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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 February 2009 (26.02.2009)

PCT

(10) International Publication Number
WO 2009/025619 A2

(51) International Patent Classification:
H04L 1/00 (2006.01)

(21) International Application Number: PCT/SE2008/050951

(22) International Filing Date: 22 August 2008 (22.08.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0701915-1 23 August 2007 (23.08.2007) SE

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
— *of inventorship (Rule 4.17(iv))*

Published:
— *without international search report and to be republished upon receipt of that report*

WO 2009/025619 A2

(54) Title: FEEDBACK REDUCTION FOR CODEBOOK SUBSET RESTRICTION

(57) Abstract: Systems and methods according to these exemplary embodiments provide for methods and systems for reducing uplink overhead from a user equipment, UE, (14) when performing communications in a mobile network. Reductions in uplink overhead may be achieved by using different control channel structures depending upon, for example, a subset of permissible transmit parameters which are under consideration for a particular connection.

Feedback Reduction for Codebook Subset Restriction

RELATED APPLICATION

[0001] This application is related to, and claims priority from, Swedish Patent Application Serial No. 0701915-1, filed on August 23, 2007, entitled "Method and Arrangement in a Telecommunication System" to Bo Göransson and George Jöngren, the entire disclosure of which is incorporated here by reference.

TECHNICAL FIELD

[0002] The present invention relates generally to telecommunications systems, and in particular to methods and systems for improving efficiency in radiocommunications systems.

BACKGROUND

[0003] Radiocommunication networks were originally developed primarily to provide voice services over circuit-switched networks. The introduction of packet-switched bearers in, for example, the so-called 2.5G and 3G networks enabled network operators to provide data services as well as voice services. Eventually, network architectures will likely evolve toward all Internet Protocol (IP) networks which provide both voice and data services. However, network operators have a substantial investment in existing infrastructures and would, therefore, typically prefer to migrate gradually to all IP network architectures in order to allow them to extract sufficient value from their investment in existing infrastructures. Also to provide the capabilities needed to support next generation radiocommunication applications, while at the same time using legacy infrastructure, network operators could deploy hybrid networks wherein a next generation radiocommunication system is overlaid onto an existing circuit-switched or packet-switched network as a first step in the transition to an all IP-based network.

[0004] One example of such a hybrid network involves an existing second generation (2G) radiocommunication system, such as the Global System for Mobile communication (GSM), onto which a next generation "long term evolution" (LTE) system is overlaid. As will be appreciated by those skilled in the art, GSM systems have been modified and updated over time. For example, GSM release 1997 added packet data capabilities using General Packet Radio Service (GPRS) and GSM release 1999 introduced higher speed data transmissions through a system called Enhanced Data Rates for GSM Evolution (EDGE). Although not yet standardized, LTE systems will ultimately be designed in accordance with a new version of the UMTS standards, see, e.g., 3GPP TR 25.913 available online at www.3gpp.org. Target performance goals for LTE systems currently include, for example, support for 200 active calls per 5 MHz cell and sub 5 ms latency for small IP packets. Each new generation, or partial generation, of mobile communication systems add complexity and abilities to mobile communication systems and this can be expected to continue with either enhancements to proposed systems or completely new systems in the future.

[0005] As these mobile communication systems continue to evolve, more data at higher bandwidths is expected to be transferred over mobile communication networks. One method for boosting the capacity and coverage of a wireless communication system involves the use of multiple antennas at the transmitter and/or the receiver end. These Multiple-Input-Multiple-Output (MIMO) systems exploit the spatial dimension of a communication channel in order to improve performance by, for example, transmitting several parallel information carrying signals. By adapting the transmission to the current channel conditions, significant additional gains can be achieved in a wireless system. One form of adaptation is to dynamically adjust, from one transmission time interval (TTI) to another TTI, the number of simultaneously transmitted information carrying signals to what the channel can support. This is commonly referred to as (transmission) rank adaptation. Another form of adaptation is precoding, wherein the phases and amplitudes of the signals are adjusted to better fit the current channel properties. The signals form a vector-valued signal and the adjustment can be described as multiplication by a precoder matrix. A common approach is to select the precoder matrix from a finite and countable set, e.g., as contained within a codebook. Such a codebook based precoding is likely to be an integral part of various mobile communication networks, e.g., LTE or MIMO for High Speed Downlink Packet Access (HSDPA) in Wideband Code Division Multiple Access (WDCMA) system.

[0006] Codebook based precoding is a form of channel quantization. A typical approach when using a system, such as, LTE or MIMO in WDCMA, is to let the receiver recommend a suitable precoder matrix to the transmitter by signaling the precoder index over a feedback link. The transmitter may choose to override the recommendation of the receiver so that it might be necessary to signal the precoder index that is actually used in the transmission to the receiver. In order to limit signaling overhead, it may be desirable to keep the codebook size as small as possible. This design desire, however, needs to be balanced against the performance impact, since a larger codebook allows a better match to the current channel conditions.

[0007] Accordingly, methods, devices, systems and software for communicating codebook-related information, or other transmission parameters, are desirable.

SUMMARY

[0008] According to one exemplary embodiment, a method for communicating in a mobile network includes the steps of: receiving a message at a user equipment, wherein the message identifies a permissible subset associated with a set of transmission parameters, selecting, by the user equipment, one of the transmission parameters from the permissible subset, and transmitting an indication of the selected one of the transmission parameters using one of a plurality of different uplink control channel structures, the one of the plurality of different uplink control channel structures being selected based on the permissible subset.

[0009] According to another exemplary embodiment a user terminal includes a transceiver for sending and receiving signals, including receiving a signal which identifies a permissible subset associated with a set of transmission parameters, a memory device for storing the set of transmission parameters, and a processor, connected to the transceiver and the memory device, and for selecting one of the transmission parameters from the permissible subset, wherein the transceiver transmits an indication of the selected one of the transmission parameters using one of a plurality of different uplink control channel structures, the one of the plurality of different uplink control channel structures being selected based on the permissible subset.

[0010] According to still another exemplary embodiment, a method for communicating in a mobile network includes the steps of transmitting a message, wherein the message identifies a permissible subset associated with a set of transmission parameters, and receiving an indication of one of the transmission parameters which has been selected from the permissible subset on one of a plurality of different uplink control channel structures, the

one of the plurality of different uplink control channel structures being selected based on the permissible subset.

[0011] According to still another exemplary embodiment, a network node includes a transceiver for sending and receiving signals, including transmitting a signal which identifies a permissible subset associated with a set of transmission parameters, a memory device for storing the set of transmission parameters, and a processor, connected to the transceiver and the memory device, wherein the transceiver receives an indication of a selected one of the transmission parameters on one of a plurality of different uplink control channel structures, the one of the plurality of different uplink control channel structures being selected based on the permissible subset.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying drawings illustrate exemplary embodiments, wherein:

[0013] Figure 1 depicts elements of a radiocommunications system according to exemplary embodiments;

[0014] Figure 2 depicts elements of another radiocommunication system according to exemplary embodiments;

[0015] Figure 3 illustrates elements of still another radiocommunication system according to exemplary embodiments;

[0016] Figure 4 shows a block diagram representation of, for example, a mobile terminal or a network node according to exemplary embodiments;

[0017] Figure 5 depicts a codebook according to exemplary embodiments;

[0018] Figure 6 shows a plurality of different control channel structures according to exemplary embodiments;

[0019] Figure 7 is a flowchart illustrating a method for communicating according to an exemplary embodiment; and

[0020] Figure 8 is a flowchart illustrating another method for communicating according to an exemplary embodiment.

DETAILED DESCRIPTION

[0021] The following detailed description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims. The following embodiments are discussed, for simplicity, with regard to the terminology and structure of LTE systems. However, the embodiments to be discussed next are not limited to LTE systems but may be applied to other existing telecommunications systems.

[0022] Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification are not necessarily all referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

[0023] Codebook subset restrictions (CBSSRs) can be used by the system to restrict the user equipment (UE) from using the complete set of available precoders. One reason for using CBSSRs is that only parts of the entries in a codebook may be suitable for a particular antenna arrangement. For example, if a correlated array (also known as a traditional beamformer) is used at the cell site, only elements in the codebook corresponding to beamforming vectors are of value for selection and use. To ensure that a UE selects an appropriate beamforming vector, the system can restrict the UE to search for the "best" precoder among the subset of precoders which containing suitable beamforming vectors, and prevent the UE from using and/or evaluating other codebook elements, i.e., those which do not provide such beamforming vectors.

[0024] To provide some context for the following exemplary embodiments related to restricted codebooks and associated signaling, consider the exemplary radiocommunication system as shown from two different perspectives in Figures 1 and 2, respectively. To increase the transmission rate of the systems, and to provide additional diversity against fading on the radio channels, modern wireless communication systems include transceivers that use multi-antennas (often referred to as a MIMO systems). The multi-antennas may be distributed to the receiver side, to the transmitter side and/or provided at both sides as shown in Figure 1. More specifically, Figure 1 shows a base station 10 having four antennas 12 and a user terminal (also referred to herein as "user equipment" or "UE") 14 having two antennas 12. The number of antennas shown in Figure 1 is exemplary and is not intended to limit the actual number of antennas used at the base station or at the user terminal in the exemplary embodiments to be discussed below. Additionally, the term "base station" is used herein as a generic term. As it is known by those skilled in the art, in the Wideband Code Division Multiple Access (WCDMA) architecture, a NodeB may correspond to the base station. In other words, a base station is a possible implementation of the NodeB. However, the term "NodeB" is also broader than the conventional base station since the NodeB refers, in general, to a logical node. A NodeB in a WCDMA system handles transmission and reception in one or several cells, as shown for example in Figure 2.

[0025] Figure 2 shows two NodeB 10 and one user terminal 14. The user terminal 14 uses dedicated channels 16 to communicate with the NodeB 10. The two NodeBs 10 are wired to corresponding Radio Network Controllers (RNC) 18. One RNC 18 may control more than one NodeB 10. The RNCs 18 are connected to a Core Network 20. For the LTE architecture, there is a single node, the eNodeB. One possible LTE architecture is shown in Figure 3, in which the eNodeB 22 may include a physical layer PHY 24, a medium access control MAC 26, a radio link control RLC 28, and a packet data convergence protocol PDCP 30. Although conventionally the term "base station" is narrower than the NodeB of the WCDMA architecture or the eNodeB of the LTE architecture, the term "base station" is used in the following embodiments as defining the NodeB, eNodeB or other nodes specific for other architectures. Thus, the term "base station" defined and used in the present disclosure is not limited to the conventional base station unit of a network.

[0026] When using a restricted codebook, a mobile communications system can restrict a UE 14 from searching the whole codebook and reporting the complete results to a network node which, in turn, can result in an increase in system performance. However, this increased performance does not necessarily improve the overhead associated with uplink (UL) transmissions. For example, consider a codebook which contains 64 elements (i.e., represented by six bits of data) and a UE 14 that is restricted to use only eight of those elements by CBSSR. In this case, the UE 14 will then search (only) over the eight allowed elements and then report the index which corresponds to the "best" one of the restricted subset precoder selection. However, since the codebook contains 64 elements, six bits are used to convey the precoder information (per layer) from the UE 14 to the network node 10, 22 (e.g., base station or eNodeB). This use of six bits from the UE 14 to the network node 10, 22 is wasteful of capacity since only eight out of the possible 64 elements are allowed to be selected by the UE 14, which implies that only three bits are needed to convey the identity of this particular selection.

[0027] Exemplary embodiments of the present invention use this recognition to save uplink (UL) capacity by adapting the uplink control channel structure dependent upon whether, for example, a restricted codebook is being used for a particular connection between UE 14 and node 10, 22, or not. According to some exemplary embodiments, the number of different control channel structures can vary as a function of the number of bits used to convey the selected codebook, e.g., one control channel structure for each different number of bits which can be used to convey the codebook information, one control channel structure for every second different number of bits, down to the provision of only two different control channel structures overall. It will be appreciated that the number of different UL control channel structures which are provided in any given implementation will vary based upon, for example, the competing design considerations associated with, on the one hand, improved capacity and, on the other hand, system complexity. Moreover, although these exemplary embodiments are provided in the context of codebook signaling generally, and restricted codebook signaling, specifically, it will be appreciated that the present invention is not so limited. More generally, exemplary embodiments provide also for using different uplink control channel structures to convey other types of variable feedback from the UE 14 to network node 10, 22, e.g., modulation alphabet information, transmit power information, transport block size information, channelization code information, channel quality indicator (CQI) information, etc.

[0028] Figure 4 shows a generic structure of the user terminal or UE 14 according to an exemplary embodiment which can be used to transmit, e.g., restricted codebook selection information, on an uplink channel having a format which is selected based upon the number of selection items in the subset. The user terminal 14 includes one or more antennas 40 connected to processor 42. The processor 42 is configured to analyze and process signals received via the antennas 40. The processor 42 is connected to a memory 44 via a bus 46. One skilled in the art would understand from Figure 4 that various ones of the elements shown therein may be implemented as electrical circuitry, software instructions or a combination of these two possibilities. The user terminal 14 may also include a switching unit 48 configured to switch from a first transmission mode, e.g., using a first uplink control channel structure, to a second transmission mode, e.g., a second uplink control channel structure which is different from the first uplink control channel structure. Other units and/or elements are, for example, an input/output unit 50 that allows a user to input commands to the processor 42 or a communication port 52 that allows the user terminal 14 to receive data from another communication system. Further units, not shown, for performing various operations as encoding, decoding, modulation, demodulation, encryption, scrambling, precoding, etc. may optionally be implemented not only as electrical components but also in software or a combination of these two possibilities as would be appreciated by those skilled in the art. The elements illustrated in Figure 4 can also be found in a network node used in exemplary embodiments, e.g., a base station.

[0029] The memory 44 may also contain a stored version of a codebook. An exemplary codebook 60 is shown in Figure 5, which table is reproduced from section 6.3.4.2.3 of 3GPP TS 36.211, which is a standards document entitled "Evolved Universal Terrestrial Radio "Access (E-UTRA), Physical Channels and Modulation" available from the 3GPP organization at www.3gpp.org . Some or all of the information illustrated in Figure 5 can be stored, e.g., as a matrix, in memory 44. It will be appreciated that codebooks may come in numerous different sizes and that the one illustrated in Figure 5 is purely illustrative.

[0030] According to exemplary embodiments, codebook subset restrictions (CBSSRs) can be signaled to a UE 14 using a bitmap mask which differentiates between allowed entries and disallowed entries within a codebook, such as that illustrated in Figure 5. For example, using the exemplary codebook in Figure 5 having a size of 16, a bitmap mask pattern of [0 1 1 0 0 1 1 0 0 0 0 0 0 0 0 0] could be applied to that codebook to indicate that only options 2, 3, 6 and 7 are allowed as selectable options from the codebook. This bitmap mask can then be signaled to the UE 14 from a network node 10, 22 in a downlink (DL) control signal, e.g., an RRC configuration command signal mapped to, at least ultimately, ultimately the physical downlink shared channel (PDSCH) in an LTE system. Different combinations of codebooks and bitmap masks, e.g., 2 bits, 4 bits, etc., can be used as desired. Additionally, other methods for restricting options within a codebook (or equivalent data structure) can be used.

[0031] Continuing with this example, the UE 14 may then select one of the four unrestricted codebook options from its codebook 60 using any desired technique, e.g., knowledge of channel conditions, etc. Thus the UE 14 restricts its choice to, and reports back to the network node 10, 22, one out of the four permissible codebook entries as the preferred choice. This response from UE 14 only requires two bits of feedback as compared to the three bits of feedback that would have been required if the codebook had not been restricted, i.e., using the original unrestricted codebook. According to exemplary embodiments of the present invention, this feedback information can be reported back to the network node using one of a plurality of different uplink control channel structures. Conceptually, this can be visualized as shown in Figure 6, wherein three different control channel structures are defined for an exemplary system, each of which has a different number of bits assigned to the field "Precoder Sel.". As mentioned earlier, the number of different control channel structures which are defined for a given implementation may be different than three, e.g., 2, 4, or any other number. However, for this example, the UE 14 would select the uplink control channel structure of CC#1 since it has a precoder selection field with the fewest number of bits which can identify its selection given the number of permissible choices due to the codebook restriction. When the network node 10, 22 receives this uplink signal from the UE 14, it will know that the structure selected will be CC#1, since it sent the UE 14 the original CBSSR message restricting it to four possible codebook choices and, thus, will process the received signal using this knowledge of the correct control channel structure.

[0032] Of course the actual, physical structure of the uplink channel will vary based upon the system implementation such that the illustration of Figure 6 should be considered merely illustrative of the concept of varying uplink control channel structures according to an exemplary embodiment. For example, in an LTE system such as that shown in Figure 3, the codebook selection information can be transmitted as part of the Layer 1/Layer 2 (L1/L2) signaling information, e.g., as part of, or in a manner similar to CQI/PMI/RI (i.e., feedback of channel state information parameters). This information can be conveyed on the physical uplink control channel (PUCCH), e.g., as part of an OFDM subframe assigned for uplink L1/L2 control or, alternatively, as part of the control information field on a physical uplink shared channel (PUSCH), wherein it is multiplexed together with uplink data from the UE 14.

[0033] One challenge that can arise from having a multitude of combinations for both the original codebook size and the different restriction sizes, e.g., different sized bitmap masks, is the potentially large number of control channels to be accounted for if, for example, a different control channel structure is available for every different minimum number of bits which can be used to convey a particular selection. For example, the absolute minimum number of bits needed to convey a selection of one of two elements or parameters is one, a selection of one of four elements or parameters is two, a selection of one of eight elements or parameters is three, a selection of one of sixteen elements or parameters is four, a selection of one of 32 elements or parameters is five, a selection of one of 64 elements or parameters is six, and so on. Thus, for an exemplary codebook having 64 elements and defined subsets of 4, 6, 12, 20, 36 and 40 elements, one system implementation according to these exemplary embodiments would involve defining six different uplink control channel structures each of which used a different number of bits to convey an indicator of which codebook element was selected by the UE 14. Alternatively, to balance the complexity of having a greater number of control channels against, while still obtaining uplink overhead reduction (i.e., potential efficiency improvement), from a reduced number of bits to be transmitted, exemplary systems and methods provide for fewer different control channel structures.

[0034] For example, a restriction can be introduced by defining only two (or a few) control channel structures, i.e., some number of control channel structures fewer than the different number of minimum bits needed to convey the indicator. For example, one control channel structure could be used to convey indicators associated with selection of an unrestricted codebook and one (or a few) different control channel structure(s) could be used to convey precoder information (or other desired information as previously described above) for a restricted codebook. For example, if the original codebook contains 64 elements, the main control channel structure would carry six bits of precoder information (per layer). If an additional control channel structure is defined that can carry four bits, then all CBSSR resulting in a restricted codebook with less than 16 entries could use this control channel structure.

[0035] According to another exemplary embodiment, a control channel structure can be defined in such a way that it can carry two bits of precoder information. This exemplary control channel structure can be used whenever the CBSSR leads to a restricted codebook smaller than 4 elements. Alternatively, different amounts of bits of precoder information can be defined to be carried over a control channel structure dependent upon system needs and codebook size. From this reduction in response bits the uplink overhead can be reduced which potentially leads to an increase in system performance or, alternatively, allow for other information to be transmitted in unused bits within this space.

[0036] It will be appreciated from the foregoing that the number of bits used to convey the indicator of a transmission parameter from the UE 14 back to the network node 10, 22 may, in some cases, equal an absolute minimum number of bits necessary to convey such information or may be more than the absolute minimum number of bits, i.e., a relative minimum number of bits based upon the decision to limit the number of different control channel structures which are provided in a given system. Thus, as used herein, the phrase "minimum number of bits which are needed for transmitting" may be the absolute minimum, or may be more than the absolute minimum but represent a relative minimum given the number of different control structures which are defined.

[0037] Thus, a method for communicating in a mobile network from the UE 14's perspective can include the steps illustrated in Figure 7. Therein, at step 700, a message is received at a user equipment which message identifies a permissible subset associated with a set of transmission parameters, e.g., a set of codebook elements or other types of transmission parameters as described above. The user equipment selects one of the transmission parameters from the permissible subset at step 702 and transmits an indication of the selected one of the transmission parameters using one of a plurality of different uplink control channel structures (step 704), which can be selected based on said permissible subset. For example, if the permissible subset includes four elements, then the selected uplink control channel structure could be the one which provides the closest number to (but at least) two bits for conveying such information.

[0038] Similarly, a method for communicating in a mobile network from the network's perspective can include the steps illustrated in the flow chart of Figure 8. Therein, at step 800, a message is transmitted which identifies a permissible subset associated with a set of transmission parameters. An indication is received, by the network node, of one of the transmission parameters which has been selected from the permissible subsets on one of a plurality of different uplink control channel structures, which uplink control channel structure was selected based on the permissible subset, at step 802.

[0039] The above-described exemplary embodiments are intended to be illustrative in all respects, rather than restrictive, of the present invention. All such variations and modifications are considered to be within the scope and spirit of the present invention as defined by the following claims. No element, act, or instruction used in the description of the present application should be construed as critical or essential to the invention unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items.

CLAIMS:

1. A method for communicating in a mobile network comprising:

receiving (700) a message at a user equipment (14), wherein said message identifies a permissible subset associated with a set of transmission parameters;

selecting (702), by said user equipment (14), one of said transmission parameters from said permissible subset; and

transmitting (704) an indication of said selected one of said transmission parameters using one of a plurality of different uplink control channel structures, said one of said plurality of different uplink control channel structures being selected based on said permissible subset.

2. The method of claim 1, wherein said set of transmission parameters is a set of codebook elements, said message restricts said set of codebook elements to said permissible subset and wherein each of said plurality of different uplink control channel structures provides a different number of bits for transmitting said indication of a selected one of said codebook elements.

3. The method of claim 2, wherein said user equipment selects said one of said plurality of different uplink control channel structures having a minimum number of bits which are needed for transmitting said indication.

4. The method of claim 2, wherein said message is a bitmap mask which describes

which elements of a codebook matrix can be selected and which elements may not be selected.

5. The method of claim 1, wherein said set of transmission parameters includes at least one of: modulation alphabet information, transmit power information, transport block size information, channelization code information, channel quality indicator (CQI) information, and precoding information.

6. The method of claim 1, further comprising the step of:

transmitting, from said user equipment, data which has been processed in accordance with said selected one of said transmission parameters.

7. The method of claim 1, wherein said permissible subset is all of the members of the set.

8. A user terminal (14) comprising:

a transceiver (52) for sending and receiving signals, including receiving a signal which identifies a permissible subset associated with a set of transmission parameters;

a memory device (44) for storing said set of transmission parameters; and

a processor (42), connected to said transceiver (52) and said memory device (44), and for selecting one of said transmission parameters from said permissible subset,

wherein said transceiver (52) transmits an indication of said selected one of said transmission parameters using one of a plurality of different uplink control channel structures, said one of said plurality of different uplink control channel structures being selected based on said permissible subset.

9. The user terminal of claim 8, wherein said set of transmission parameters is a set of codebook elements, said message restricts said set of codebook elements to said permissible subset and wherein each of said plurality of different uplink control channel structures provides a different number of bits for transmitting said indication of a selected one of said codebook elements.

10. The user terminal of claim 9, wherein said user equipment selects said one of said plurality of different uplink control channel structures having a minimum number of bits which are needed for transmitting said indication.

11. The user terminal of claim 9, wherein said message is a bitmap mask which describes which elements of a codebook matrix can be selected and which elements may not be selected.

12. The user terminal of claim 8, wherein said set of transmission parameters includes at least one of: modulation alphabet information, transmit power information, transport block size information, channelization code information, channel quality indicator (CQI) information, and precoding information.

13. The user terminal of claim 8, wherein said transceiver subsequently transmits data which has been processed in accordance with said selected one of said transmission parameters.

14. The user terminal of claim 8, wherein said permissible subset is all of the members of the set.

15. A method for communicating in a mobile network comprising:

transmitting (800) a message, wherein said message identifies a permissible subset associated with a set of transmission parameters; and

receiving (802) an indication of one of said transmission parameters which has been selected from said permissible subset on one of a plurality of different uplink control channel structures, said one of said plurality of different uplink control channel structures being selected based on said permissible subset.

16. The method of claim 15, wherein said set of transmission parameters is a set of codebook elements, said message restricts said set of codebook elements to said permissible subset and wherein each of said plurality of different uplink control channel structures provides a different number of bits for transmitting said indication of a selected one of said codebook elements.

17. The method of claim 16, wherein said one of said plurality of different uplink control channel structures has a minimum number of bits which are needed for said indication.

18. The method of claim 16, wherein said message is a bitmap mask which describes which elements of a codebook matrix can be selected and which elements may not be selected.

19. The method of claim 15, wherein said set of transmission parameters includes at least one of: modulation alphabet information, transmit power information, transport block size information, channelization code information, channel quality indicator (CQI) information, and precoding information.

20. The method of claim 15, further comprising the step of:

receiving data which has been processed in accordance with said selected one of said transmission parameters.

21. The method of claim 15, wherein said permissible subset is all of the members of the set.

22. A network node (10) comprising:

a transceiver (52) for sending and receiving signals, including transmitting a signal which identifies a permissible subset associated with a set of transmission parameters;

a memory device (44) for storing said set of transmission parameters; and

a processor (42), connected to said transceiver and said memory device (44), wherein said transceiver (52) receives an indication of a selected one of said transmission parameters on one of a plurality of different uplink control channel structures, said one of said plurality of different uplink control channel structures being selected based on said permissible subset.

23. The network node of claim 22, wherein said set of transmission parameters is a set of codebook elements, said message restricts said set of codebook elements to said permissible subset and wherein each of said plurality of different uplink control channel structures provides a different number of bits for transmitting said indication of a selected one of said codebook elements.

24. The network node of claim 23, wherein said one of said plurality of different uplink control channel structures has a minimum number of bits which are needed for transmitting said indication.

25. The network node of claim 23, wherein said message is a bitmap mask which describes which elements of a codebook matrix can be selected and which elements may not be selected.

26. The network node of claim 22, wherein said set of transmission parameters includes at least one of: modulation alphabet information, transmit power information, transport block size information, channelization code information, channel quality indicator (CQI) information, and precoding information.

27. The network node of claim 22, wherein said transceiver subsequently receives data which has been processed in accordance with said selected one of said transmission parameters.

28. The network node of claim 22, wherein said permissible subset is all of the members of the set.

29. The network node of claim 22, wherein said network node is a base station.

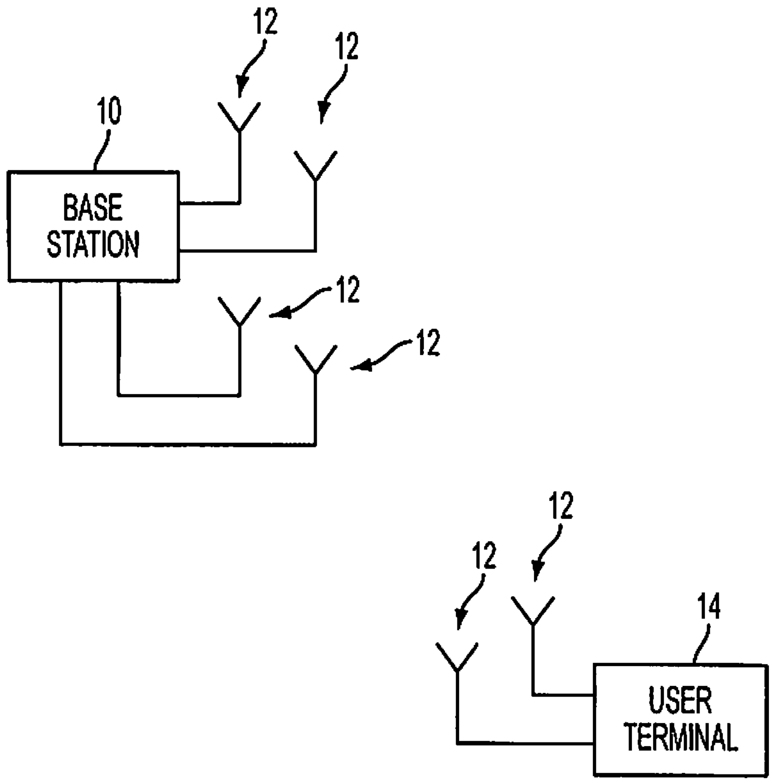

FIG. 1

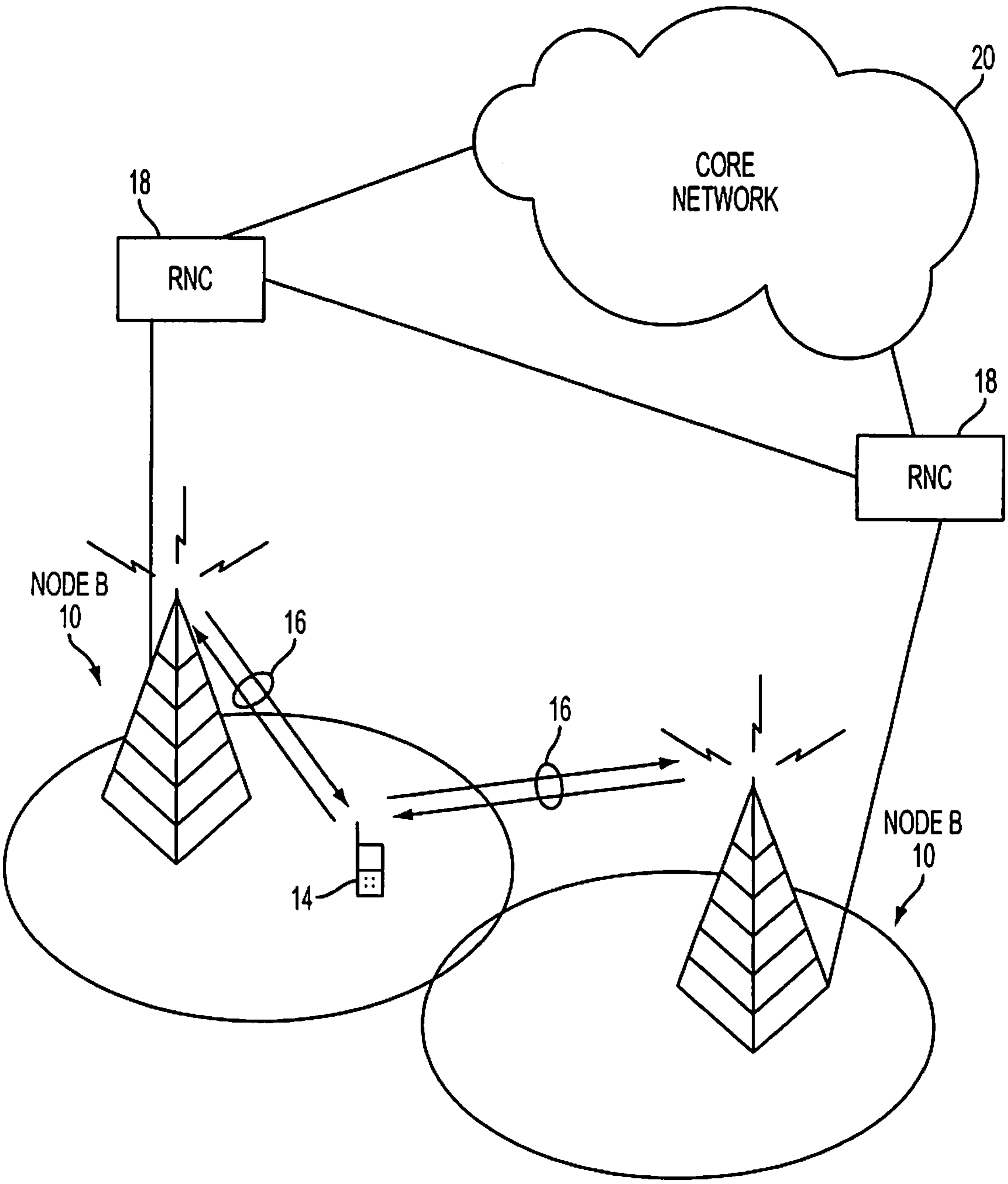

FIG. 2

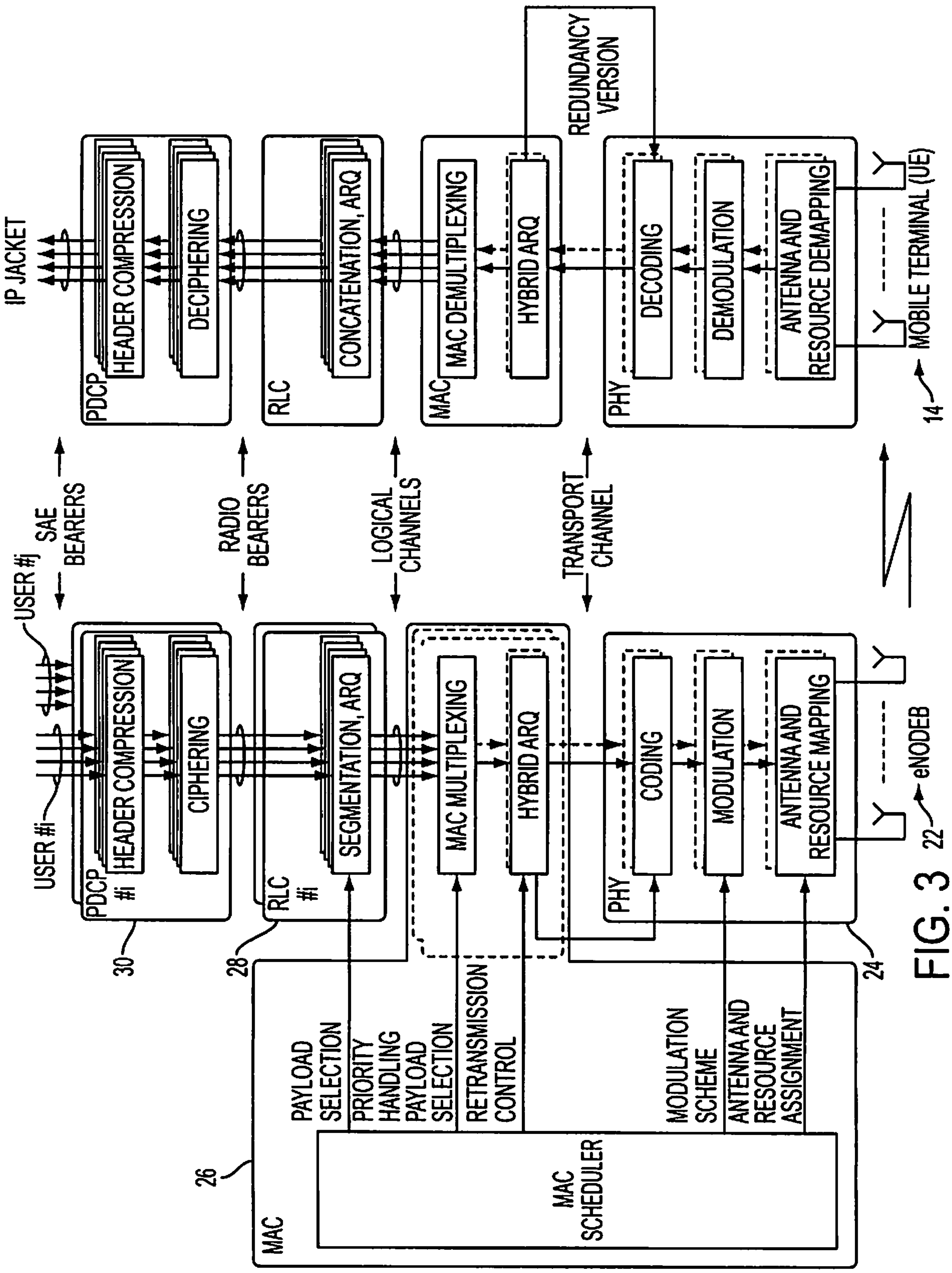
IP JACKET
PDCP
HEADER COMPRESSION
DECIPHERING
RLC
CONCATENATION, ARQ
MAC
MAC DEMULTIPLEXING
HYBRID ARQ
REDUNDANCY VERSION
PHY
DECODING
DEMODULATION
ANTENNA AND RESOURCE DEMAPPING
14
MOBILE TERMINAL (UE)
USER #j
SAE BEARERS
RADIO BEARERS
LOGICAL CHANNELS
TRANSPORT CHANNEL
USER #i
PDCP #i
HEADER COMPRESSION
CIPHERING
RLC #i
SEGMENTATION, ARQ
MAC MULTIPLEXING
HYBRID ARQ
PHY
CODING
MODULATION
ANTENNA AND RESOURCE MAPPING
22
eNODEB
30
28
24
26
MAC
PAYLOAD SELECTION
PRIORITY HANDLING PAYLOAD SELECTION
RETRANSMISSION CONTROL
MODULATION SCHEME
ANTENNA AND RESOURCE ASSIGNMENT
MAC SCHEDULER

FIG. 3

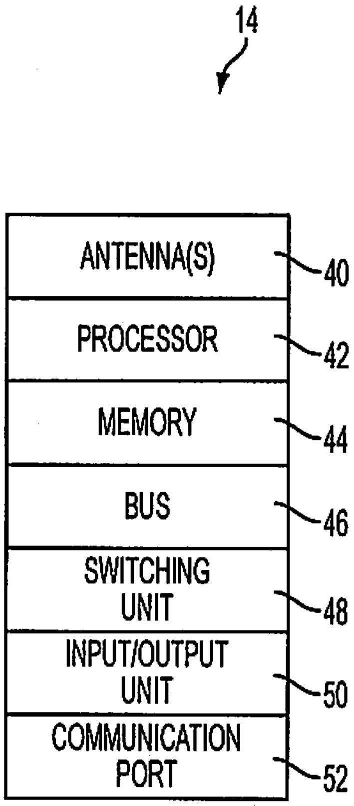
14
ANTENNA(S)
40
PROCESSOR
42
MEMORY
44
BUS
46
SWITCHING UNIT
48
INPUT/OUTPUT UNIT
50
COMMUNICATION PORT
52

FIG. 4

60

CODEBOOK INDEX	u_n	NUMBER OF LAYERS υ			
		1	2	3	4
0	$u_0 = [1\ -1\ -1\ -1]^T$	$W_0^{\{1\}}$	$W_0^{\{14\}}/\sqrt{2}$	$W_0^{\{124\}}/\sqrt{3}$	$W_0^{\{1234\}}/2$
1	$u_1 = [1\ -j\ 1\ j]^T$	$W_1^{\{1\}}$	$W_1^{\{12\}}/\sqrt{2}$	$W_1^{\{123\}}/\sqrt{3}$	$W_1^{\{1234\}}/2$
2	$u_2 = [1\ 1\ -1\ 1]^T$	$W_2^{\{1\}}$	$W_2^{\{12\}}/\sqrt{2}$	$W_2^{\{123\}}/\sqrt{3}$	$W_2^{\{3214\}}/2$
3	$u_3 = [1\ j\ 1\ -j]^T$	$W_3^{\{1\}}$	$W_3^{\{12\}}/\sqrt{2}$	$W_3^{\{123\}}/\sqrt{3}$	$W_3^{\{3214\}}/2$
4	$u_4 = [1\ (-1-j)/\sqrt{2}\ -j\ (1-j)/\sqrt{2}]^T$	$W_4^{\{1\}}$	$W_4^{\{14\}}/\sqrt{2}$	$W_4^{\{124\}}/\sqrt{3}$	$W_4^{\{1234\}}/2$
5	$u_5 = [1\ (1-j)/\sqrt{2}\ j\ (-1-j)/\sqrt{2}]^T$	$W_5^{\{1\}}$	$W_5^{\{14\}}/\sqrt{2}$	$W_5^{\{124\}}/\sqrt{3}$	$W_5^{\{1234\}}/2$
6	$u_6 = [1\ (1+j)/\sqrt{2}\ -j\ (-1+j)/\sqrt{2}]^T$	$W_6^{\{1\}}$	$W_6^{\{13\}}/\sqrt{2}$	$W_6^{\{134\}}/\sqrt{3}$	$W_6^{\{1324\}}/2$
7	$u_7 = [1\ (-1+j)/\sqrt{2}\ j\ (1+j)/\sqrt{2}]^T$	$W_7^{\{1\}}$	$W_7^{\{13\}}/\sqrt{2}$	$W_7^{\{134\}}/\sqrt{3}$	$W_7^{\{1324\}}/2$
8	$u_8 = [1\ -1\ 1\ 1]^T$	$W_8^{\{1\}}$	$W_8^{\{12\}}/\sqrt{2}$	$W_8^{\{124\}}/\sqrt{3}$	$W_8^{\{1234\}}/2$
9	$u_9 = [1\ -j\ -1\ -j]^T$	$W_9^{\{1\}}$	$W_9^{\{14\}}/\sqrt{2}$	$W_9^{\{134\}}/\sqrt{3}$	$W_9^{\{1234\}}/2$
10	$u_{10} = [1\ 1\ 1\ -1]^T$	$W_{10}^{\{1\}}$	$W_{10}^{\{13\}}/\sqrt{2}$	$W_{10}^{\{123\}}/\sqrt{3}$	$W_{10}^{\{1324\}}/2$
11	$u_{11} = [1\ j\ -1\ j]^T$	$W_{11}^{\{1\}}$	$W_{11}^{\{13\}}/\sqrt{2}$	$W_{11}^{\{134\}}/\sqrt{3}$	$W_{11}^{\{1324\}}/2$
12	$u_{12} = [1\ -1\ -1\ 1]^T$	$W_{12}^{\{1\}}$	$W_{12}^{\{12\}}/\sqrt{2}$	$W_{12}^{\{123\}}/\sqrt{3}$	$W_{12}^{\{1234\}}/2$
13	$u_{13} = [1\ -1\ 1\ -1]^T$	$W_{13}^{\{1\}}$	$W_{13}^{\{13\}}/\sqrt{2}$	$W_{13}^{\{123\}}/\sqrt{3}$	$W_{13}^{\{1324\}}/2$
14	$u_{14} = [1\ 1\ -1\ -1]^T$	$W_{14}^{\{1\}}$	$W_{14}^{\{13\}}/\sqrt{2}$	$W_{14}^{\{123\}}/\sqrt{3}$	$W_{14}^{\{3214\}}/2$
15	$u_{15} = [1\ 1\ 1\ 1]^T$	$W_{15}^{\{1\}}$	$W_{15}^{\{12\}}/\sqrt{2}$	$W_{15}^{\{123\}}/\sqrt{3}$	$W_{15}^{\{1234\}}/2$

FIG. 5

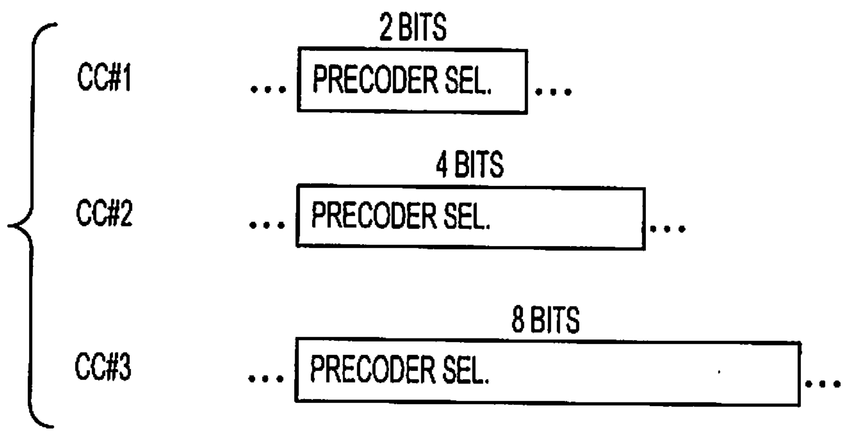
2 BITS
CC#1
PRECODER SEL.
4 BITS
CC#2
PRECODER SEL.
8 BITS
CC#3
PRECODER SEL.

FIG. 6

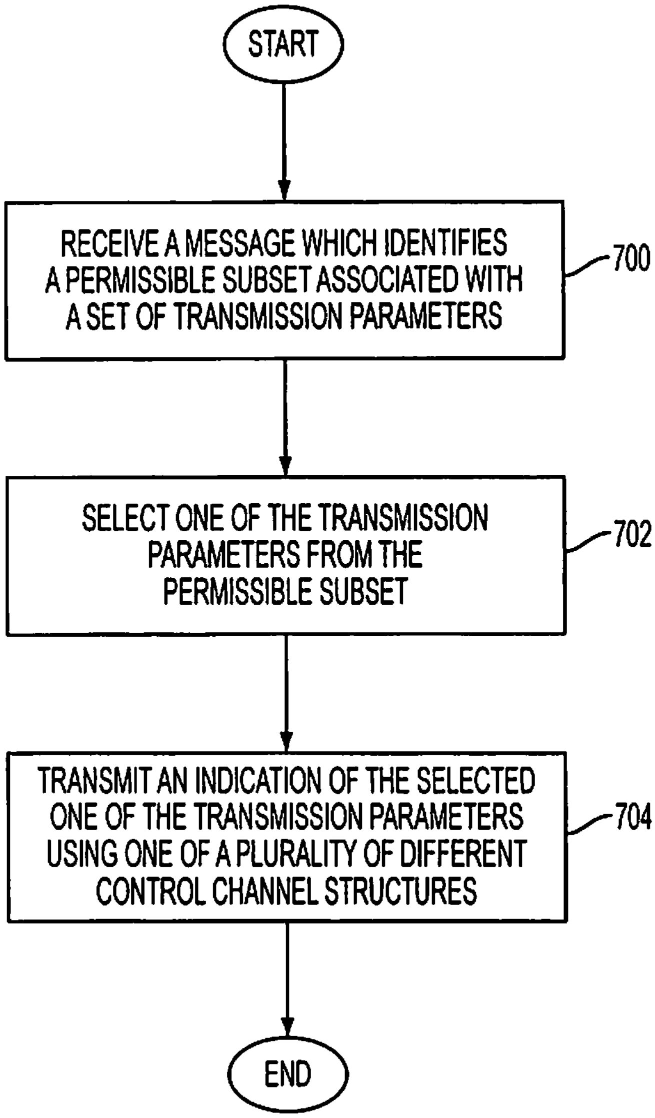
START
RECEIVE A MESSAGE WHICH IDENTIFIES A PERMISSIBLE SUBSET ASSOCIATED WITH A SET OF TRANSMISSION PARAMETERS
700
SELECT ONE OF THE TRANSMISSION PARAMETERS FROM THE PERMISSIBLE SUBSET
702
TRANSMIT AN INDICATION OF THE SELECTED ONE OF THE TRANSMISSION PARAMETERS USING ONE OF A PLURALITY OF DIFFERENT CONTROL CHANNEL STRUCTURES
704
END

FIG. 7

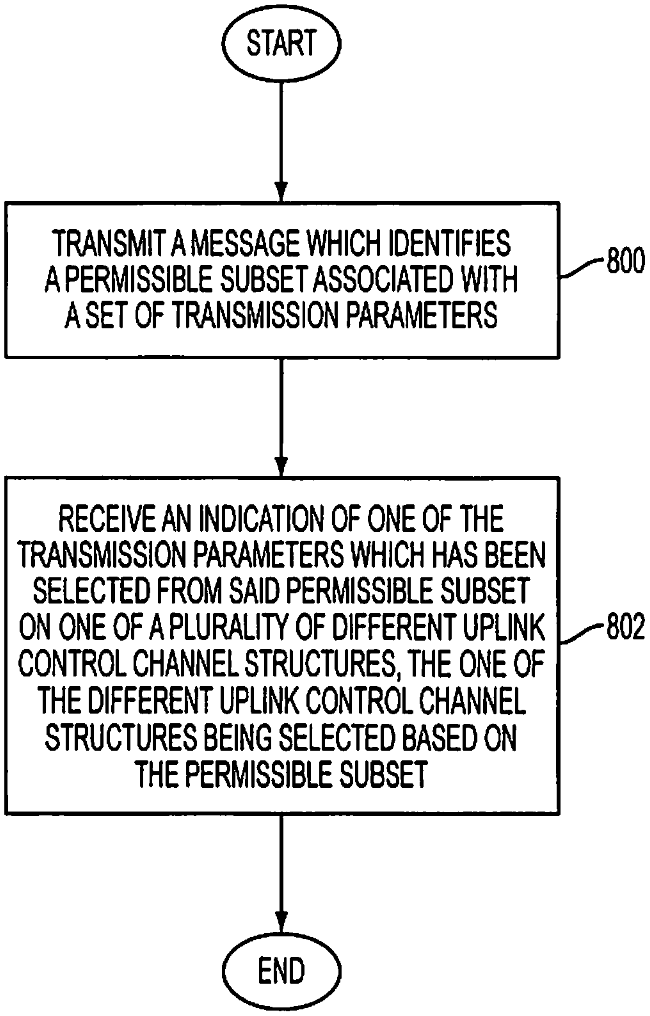
START
TRANSMIT A MESSAGE WHICH IDENTIFIES A PERMISSIBLE SUBSET ASSOCIATED WITH A SET OF TRANSMISSION PARAMETERS
800
RECEIVE AN INDICATION OF ONE OF THE TRANSMISSION PARAMETERS WHICH HAS BEEN SELECTED FROM SAID PERMISSIBLE SUBSET ON ONE OF A PLURALITY OF DIFFERENT UPLINK CONTROL CHANNEL STRUCTURES, THE ONE OF THE DIFFERENT UPLINK CONTROL CHANNEL STRUCTURES BEING SELECTED BASED ON THE PERMISSIBLE SUBSET
802
END

FIG. 8