a wireless manner. The base station may be a NodeB, eNB, home NodeB or HeNB, or any other kind of access point.

The base station may comprise a receiving unit, for example a receiver as known by a skilled person. The base station may also comprise a transmitting or sending unit, for

example a transmitter. The receiver and the transmitter may be implemented as one single unit, for example as a transceiver 401. The transceiver or the receiving unit and the sending unit may be adapted to communicate with the user equipment and a further base station via an antenna.

5

The determination unit 402 and the definition unit 403 may be implemented as single units or may be implemented for example as part of a standard control unit, like a CPU or a microcontroller.

10 The user equipment (UE) may be any type of communication end device, which is capable of connecting with the described base station. The UE may be in particular a cellular mobile phone, a Personal Digital Assistant (PDA), a notebook computer, a printer and/or any other movable communication device.

15 The user equipment may comprise a receiving unit or receiver which is adapted for receiving signals from the base station. The user equipment may comprise a transmitting unit for transmitting signals. The transmitting unit may be a transmitter as known by a skilled person. The receiver and the transmitting unit may be implemented as one single unit, for example as a transceiver 404. The transceiver or the receiver and the transmitting
20 unit may be adapted to communicate with the base station via an antenna.

The user equipment may further comprise a configuration unit 405 for configuring the transmission of the user equipment based on control signals comprising downlink control information received from the base station. The configuration unit may be implemented as
25 a single unit or may be implemented for example as part of a standard control unit, like a CPU or a microcontroller.

Having regard to the subject matter disclosed herein, it should be mentioned that, although some embodiments refer to a "base station", "eNB", etc., it should be understood that each
30 of these references is considered to implicitly disclose a respective reference to the general term "network component" or, in still other embodiments, to the term "network access node". Also other terms which relate to specific standards or specific communication techniques are considered to implicitly disclose the respective general term with the desired functionality.

35

It should further be noted that a base station as disclosed herein is not limited to dedicated entities as described in some embodiments. Rather, the herein disclosed subject matter may

be implemented in various ways in various locations in the communication network while still providing the desired functionality.

5 According to embodiments of the invention, any suitable entity (e.g. components, units and devices) disclosed herein, e.g. the determination unit, are at least in part provided in the form of respective computer programs which enable a processor device to provide the functionality of the respective entities as disclosed herein. According to other embodiments, any suitable entity disclosed herein may be provided in hardware. According to other - hybrid - embodiments, some entities may be provided in software while other entities are
10 provided in hardware.

It should be noted that any entity disclosed herein (e.g. components, units and devices) are not limited to a dedicated entity as described in some embodiments. Rather, the herein disclosed subject matter may be implemented in various ways and with various
15 granularities on device level while still providing the desired functionality. Further, it should be noted that according to embodiments a separate entity (e.g. a software module, a hardware module or a hybrid module) may be provided for each of the functions disclosed herein. According to other embodiments, an entity (e.g. a software module, a hardware module or a hybrid module (combined software/hardware module)) is configured for
20 providing two or more functions as disclosed herein.

It should be noted that the term “comprising” does not exclude other elements or steps. It may also be possible in further refinements of the invention to combine features from different embodiments described herein above. It should also be noted that reference signs
25 in the claims should not be construed as limiting the scope of the claims.

List of reference signs:

	100	Cellular network system
	101	Base station
5	102	User equipment
	103	Cell
	201	Physical resource block
10	300	Channel coding
	301	Modulation
	302	Spreading
	303	Scrambling
	304	PRB mapping
15	400	Cellular network system
	401	Transceiver of the base station
	402	Determination unit of the base station
	403	Definition unit of the base station
20	404	Transceiver of the user equipment
	405	Configuration unit of the user equipment

WHAT IS CLAIMED IS:

1. A method for defining a control channel element, which corresponds to a subset of resources within a physical resource block of a control channel, the control channel
5 element to be used for sending downlink control information being responsive for controlling a transmission between a user equipment (102) and a base station (101) via a radio transmission channel, wherein the control channel is part of the radio transmission channel, the method comprising
determining parameters, wherein the parameters are used for channelizing downlink
10 control information, the parameters comprising a position of a physical resource block in the frequency domain of the radio transmission channel, a spreading code and a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel, and
defining the control channel element based on the determined parameters.
15
2. The method as set forth in claim 1,
wherein the spreading code creates a first sequence of symbols based on a sequence of modulated symbols corresponding to the downlink control information,
wherein the scrambling sequence creates a second sequence of symbols based on
20 the first sequence of symbols, and,
wherein the scrambling identity is assigned to the second sequence of symbols being indicative for the scrambling sequence.
3. The method as set forth in any one of the preceding claims, wherein the scrambling
25 sequence is a pseudo-random sequence.
4. The method as set forth in any one of the preceding claims, the method further comprising allocating a physical resource block for the control channel element.
- 30 5. The method as set forth in claim 4, the method further comprising assigning different spreading codes to different control channel elements within one physical resource block for allocating the physical resource block for a plurality of control channels.
- 35 6. The method as set forth in claim 5, wherein a multiplexing scheme for multiplexing different control channel elements within one physical resource block is based on code division multiplexing.

7. The method as set forth in any one of the claims 4 to 6, the method further comprising

allocating a plurality of physical resource blocks for a distributed control channel, wherein the control channel elements corresponding to each physical resource block is
5 based on a position of the physical resource block in the frequency domain of the radio transmission channel being unique for each physical resource block.

8. The method as set forth in any one of the preceding claims, the method further comprising

10 exchanging, between the base station (101) and a neighboring base station, information on the position of the physical resource block, the spreading code and/or the scrambling sequence being allocated for a control channel.

9. The method as set forth in claim 8, the method further comprising

15 adapting the spreading code and/or the scrambling sequence for reducing interferences between the base station (101) and the neighboring base station.

10. A base station (101) for defining a control channel element, which corresponds to a subset of resources within a physical resource block of a control channel, the control
20 channel element to be used for sending downlink control information being responsive for controlling a transmission between a user equipment (102) and the base station (101) via a radio transmission channel, wherein the control channel is part of the radio transmission channel, the base station (101) comprising

a determination unit (402) being adapted to determine parameters, wherein the
25 parameters are used for channelizing downlink control information, the parameters comprising a position of a physical resource block in the frequency domain of the radio transmission channel, a spreading code and a scrambling identity being indicative for a scrambling sequence used for randomizing the transmission of the control channel, and
a definition unit (403) being adapted to define the control channel element based on
30 the determined parameters.

11. A user equipment (102) being adapted to communicate with the base station as set forth in claim 10.

35 12. A cellular network system (100), the cellular network system comprising a base station (101) as set forth in claim 10.

13. The cellular network system (100) as set forth in claim 12, further comprising a user equipment (102) as set forth in claim 11.

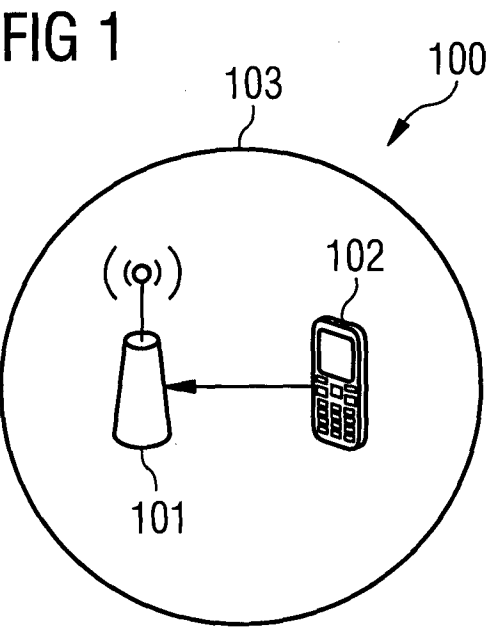


FIG 2

SF1			
SF2		SF2	
SF4	SF4	SF4	SF4

201

FIG 3

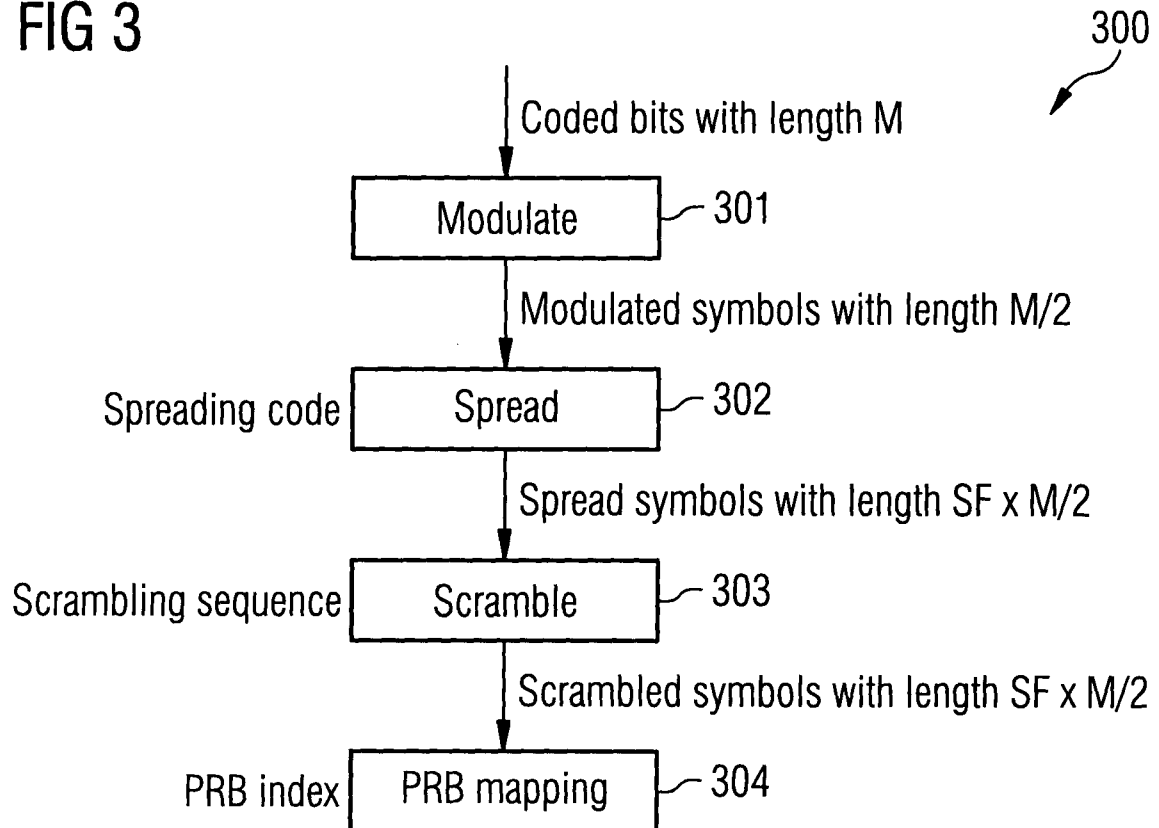
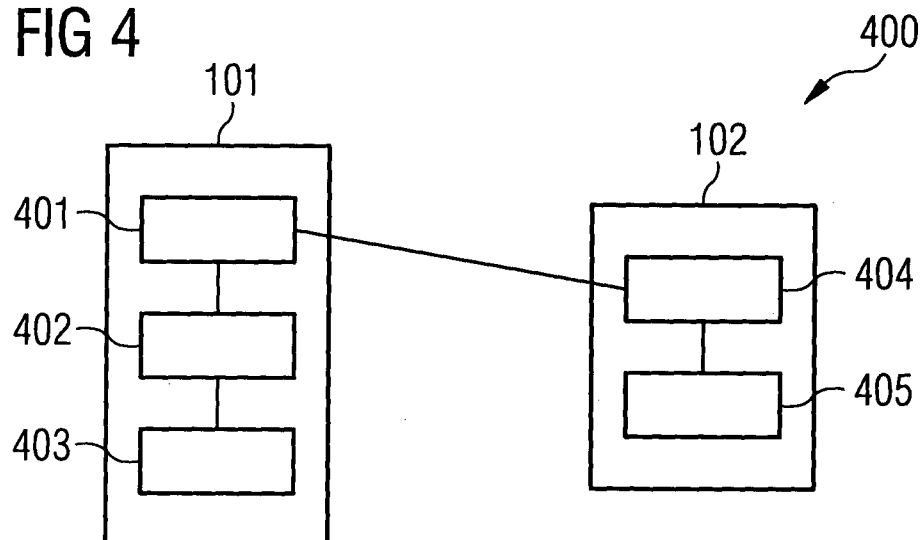


FIG 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/070990

A. CLASSIFICATION OF SUBJECT MATTER

H04W 52/58 (2009.01) i

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:H04W;H04Q;H04L

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)

CNKI, CPRS, WPI, EPODOC: random, base station, node B, downlink, control, channel, resource, frequency, spread+, scramble+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN101132626A (ZTE CORP) 27 Feb. 2008 (27.02.2008) page 1 lines 11-21, page 6 line 27-page 7 line 26 of the description, fig.2	1,3-7,10-13
X	CN101192906A (ZTE CORP) 04 Jun. 2008 (04.06.2008) claims 1-14, page 1 lines 11-21 of the description	1,3-7,10-13
A	US6882841B1 (LG INF & COMM LTD) 19 Apr. 2005 (19.04.2005) the whole document	1-13

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

* Special categories of cited documents:	“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
“A” document defining the general state of the art which is not considered to be of particular relevance	“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
“E” earlier application or patent but published on or after the international filing date	“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
“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)	“&” document member of the same patent family
“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	

Date of the actual completion of the international search 03 Nov. 2012 (03.11.2012)	Date of mailing of the international search report 15 Nov. 2012 (15.11.2012)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer CHEN, Wei Telephone No. (86-10)62411349

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/070990

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101132626A	27.02.2008	WO2008025187A1	06.03.2008
		CN101132626B	29.12.2010
CN101192906A	04.06.2008	CN101192906B	29.09.2010
US6882841B1	19.04.2005	KR100413419B	14.02.2004
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