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(54) ADDITIONAL MODULATION INFORMATION SIGNALING FOR HIGH SPEED DOWNLINK PACKET ACCESS

ZUSÄTZLICHE MODULATIONSINFORMATIONSSIGNALISIERUNG FÜR SCHNELLEN ABWÄRTSSTRECKEN-PAKETZUGANG

SIGNALISATION D'INFORMATIONS DE MODULATION SUPPLÉMENTAIRE POUR UN ACCÈS PAR PAQUETS DE LIAISON DESCENDANTE HAUTE VITESSE

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(56) References cited:
US-A1- 2004 028 020

- **ERICSSON: "Higher Order Modulation for HSPA - Impact on RAN1 specifications, R1-062935" TSG-RAN WG1 MEETING #46BIS, 9 October 2006 (2006-10-09), - 13 October 2006 (2006-10-13) XP002473742 Seoul, Korea cited in the application**
- **PHILIPS, QUALCOMM, MOTOROLA, ERICSSON, NOKIA, RENESAS: "Change request 25.212 CR 0245: Introduction of 64QAM for HSDPA" *GPP TSG-RAN WG1 MEETING #48, 13 February 2007 (2007-02-13), XP002473743 St. Louis, USA**

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Description

FIELD OF THE INVENTION

[0001] The invention relates generally to the field of wireless communication systems and deals with HSDPA with adaptive modulation, and more specifically with signaling support for 64QAM for HSDPA. In particular, the invention relates to a method for interpreting the modulation indication bit as a QPSK/xQAM indication if both the UE and the cell support 64QAM.

[0002] The invention further relates to a method for indicating the modulation of the second data stream in MIMO dual stream transmit diversity signaling on HSDPA.

LIST OF ABBREVIATIONS

[0003]

ACI:	Adjacent Channel Interference
ACPR:	Adjacent channel power ratio
AP:	Access Point
B3G:	Beyond 3rd Generation
CHUNK:	Basic time-frequency resource unit for OFDM links
DL:	Downlink
DRX:	Discontinuous Reception
DTX:	Discontinuous Transmission
FDD:	Frequency division duplex
HARQ:	Hybrid Automatic Repeat Request
HSDPA:	High Speed Downlink Packet Access
HS-DSCH:	High Speed Downlink Shared Channel
HS-PDSCH:	High Speed Physical Downlink Shared Channel
HS-SCCH:	High Speed Shared Control Channel
LTE:	Long Term Evolution
MIMO:	Multiple Input - Multiple Output
MT:	Mobile Terminal
NB:	Narrowband (FDD mode of the WINNER system)
OFDM:	Orthogonal Frequency Division Multiplexing
QAM:	Quadrature Amplitude Modulation
QPSK:	Quadrature Phase Shift Keying
RAN:	Radio Access Network
RAT:	Radio Access Technology
TDD:	Time division duplex
UE:	User Equipment
UL:	Uplink
UT:	User Terminal
WB:	Wideband (TDD mode of the WINNER system)
WLAN:	Wireless Local Area Network
WINNER:	Wireless World Initiative New Radio

BACKGROUND OF THE INVENTION

[0004] The 3GPP Release-5/6/7 specifications define HSDPA with adaptive modulation where the used modulation is either QPSK or 16QAM depending on the Node B scheduler decision for providing communication in for example, a cellular telecommunications system such as schematically represented in Figure 1 and generally designated 4. Recently there has been discussion on also introducing the possibility of using 64QAM with HSDPA in 3GPP. At the same time, 3GPP is specifying a MIMO (multiple input - multiple output) multi-antenna technique for HSDPA MIMO which requires some redesign for the HSDPA related control channels.

[0005] With reference to Figure 2, the current HS-SCCH structure used to inform the format of the actual HS-DSCH transmission (including the used modulation) is split to two parts. HS-SCCH Part 1 contains 8 bits of which 7 bits are used to inform the used HS-PDSCH codes for the HS-DSCH transmission and one bit is used to inform or identify the modulation (QPSK/16QAM) used on those HS-PDSCH codes. HS-SCCH Part 2 provides further information for example,

transport block size, HARQ information, etc.

[0006] The reader is referred to the literature in the art and numerous text references for a further understanding of HSDPA such as found for example in Chapter 12 of the text titled "WCDMA Requirements and Practical Design" published by Wiley.

[0007] Still considering Figure 2, the HS-SCCH transmission starts 5120 chips earlier than the HS-DSCH transmission in order to allow the user equipment (UE) receiver to get the first part (part 1) of the HS-SCCH before the HS-DSCH reception starts and thus to know in advance the codes and modulation used on the HS-DSCH.

[0008] Now with the added requirement of HSDPA MIMO, the intention is to further add two bits of the antenna weights used for the HS-DSCH transmission to HS-SCCH part 1 and one bit indicating the number of streams, one or two, used in the downlink's transmission (a rank-indicator bit) to also provide this MIMO specific information to the receiver. Part 1 of HS-SCCH structure therefore would be required to carry either 8 bits or 11 bits depending on whether MIMO is in use or not. As a consequence of the HSDPA MIMO requirement, two different HS-SCCH Part 1 formats must be specified.

[0009] The problem that must now be solved is how to add a new modulation (64QAM) indication to the part 1 of the HS-SCCH structure.

[0010] Ericsson's R1-062935 in 3GPP RANI meeting #46bis in October 2006, entitled "Higher Order Modulation for HSPA-Impact on RANI specifications" suggests using the same approach as was done with the antenna weight bits with MIMO, that is, to make room for one additional bit to the part 1 of the HS-SCCH structure by reducing the error correction coding of the part 1. The approach described by Ericsson for adding a new modulation indication to the HS-SCCH part 1 for identifying 64QAM modulation is not satisfactory because a further additional bit must be added to the HS-SCCH part 1 structure.

The disadvantages of adding a new modulation bit to the HS-SCCH first part for 64 QAM or HSDPA MIMO operation include at least the following concerns that make the proposal unacceptable:

1) two new HS-SCCH formatted structures are required in addition to the other two HS-SCCH formatted structures. The number of HS-SCCH formats would be doubled to 4 different HS-SCCH formats to cover the situations with/without MIMO and with/without 64QAM support and would require additional buffering to determine the modulation indication to distinguish between 16QAM modulation and 64QAM modulation, and

2) there would be a reduction in the coding protection of the HS-SCCH part 1 as less error correction coding can be applied resulting a non-negligible impact to the performance.

[0011] What is needed is a single HS-SCCH structure that allows for the introduction of 64QAM modulation indication without requiring additional room for bits in the HS-SCCH part 1 structure to provide the 64 QAM modulation indication without requiring a different coding for the HS-SCCH when 64QAM modulation usage is enabled, or reducing the error correction coding that can be applied when 64 QAM modulation is enabled.

[0012] US 2004/0028020 discloses a method an system for transport block size signalling where information including a first modulation scheme, first transport block size, and first redundancy version many be transmitted. The first transport block size and first redundancy version each are represented by a set number of bits. A packet is transmitted using a first modulation scheme. Second information is transmitted including a second modulation scheme, second transport block size and second redundancy version. The second transport block size is represented by a set number of bits larger than the number of bits representing the first transport block size.

SUMMARY OF THE INVENTION

[0013] In one aspect, the invention concerns a method according to claim 1.

[0014] In another aspect, the invention concerns an apparatus according to claim ~~7.~~ 3.

[0015] In another aspect, there is a mobile terminal according to claim ~~12.~~ 5.

[0016] In another aspect, there is a node according to claim ~~13.~~ 6.

[0017] In another aspect, there is an access point according to claim ~~14.~~ 7.

[0018] In another aspect, there is a computer program according to claim ~~15.~~ 8.

BRIEF DESCRIPTION OF THE FIGURES

[0019]

Figure 1 is a schematic representation of a cellular telecommunications system showing signaling between a UE or mobile terminal and a base station in a cell.

Figure 2 is a timing diagram showing the timing relation between the HS-SCCH and the HS-PDSCH.

Figure 3A shows the channelization code-set bits in HS-SCCH part 1 structure as they are currently interpreted in

the normal manner.

Figure 3B shows the channelization code-set bits in HS-SCCH part 1 structure as they are interpreted in accordance with the present invention.

Figures 4A and 4B show flow charts of the basic steps of some embodiments of the present invention.

Figure 5 shows a QPSK/xQAM signaling support enabled apparatus according to some embodiments of the present invention.

Figure 6A shows a schematic representation of a MIMO wireless communication system in which a "rank indication" bit is used for informing how the 7 channelization code set information bits are interpreted as the modulation indication of the second data stream.

Figure 6B shows the channelization code-set bits in a HS-SCCH part 1 structure as they are interpreted according to some embodiments of the invention in MIMO wireless communication systems.

Figure 7A is a functional block diagram of an example of a signal processor for carrying out the invention.

Figure 7B is a functional block diagram of an example of a UE or mobile terminal having QPSK/xQAM signaling support according to some embodiments of the present invention.

Figure 8 is a block diagram/ flow diagram of a wireless communication system in which the present invention may be implemented, including various communication terminals, and in particular a user equipment (UE) terminal and a wireless terminal of a radio access network (RAN).

Figure 9 is a reduced block diagram (only portions relevant to the invention being shown) of the UE terminal or the wireless terminal of the RAN of Figure 8.

Figure 10 is a reduced block diagram of two communications terminals of Figure 8 in terms of a multi-layered communication protocol stack.

Figure 11 is a reduced block diagram of the user equipment terminal and the wireless terminal of the radio access network in terms of functional blocks corresponding to hardware equipment used in sending and receiving communication signals over an air interface communication channel linking the two communications terminals.

Figure 12 shows an example of an E-UTRAN architecture with which the concept according to some embodiments of the invention may be used.

WRITTEN DESCRIPTION OF EXEMPLARY EMBODIMENTS OF THE INVENTION

[0020] Figure 4A shows a flowchart generally indicated as 6 having the basic steps 6a, 6b and 6c for implementing the inventive method according to some embodiments of the present invention, including steps for interpreting the modulation indication bit in the HS-SCCH structure as an indication of QPSK/xQAM if both the user equipment (UE) and the serving cell support 64QAM (step 6a).

[0021] If QPSK is indicated, then the 7 code information bits or channelization code-set bits in the HS-SCCH structure part 1 are interpreted as currently interpreted as defined in the 3GPP release 5 specification (step 6b). In Figure 3A, the first three bits represent the group code indicator with the first bit of the three being the most significant bit. The last four bits represent the code offset indication with the first bit of the last four bits being the most significant bit.

[0022] If xQAM is indicated, then the 7 code information bits or channelization code-set bits in the HS-SCCH structure part 1 are interpreted as schematically shown in Figure 3B for example such that only 6 bits are used for code information for example the first 6 bits, and one bit is used for 16QAM/64QAM selection for example the seventh bit (step 6c). In Figure 3B, the first three bits represent the group code indicator with the first bit of the three bits being the most significant bit. The next three bits represent the code offset indicator with the first bit if the three bits being the most significant bit. The last or seventh bit is stolen and represents the QAM selection indicator, for example, a "0" may be used to indicate a 16QAM selection and a "1" may be used to indicate a 64QAM selection. Obviously, the "0" and "1" may be reversed with a "1" indicating a 16QAM selection and a "0" indicating a 64QAM selection. Thus, the last or seventh channelization code-set bit is stolen to provide the choice between 16QAM and 64QAM.

[0023] The scope of the invention is not intended to be limited to the order in which the steps in Figure 4A are performed. The steps 6a, 6b, 6c may be implemented in one or more modules configured to do the same and located in suitable user equipment, terminals, nodes, access points or devices, for example a mobile terminal.

[0024] Figure 4B shows a flowchart generally indicated as 8 having steps 8a -8k for implementing the inventive method according to some embodiments of the present invention including determining if the cell and user equipment support 64QAM (steps 8a, 8b), if QPSK or QAM is indicated (steps 8c, 8d), and if QPSK is indicated interpreting the seven information bits as currently defined in 3PGG specification release 5 (step 8e), or if QAM is indicated interpreting six bits of HS-SCCH part 1 for code information (step 8f), and interpreting the seventh bit of HS-SCCH part 1 for xQAM selection (step 8g), testing the seventh bit to determine if it is a "zero" or a "one" (steps 8h, 8j) and if a "zero" selecting xQAM as 16QAM (step 8i), and if a "one" selecting xQAM as 64QAM (step 8k). The scope of the invention is not intended to be limited to the order in which the steps in Figure 4B are performed for example, the order of determining whether the user equipment and/or the cell supports 64QAM can be determined in any order.

[0025] It is understood that the aforementioned methods as shown for example in Figures 4A and 4B may include other steps known in the art that do not form part of the underlying invention.

[0026] The basic premise according to some embodiments of the present invention is to interpret the current modulation indication bit in the HS-SCCH structure as a QPSK/xQAM indication if both the UE and the cell support 64QAM. If QPSK is indicated, then the 7 code information bits in the HS-SCCH part 1 is interpreted as is presently interpreted today according to 3GPP release 5 specifications. If xQAM is indicated (the modulation bit indicates 16QAM according to the 3GPP release 5 specifications, but 64QAM support has been enabled to the receiver), then the 7 code information bits in the HS-SCCH part 1 is interpreted in accordance with the present invention such that only 6 bits are used for code information and one bit is used to indicate the 16QAM/64QAM selection.

[0027] In accordance with some embodiments the invention may be implemented as described in the following example.

[0028] A modulation indication bit $X_{ms,1}$ is derived from the modulation and given by the following condition:

$$X_{ms,1} = \begin{cases} 0 \text{ if QPSK} \\ 1 \text{ otherwise} \end{cases}$$

[0029] At the present time and in accordance to 3GPP release 5 specifications, the 7 bits for channelization code set information are defined as set forth in TS25.212.

~~**[0030]** The channelization code-set bits $X_{ccs,1}, X_{ccs,2}, \ldots, X_{ccs,7}$ are coded according to the following condition: given P (multi-)codes starting at code O, and given the HS-SCCH number, if 64QAM is configured for the user equipment (UE) and $x_{ms,1}$=1, calculating the information field using the unsigned binary representation of integers calculated by the expressions, for the first three bits (code group indicator) of which $x_{ccs,1}$ is the MSB: $x_{ccs,1}, x_{ccs,2}, x_{ccs,3}$ = min(P-1,15-P); or if 64QAM is not configured for the user equipment (UE), or if 64QAM is configured and $x_{ms,1}$=0, then for the last four bits (code offset indicator) of which $x_{ccs,4}$ is the MSB: $x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,7}$ = |O-1-⌊P/8⌋*15|; otherwise if 64QAM is configured for the user equipment (UE) and $x_{ms,1}$=1, P and O shall fulfill |O-1-⌊P/8⌋*15|mod 2 = (HS-SCCH number) mod 2, and then $x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,dummy}$ = |O-1-⌊P/8⌋*15|, where $x_{ccs,dummy}$ is a dummy bit that is not transmitted on the HS-SCCH, and~~

$$x_{ccs,7} = \begin{cases} 0 \text{ if 16QAM} \\ 1 \text{ if 64QAM} \end{cases}.$$

~~**[0031]** The definitions of P and O are given in 3GPP TS25.213. The HS-SCCH number is given by the position in the list of HS-SCCH Channelization Code Information signaled by higher layers. The HS-SCCH number is associated with the code offset indicator and code group indicator as described above if 64QAM is configured for the UE and $x_{ms,1}$=1.~~

[0032] Figure 5 shows by way of example a user equipment in the form of a QPSK/xQAM signaling support enabled apparatus according to some embodiments of the present invention for the cellular telecommunications system as shown in Figure 1 or other suitably configured and arranged network. The QPSK/xQAM signaling support enabled apparatus has one or more modules configured for interpreting the modulation indication bit as a QPSK/xQAM modulation indication if both the user equipment and the serving cell support 64QAM modulation. Consistent with that, one or more modules are configured for interpreting the 7 code information bits in the HS-SCCH part 1 structure as currently interpreted as defined in 3GPP release 5 specification if QPSK is indicated, and one or modules are configured for interpreting the 7 code information bits in the HS-SCCH part 1 structure such that only 6 bits are used for code information and one bit is used for 16QAM/64QAM selection if xQAM is indicated. One or more modules are configured for deriving from the modulation a value of a modulation indication bit to indicate QPSK or otherwise. One or more other modules are configured for coding the channelization code-set bits where the first three bits are the code group indicator and the next three bits are the code offset indicator and wherein the 7th bit is stolen to indicate 16QAM or 64QAM selection.

[0033] In accordance with some other embodiments of the invention, the channelization code-set bits $x_{ccs,1}, x_{ccs,2}, \ldots, x_{ccs,7}$ are coded according to the following:

given P (multi-)codes starting at code O calculate the information-field using the unsigned binary representation of integers calculated by the expressions, for the first three bits (code group indicator) of which $x_{ccs,1}$ is the MSB: $x_{ccs,1}, x_{ccs,2}, x_{ccs,3}$ = min(P-1,15-P); for the last four bits (code offset indicator) of which $x_{ccs,4}$ is the MSB: $x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,7}$ = |O-1-[P/8]*15|.

[0034] The definitions of P and O are set forth in TS25.213.

[0035] The idea behind channelization code set information is that out of the 15 possible HS-DSCH codes, the bits

indicate which code is the first one and how many consecutive codes are to be used.

[0036] Now in accordance with some embodiments of the invention, the bits are interpreted in a novel way to realize additional modulation information signaling for HSDPA.

[0037] This interpretation is done by first modifying the interpretation of the start code to be {1,3,5,7,9,11,13,15} instead of {1,2,3,...,15}, and the bits are defined so that:

The channelization code-set bits $x_{ccs,1}$, $x_{ccs,2}$, ..., $x_{ccs,7}$ are coded according to the following:

given P (multi-)codes starting at code O calculate the information-field using the unsigned binary representation of integers calculated by the expressions, for the first three bits (code group indicator) of which $x_{ccs,1}$ is the MSB: $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$ = min(P-1,15-P); for the next three bits (code offset indicator) of which $x_{ccs,4}$ is the MSB: $x_{ccs,4}$, $x_{ccs,5}$, $x_{ccs,6}$ = |O-1-P/8*15|/2, and O is always an odd number.

[0038] For the last bit (16QAM/64QAM indicator) $x_{ccs,7}$:

$$x_{ccs,7} = \begin{cases} 0 & if \quad 16QAM \\ 1 & if \quad 64QAM \end{cases}$$

[0039] In other words only the three most significant bits of the code offset indicator are sent and the O is always assumed to be an odd number and the bit saved from the code offset indicator bits is used to indicate whether 16QAM or 64QAM modulation is used.

[0040] In accordance with some embodiments of the invention, one bit is stolen from the number of codes so that the number of HS-PDSCH codes is {1, 3, 5, ...,15} instead of {1,2,3,...,15}.

[0041] In accordance with some other embodiments of the invention, both the number of codes and the starting code is limited to odd numbers and have two bits available for additional signaling.

[0042] It is also pointed out that this mechanism could be used to deliver some other information for example, relative HS-PDSCH code power instead of or with additional modulation information. Thus, the method for stealing bits from the code-set information should be isolated from what the stolen bit/bits are actually used for. If possible this method for reinterpreting the code set information bits should also be separated from the usage of the QPSK/QAM modulation bit in the part 1 of HS-SCCH structure.

[0043] It should be pointed out that in some embodiments of the invention the granularity of the code allocations in the HS-DSCH transmission may be somewhat reduced.

[0044] In accordance with the inventive method of some embodiments, the present invention may be implemented with MIMO (Dual-stream transmit diversity) shown schematically for example in Figure 6A, in which the HS-SCCH indicates the UE of either one (single-stream) or two (dual-stream) separate parallel HSDPA data transmissions on HS-PDSCHs. The two streams may use different modulations. The part 1 of the MIMO HS-SCCH is expected to carry three new bits, two bits indicating the D-TxAA antenna weights specific to the MIMO operation and one bit indicating whether the transmission is using one or two data streams a "rank indication" for example as shown in Figure 6B. In Figure 6B, the first three bits represent the group indicator with the first bit being the most significant bit. The next three bits represent the code offset indicator with the first of the three bits being the most significant bit. The last or seventh bit represents the rank indicator to indicate whether the transmission is using one or two data streams. In the dual stream case the selection of how many codes are to be used can be coarser than in the single stream case.

[0045] In the above MIMO example, the "rank indication" bit could inform how the seven "channelization-code-set information" bits are to be interpreted. If the "rank indicator" indicates dual-stream transmission, then at least one of the "channelization-code-set-information" bits are interpreted as the modulation indication of the second stream when the modulation of the first stream (or the only stream in the case of single-stream transmission) is always interpreted the same way based on the "modulation scheme information" bit in the HS-SCCH, for example by the method of the basic premise according to some embodimants of the invention as described herein above.

[0046] Thus in summary with the MIMO example: If the "rank indication" bit indicates single stream transmission, then the 7 code information bits in HS-SCCH part 1 is interpreted as is presently interpreted today as defined in 3GPP release 5 specification. If the "rank indication" bit indicates dual stream transmission, the 7 code information bits in the HS-SCCH part 1 is interpreted in accordance with the inventive method of some embodiments of the present invention such that only 6 bits are used for code information and one bit is used to indicate the modulation selection (QPSK/16QAM) for the second stream.

[0047] The problem with MIMO operation is that when two streams are transmitted then the modulation needs to be indicated separately for both streams. It has been earlier agreed that the same number of codes will apply for both streams. It has also been shown that the dual-stream transmission case does not require full flexibility in indicating the number of codes to be used, but maintaining that flexibility with the single-stream transmission is desirable.

[0048] Thus one aspect of the concept of the inventive method of the present invention would be to indicate with the

"rank indicator" bit also how the code information bits are to be interpreted. When the single stream operation is used then the bits are interpreted normally as defined in the standard today or as defined in some of the other embodiments of the present invention as described herein. If the dual stream operation is used then at least one bit of the "channelization-code-set information" could be used to signal the modulation used in the second stream.

[0049] The interactions between the major logical elements and functions should be obvious to those skilled in the art for the level of detail needed to gain an understanding for implementing the present invention. It should be noted that some embodiments of the invention may be implemented with an appropriate signal processor such as shown in Figure 7A, a digital signal processor or other suitable processor to carry out the intended function of the invention.

[0050] Turning now to Figure 7B, a schematic functional block diagram of a user equipment (UE) for example a mobile terminal is illustrated therein showing the major operational functional components which may be required to carry out the intended functions of the mobile terminal and implement the concept of the invention. A processor such as the signal processor of Figure 7A carries out the computational and operational control of the mobile terminal in accordance with one or more sets of instructions stored in a memory. A user interface may be used to provide alphanumeric input and control signals by a user and is configured in accordance with the intended function to be carried out. A display sends and receives signals from the controller that controls the graphic and text representations shown on a screen of the display in accordance with the function being carried out.

[0051] The controller controls a transmit/receive unit that operates in a manner well known to those skilled in the art. The functional logical elements for indicating 64QAM support according to some embodiments of the present invention for example, the QPSK/xQAM signaling support enabled apparatus as shown in Figure 5 are suitably interconnected with the controller to carry out the modulation indication and interpretation of the channelization information codes as contemplated in accordance with some embodiments of the invention. An electrical power source such as a battery is suitably interconnected within the mobile terminal to carry out the functions described above. It will be recognized by those skilled in the art that the user equipment may be implemented in other ways other than that shown and described and may be implemented for example in a node, access point, or other suitably configured and arranged devices and apparatus.

[0052] The invention involves or is related to cooperation between elements of a communication system. Examples of a wireless communication system include implementations of GSM (Global System for Mobile Communication) and implementations of UMTS (Universal Mobile Telecommunication System). These elements of the communication systems are exemplary only and does not bind, limit or restrict the invention in any way to only these elements of the communication systems since the invention is likely to be used for B3G systems. Each such wireless communication system includes a radio access network (RAN). In UMTS, the RAN is called UTRAN (UMTS Terretrial RAN). A UTRAN includes one or more Radio Network Controllers (RNCs), each having control of one or more Node Bs, which are wireless terminals configured to communicatively couple to one or more UE terminals. The combination of an RNC and the Node Bs it controls is called a Radio Network System (RNS). A GSM RAN includes one or more base station controllers (BSCs), each controlling one or more base transceiver stations (BTSs). The combination of a BSC and the BTSs it controls is called a base station system (BSS).

[0053] Referring now to Figure 8, a wireless communication system 110a in which the present invention may be implemented is shown, including a UE terminal 111, a radio access network 112, a core network 114 and a gateway 115, coupled via the gateway to another communications system 110b, such as the Internet, wireline communication systems (including the so-called plain old telephone system), and/or other wireless communication systems. The radio access network includes a wireless terminal 112a (e.g. a Node B or a BTS) and a controller 112b (e.g. a RNC or a BSC). The controller is in wireline communication with the core network. The core network typically includes a mobile switching center (MSC) for circuit-switched communication, and a serving general packet radio service (GPRS) support node (SGSN) for packet-switched communication.

[0054] Figure 9 shows some components of a communication terminal 120, which could be either the UE terminal 111 or the RAN wireless terminal 112a of Figure 8. The communication terminal includes a processor 122 for controlling operation of the device, including all input and output. The processor, whose speed/timing is regulated by a clock 122a, may include a BIOS (basic input/output system) or may include device handlers for controlling user audio and video input and output as well as user input from a keyboard. The BIOS/ device handlers may also allow for input from and output to a network interface card. The BIOS and/or device handlers also provide for control of input and output to a transceiver (TRX) 126 via a TRX interface 125 including possibly one or more digital signal processors (DSPs), application specific integrated circuits (ASICs), and/or field programmable gate arrays (FPGAs). The TRX enables communication over the air with another similarly equipped communication terminal.

[0055] Still referring to Figure 9, the communication terminal includes volatile memory, i.e. so-called executable memory 123, and also non-volatile memory 124, i.e. storage memory. The processor 122 may copy applications (e.g. a calendar application or a game) stored in the non-volatile memory into the executable memory for execution. The processor functions according to an operating system, and to do so, the processor may load at least a portion of the operating system from the storage memory to the executable memory in order to activate a corresponding portion of the operating

system. Other parts of the operating system, and in particular often at least a portion of the BIOS, may exist in the communication terminal as firmware, and are then not copied into executable memory in order to be executed. The booting up instructions are such a portion of the operating system.

[0056] Referring now to Figure 10, the wireless communication system of Figure 8 is shown from the perspective of layers of a protocol according to which communication is performed. The layers of protocol form a protocol stack, and include CN protocol layers 132 located in the UE 111 and CN 114, and radio protocol layers 131a located in the UE terminal and in the RAN 112 (in either the RAN wireless terminal 112a or the RAN controller 112b). Communication is peer-to-peer. Thus, a CN protocol layer in the UE communicates with a corresponding layer in the CN, and vice versa, and the communication is provided via lower/intervening layers. The lower/intervening layers thus provide as a service to the layer immediately above them in the protocol stack the packaging or unpackaging of a unit of communication (a control signal or user data).

[0057] The CN protocols typically include one or more control protocol layers and/or user data protocol layers (e.g. an application layer, i.e. the layer of the protocol stack that interfaces directly with applications, such as a calendar application or a game application).

[0058] The radio protocols typically include a radio resource control (protocol) layer, which has as its responsibilities, among quite a few others, the establishment, reconfiguration, and release of radio bearers. Another radio protocol layer is a radio link control/ media access control layer (which may exist as two separate layers). This layer in effect provides an interface with the physical layer, another of the radio access protocol layers, and the layer that enables actual communication over the air interface.

[0059] The radio protocols are located in the UE terminal and in the RAN, but not the CN. Communication with the CN protocols in the CN is made possible by another protocol stack in the RAN, indicated as the radio/CN protocols stack. Communication between a layer in the radio/ CN protocols stack and the radio protocols stack in the RAN may occur directly, rather than via intervening lower layers. There is, as shown in Figure 9, a corresponding radio/ CN protocols stack located in the CN, allowing then communication between the application level in the UE terminal and the application level in the CN.

[0060] Figure 11 is a reduced block diagram of the UE communication terminal 111 and the RAN wireless communication terminal 112a of Figure 8, in terms of functional blocks corresponding to typically hardware (but in some cases software) equipment used in sending and receiving communication signals over a communication channel linking the two communications terminals 111, 112a. Both typically include a source coder 141a responsive to information to be transmitted, and a corresponding source decoder 141b. The source coder removes redundancy in the information not needed to communicate the information. Both also include a channel coder 142a and a corresponding channel decoder 142b. The channel coder typically adds redundancy that can be used to correct error, i.e. it performs forward error correction (FEC) coding. Both communication terminals also include a rate matcher 143a and corresponding inverse rate matcher 143b. The rate matcher adds or removes (by so-called puncturing) bits from the bit stream provided by the channel coder, in order to provide a bit stream at a rate compatible with the physical channel being used by the communication terminals. Both communication terminals also include an interleaver 145a and a deinterleaver 145b. The interleaver reorders bits (or blocks of bits) so that strings of bits representing related information are not contiguous in the output bit stream, thus making the communication more resistant to so-called bursty errors, i.e. to errors from temporary causes and so that affect the communication for only a limited time, and so affect only a portion of the communicated bit stream. Both communication terminals also include a modulator 147a and a demodulator 147b. The modulator 147a maps blocks of the bits provided by the interleaver to symbols according to a modulation scheme/ mapping (per a symbol constellation). The modulation symbols thus determined are then used by a transmitter 49a included in both communication terminals, to modulate one or more carriers (depending on the air interface, e.g. WCDMA, TDMA, FDMA, OFDM, OFDMA, CDMA2000, etc.) for transmission over the air. Both communication terminals also include a receiver 149b that senses and so receives the communication terminal and determines a corresponding stream of modulation symbols, which it passes to the demodulator 147b, which in turn determines a corresponding bit stream (possibly using FEC coding to resolve errors), and so on, ultimately resulting in a providing of received information (which of course may or may not be exactly the transmitted information). Usually, the channel decoder includes as components processes that provide so-called HARQ (hybrid automatic repeat request) processing, so that in case of an error not able to be resolved on the basis of the FEC coding by the channel coder, a request is sent to the transmitter (possibly to the channel coder component) to resend the transmission having the unresolvable error.

[0061] The functionality described above (for both the radio access network and the UE) can be implemented as software modules stored in a non-volatile memory, and executed as needed by a processor, after copying all or part of the software into executable RAM (random access memory). Alternatively, the logic provided by such software can also be provided by an ASIC (application specific integrated circuit). In case of a software implementation, the invention provided as a computer program product including a computer readable storage structure embodying computer program code--i.e. the software--thereon for execution by a computer processor.

[0062] The concept of the invention may be used in any wireless system including but not limited to B3G wireless

systems for example, Long Term Evolution (LTE) (also known as 3.9G), which refers to research and development involving the Third Generation Partnership Project (3GPP) aimed at identifying technologies and capabilities that can improve systems such as the UMTS.

[0063] Generally speaking, a prefix of the letter "E" in upper or lower case signifies LTE, although this rule may have exceptions. The E-UTRAN consists of eNBs (E-UTRAN Node B), providing the E-UTRA user plane (RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs interface to the access gateway (aGW) via the S1, and are inter-connected via the X2.

[0064] An example of the E-UTRAN architecture is illustrated in Figure 12. This example of E-UTRAN consists of eNBs, providing the E-UTRA user plane (RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNBs are interconnected with each other by means of the X2 interface. The eNBs are also connected by means of the S1 interface to the EPC (evolved packet core) more specifically to the MME (mobility management entity) and the UPE (user plane entity). The S1 interface supports a many-to-many relation between MMEs/UPEs and eNBs. The S1 interface supports a functional split between the MME and the UPE. The MMU/UPE in the example of Figure 10 is one option for the access gateway (aGW).

[0065] In the example of Figure 12, there exists an X2 interface between the eNBs that need to communicate with each other. For exceptional cases (e.g. inter-PLMN handover), LTE_ACTIVE inter-eNB mobility is supported by means of MME/UPE relocation via the S1 interface.

[0066] The eNB may host functions such as radio resource management (radio bearer control, radio admission control, connection mobility control, dynamic allocation of resources to UEs in both uplink and downlink), selection of a mobility management entity (MME) at UE attachment, routing of user plane data towards the user plane entity (UPE), scheduling and transmission of paging messages (originated from the MME), scheduling and transmission of broadcast information (originated from the MME or O&M), and measurement and measurement reporting configuration for mobility and scheduling. The MME/UPE may host functions such as the following: distribution of paging messages to the eNBs, security control, IP header compression and encryption of user data streams; termination of U-plane packets for paging reasons; switching of U-plane for support of UE mobility, idle state mobility control, SAE bearer control, and ciphering and integrity protection of NAS signaling.

[0067] The functionality described above (for both the radio access network and the UT) can be implemented as software modules stored in a non-volatile memory, and executed as needed by a processor, after copying all or part of the software into executable RAM (random access memory). Alternatively, the logic provided by such software can also be provided by an ASIC (application specific integrated circuit). In case of a software implementation, the invention provided as a computer program product including a computer readable storage structure embodying computer program code--i.e. the software--thereon for execution by a computer processor.

[0068] It is to be understood that the above-described arrangements are only illustrative of the application of the principles of the present invention. Numerous modifications and alternative arrangements may be devised by those skilled in the art without departing from the scope of the appended claims.

Claims

1. A method, comprising:
   interpreting (6a) ~~a~~ the High Speed Downlink Packet Access, HSDPA, modulation indication bit as a quadrature phase shift keying/ quadrature amplitude modulation indication if both a user equipment and a serving cell support 64 quadrature amplitude modulation according to the following condition:

   if the HSDPA modulation indication bit indicates quadrature phase shift keying, interpreting (6b) 7 channelization code-set information bits in a ~~h~~High-~~s~~Speed-~~s~~Shared-~~e~~Control-~~e~~Channel, HS-SCCH, part 1 structure as currently interpreted as defined in the 3GPP release 5 specification such that the first three bits of the channelization code-set information bits represent a group code indicator and the last four bits of the channelization code-set information bits represent a code offset indication; and
   if the HSDPA modulation indication bit indicates quadrature amplitude modulation, interpreting (6c) the 7 channelization code-set information bits in HS-SCCH part 1 structure such that only 6 bits of the channelization code-set information bits are interpreted as code-set information and one bit of the channelization code-set information bits is interpreted as selection between 16 quadrature amplitude modulation and 64 quadrature amplitude modulation.

2. The method according to claim 1 further comprising the HSDPA modulation indication bit being $X_{ms,i}$ wherein if $X_{ms,i} = 0$ the modulation is quadrature phase shift keying and if $X_{ms,i} = 1$ the modulation is quadrature amplitude modulation.

3. The method according to claim 2 further comprising coding the 7 channelization code set information bits $X_{ccs,1}$, $X_{ccs,2}$, $X_{ccs,3}$, $X_{ccs,4}$, $X_{ccs,5}$, $X_{ccs,6}$, $X_{ccs,7}$ according to the following condition:

given P codes, or P multicodes, or P codes and multicodes starting at code O, and given a high speed shared control channel number, if64 quadrature amplitude modulation is configured for the user equipment and $X_{ms,1}$=1, calculating an information field using an unsigned binary representation of integers calculated by the expressions,
for the first three bits of which $x_{ccs,1}$ is the most significant bit, MSB: $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$ = min(P-1,15-P); or if 64 quadrature amplitude modulation is not configured for the user equipment, or if 64 quadrature amplitude modulation is configured and $x_{ms,1}$=0, then for the last four bits of which $x_{ccs,4}$ is the MSB:

$$x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,7} = |O-1-\lfloor P/8 \rfloor * 15|;$$

otherwise if 64 quadrature amplitude modulation is configured for the user equipment and $x_{ms,1}$=1, P and O shall fulfil |O-1-LP/8J*15| mod 2 = (high-speed-shared-control-channel-number)mod 2, and then $x_{ccs,4}$, $x_{ccs,5}$, $x_{ccs,6}$, $x_{ccs,dummy}$ = |O-1-LP/8J*15|, where $x_{ccs,dummy}$ is a dummy bit that is not transmitted on the high-speed shared-control-channel, and $X_{ccs,7}$ =
0 if 16 quadrature amplitude modulation is configured for the user equipment or $X_{ccs,7}$ =
1 if 64 quadrature amplitude modulation is configured for the user equipment.

4. The method according to claim 3 wherein the high-speed-shared-control-channel-number is given by a position in a list of high-speed-shared-control-channel-channelization-code-information signalled by higher layers.

5. The method according to claim 3 wherein the high-speed-shared-control-channel-number is associated with the code-offset-indicator and the code-group-indicator if 64-quadrature-amplitude-modulation is configured for the user equipment and $x_{ms,1}$=1.

6. The method according to claim 3 further comprising indicating the modulation of a second data stream in multiple-input multiple-output signalling in which the high-speed-shared-control-channel-structure indicates the user equipment as either a single-stream or a dual-stream separate-parallel high-speed-data-packet-access-data-transmission on high-speed-physical-downlink-shared-channels in which a rank indicator bit in the HS-SCCH part 1 structure indicates whether one or two data streams are being transmitted.

7. 3. An apparatus, comprising:

means for interpreting a the High-Speed Downlink Packet Access, HSDPA, modulation indication bit as a quadrature phase shift keying/ quadrature amplitude modulation indication if both a user equipment and a serving cell in a cellular telecommunications network support 64 quadrature amplitude modulation;
means for, if the HSDPA modulation indication bit indicates quadrature phase shift keying, interpreting 7 channelization code-set information bits in hHigh-sSpeed-sShared-cControl-cChannel, HS-SCCH, part 1 structure as currently inter-preted as defined in the 3GPP release 5 specification such that the first three bits of the channelization code-set information bits represent a group code indicator and the last four bits of the channelization code-set infor-mation bits represent the code offset indication; and
means for, if the HSDPA modulation indication bit indicates quadrature amplitude modulation, interpreting the 7 chan-nelization code-set information bits in HS-SCCH part 1 structure such that only 6 bits of the channelization code-set information bits are interpreted as code-set information and one bit of the channelization code-set information bits is interpreted as selection between for 16 quadrature amplitude modulation and 64 quadrature amplitude modulation.

8. 4. The apparatus according to claim 7 3 further comprising the HSDPA modulation indication bit being $X_{ms,1}$=1 wherein if $X_{ms,i}$ = 0 the modulation is quadrature phase shift keying and if $X_{ms,i}$ =1 the modulation is quadrature amplitude modulation.

9. The apparatus according to claim 8 further comprising:
means for coding the 7 channelization code-set information bits $X_{ccs,1}$, $X_{ccs,2}$, $X_{ccs,3}$, $X_{ccs,4}$, $X_{ccs,5}$, $X_{ccs,6}$, $X_{ccs,7}$ according to the following condition:
given P codes, or P multicodes, or P multicodes and codes starting at code O, and given a high speed shared

~~control channel number, if 64 quadrature amplitude modulation is configured for the user equipment and $X_{ms,1}$=1, calculating an information field using an unsigned binary representation of integers calculated by the expressions,~~

~~for the first three bits of which $x_{ccs,7}$ is the most significant bit, MSB: $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$ = min(P-1,15-P); or if 64 quadrature amplitude modulation is not configured for the user equipment, or if 64QAM is configured and $x_{ms,1}$=0, then for the last four bits of which $x_{ccs,4}$ is the MSB:~~

$$x_{ccs,4},\ x_{ccs,5},\ x_{ccs,6},\ x_{ccs,7} = |O-1-\lfloor P/8 \rfloor * 15|,$$

~~otherwise if 64 quadrature amplitude modulation is configured for the user equipment and $X_{ms,1}$=1, P and O shall fulfil $|O-1-\lfloor P/8 \rfloor * 15|$ mod 2 = (high speed shared control channel number) mod 2, and then $x_{ccs,4}$, $x_{ccs,5}$, $x_{ccs,6}$, $x_{ccs,dummy}$ = $|O-1-\lfloor P/8 \rfloor * 15|$, where $x_{ccs,dummy}$ is a dummy bit that is not transmitted on the high speed shared control channel, and $X_{ccs,7}$ =~~

~~0 if 16 quadrature amplitude modulation is configured for the user equipment or $X_{ccs,7}$ = 1 if 64 quadrature amplitude modulation is configured for the user equipment.~~

~~10. The apparatus according to claim 9 further comprising means for preparing the HS-SCCH part 1 structure signal for transmission, and means for providing the HS-SCCH part 1 structure signal for transmission.~~

~~11. The apparatus according to claim 9 further comprising means for preparing a x quadrature amplitude modulation capability signal for transmission, and means for providing the x quadrature amplitude modulation capability signal for transmission, and means for transmitting the x quadrature amplitude modulation capability signal.~~

12. 5. A mobile terminal comprising an apparatus according to claim ~~7.~~ 3.

13. 6. A node comprising an apparatus according to claim ~~7.~~ 3.

14. 7. An access point comprising an apparatus according to claim ~~7.~~ 3.

15. 8. A computer program product comprising instructions which, when the program is executed by a computer, cause the computer to carry out the method according to claims 1 to ~~6.~~ 2.

Patentansprüche

1. Verfahren, umfassend:
Interpretieren (6a) eines Modulationsindikationsbits als eine Quadraturphasenumtastung-/ Quadraturamplitudenmodulation-Indikation, falls sowohl ein Benutzergerät als auch eine versorgende Zelle eine 64-Quadraturamplitudenmodulation unterstützen, gemäß der folgenden Bedingung:

   falls das Modulationsindikationsbit eine Quadraturphasenumtastung angibt, Interpretieren (6b) von 7 Kanalisierungscodesatz-Informationsbits in einer Struktur von Teil 1 eines schnellen gemeinsam genutzten Steuerkanals bzw. HS-SCCH als gegenwärtig als in der 3GPP-Release-5-Spezifikation definiert interpretiert, sodass die ersten drei Bits der Kanalisierungscodesatz-Informationsbits einen Gruppencodeindikator repräsentieren und die letzten vier Bits der Kanalisierungscodesatz-Informationsbits eine Codeoffsetindikation repräsentieren; falls das Modulationsindikationsbit eine Quadraturamplitudenmodulation angibt, Interpretieren (6c) der 7 Kanalisierungscodesatz-Informationsbits in einer HS-SCCH-Teil-1-Struktur, sodass nur 6 Bits der Kanalisierungscodesatz-Informationsbits als Codesatzinformationen interpretiert werden und ein Bit der Kanalisierungscodesatz-Informationsbits als eine Auswahl zwischen einer 16-Quadraturamplitudenmodulation und einer 64-Quadraturamplitudenmodulation interpretiert wird.

2. Verfahren nach Anspruch 1, ferner umfassend, dass das Modulationsindikationsbit $X_{ms,i}$ ist, wobei, falls $X_{ms,i}$ = 0, die Modulation eine Quadraturphasenumtastung ist, und, falls $X_{ms,i}$ = 1, die Modulation eine Quadraturamplitudenmodulation ist.

3. Verfahren nach Anspruch 2, ferner umfassend Codieren der 7 Kanalisierungscodesatz-Informationsbits $X_{ccs,1}$, $X_{ccs,2}$, $X_{ccs,3}$, $X_{ccs,4}$, $X_{ccs,5}$, $X_{ccs,6}$, $X_{ccs,7}$ gemäß der folgenden Bedingung:

wenn P Codes oder P Multicodes oder P Codes und Multicodes, die bei Code O beginnen, gegeben sind, und wenn eine Nummer des schnellen gemeinsam genutzten Steuerkanals gegeben ist, falls eine 64-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist und $X_{ms,1} = 1$, Berechnen eines Informationsfelds unter Verwendung einer unsignierten binären Repräsentation von ganzen Zahlen, die durch die Ausdrücke berechnet werden, für die ersten drei Bits, von denen $x_{ccs,1}$ das höchstwertigste Bit bzw. MSB ist: $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$ = min(P-1, 15-P); oder
falls eine 64-Quadraturamplitudenmodulation nicht für das Benutzergerät konfiguriert ist oder falls eine 64-Quadraturamplitudenmodulation konfiguriert ist und $x_{ms,1} = 0$, dann für die letzten vier Bits, von denen $x_{ccs,4}$ das MSB ist:

$$x_{ccs,4},\ x_{ccs,5},\ x_{ccs,6},\ x_{ccs,7} = |O - 1 - \lfloor P/8 \rfloor * 15|;$$

ansonsten, falls eine 64-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist und $x_{ms,1} = 1$, sollen P und O $|O\text{-}1\text{-}\lfloor P/8 \rfloor * 15|$ mod 2 = (Nummer des schnellen gemeinsam genutzten Steuerkanals) mod 2 erfüllen, und dann $x_{ccs,4}$, $x_{ccs,5}$, $x_{ccs,6}$, $x_{ccs,dummy} = |O\text{-}1\text{-}\lfloor P/8 \rfloor * 15|$, wobei $x_{ccs,dummy}$ ein Dummy-Bit ist, das nicht auf dem schnellen gemeinsam genutzten Steuerkanal übertragen wird, und $X_{ccs,7}$ =
0, falls eine 16-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist, oder $X_{ccs,7}$ =
1, falls eine 64-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist.

4. Verfahren nach Anspruch 3, wobei die Nummer des schnellen gemeinsam genutzten Steuerkanals durch eine Position in einer Liste von Kanalisierungscodeinformationen des schnellen gemeinsam genutzten Steuerkanals gegeben wird, die durch höhere Schichten signalisiert werden.

5. Verfahren nach Anspruch 3, wobei die Nummer des schnellen gemeinsam genutzten Steuerkanals mit dem Codeoffsetindikator und dem Codegruppenindikator assoziiert ist, falls eine 64-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist und $x_{ms,1} = 1$.

6. Verfahren nach Anspruch 3, ferner umfassend Angeben der Modulation eines zweiten Datenstroms in einer Signalisierung mit mehreren Eingängen und mehreren Ausgängen, bei der die Struktur des schnellen gemeinsam genutzten Steuerkanals das Benutzergerät als entweder eine schnelle Einzelstrom- oder separate parallele Doppelstrom-Datenpaket-Zugangsdatenübertragung auf schnellen physischen gemeinsam genutzten Abwärtsstreckenkanälen angibt, in denen ein Rangindikatorbit in der HS-SCCH-Teil-1-Struktur angibt, ob ein oder zwei Datenströme übertragen werden.

7. Vorrichtung, umfassend:

Mittel zum Interpretieren eines Modulationsindikationsbits als eine Quadraturphasenumtastung-/ Quadraturamplitudenmodulation-Indikation, falls sowohl ein Benutzergerät als auch eine versorgende Zelle in einem zellularen Telekommunikationsnetz eine 64-Quadraturamplitudenmodulation unterstützen;
Mittel, falls das Modulationsindikationsbit eine Quadraturphasenumtastung angibt, zum Interpretieren von 7 Kanalisierungscodesatz-Informationsbits in einer Struktur von Teil 1 eines schnellen gemeinsam genutzten Steuerkanals bzw. HS-SCCH als gegenwärtig als in der 3GPP-Release-5-Spezifikation definiert interpretiert, sodass die ersten drei Bits der Kanalisierungscodesatz-Informationsbits einen Gruppencodeindikator repräsentieren und die letzten vier Bits einer Kanalisierungscodesatz-Informationsbits die Codesatzoffsetindikation repräsentieren; und
Mittel, falls das Modulationsindikationsbit eine Quadraturamplitudenmodulation angibt, zum Interpretieren der 7 Kanalisierungscodesatz-Informationsbits in der HS-SCCH-Teil-1-Struktur, sodass nur 6 Bits der Kanalisierungscodesatz-Informationsbits als Codeinformationen interpretiert werden und ein Bit der Kanalisierungscodesatz-Informationsbits als eine Auswahl zwischen einer 16-Quadraturamplitudenmodulation und einer 64-Quadraturamplitudenmodulation interpretiert wird.

8. Vorrichtung nach Anspruch 7, ferner umfassend, dass das Modulationsindikationsbit $X_{ms,1}$=1 ist, wobei, falls $X_{ms,i}$ = 0, die Modulation eine Quadraturphasenumtastung ist, und, falls $X_{ms,i} = 1$, die Modulation eine Quadraturamplitudenmodulation ist.

9. Vorrichtung nach Anspruch 8, ferner umfassend:
Mittel zum Codieren der 7 Kanalisierungscodesatz-Informationsbits $X_{ccs,1}$, $X_{ccs,2}$, $X_{ccs,3}$, $X_{ccs,4}$, $X_{ccs,5}$, $X_{ccs,6}$, $X_{ccs,7}$

gemäß der folgenden Bedingung:

wenn P Codes oder P Multicodes oder P Multicodes und Codes, die bei Code O beginnen, gegeben sind, und wenn eine Nummer des schnellen gemeinsam genutzten Steuerkanals gegeben ist, falls eine 64-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist und $X_{ms,1} = 1$, Berechnen eines Informationsfelds unter Verwendung einer unsignierten binären Repräsentation von ganzen Zahlen, die durch die Ausdrücke berechnet werden,
für die ersten drei Bits, von denen $x_{ccs,1}$ das höchstwerigste Bit bzw. MSB ist: $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$ = min(P-1, 15-P); oder
falls eine 64-Quadraturamplitudenmodulation nicht für das Benutzergerät konfiguriert ist oder falls eine 64-QAM konfiguriert ist und $x_{ms,1} = 0$, dann für die letzten vier Bits, von denen $x_{ccs,4}$ das MSB ist:

$$x_{ccs,4},\ x_{ccs,5},\ x_{ccs,6},\ x_{ccs,7} = |O - 1 - \lfloor P/8 \rfloor * 15|;$$

ansonsten, falls eine 64-Qadraturampltudenmodulation für das Benutzergerät konfiguriert ist und $x_{ms,1} = 1$, sollen P und O $|O\text{-}1\text{-}\lfloor P/8 \rfloor * 15| \bmod 2$ = (Nummer des schnellen gemeinsam genutzten Steuerkanals) mod 2 erfüllen, und dann $x_{ccs,4}$, $x_{ccs,5}$, $x_{ccs,6}$, $x_{ccs,dummy} = |O\text{-}1\text{-}\lfloor P/8 \rfloor * 15|$, Wobei $x_{ccs,dummy}$ ein Dummy-Bit ist, das nicht auf dem schnellen gemeinsam genutzten Steuerkanal übertragen wird, und $X_{ccs,7}$ = 0, falls eine 16-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist, oder $X_{ccs,7} = 1$, falls eine 64-Quadraturamplitudenmodulation für das Benutzergerät konfiguriert ist.

10. Vorrichtung nach Anspruch 9, ferner umfassend Mittel zum Vorbereiten des HS-SCCH-Teil-1-Struktur-Signals zur Übertragung und Mittel zum Bereitstellen des HS-SCCH-Teil-1-Struktur-Signals zur Übertragung.

11. Vorrichtung nach Anspruch 9, ferner umfassend Mittel zum Vorbereiten eines x-Quadraturamplitudenmodulation-Fähigkeitssignals zur Übertragung und Mittel zum Bereitstellen des x-Quadraturamplitudenmodulation-Fähigkeitssignals zur Übertragung und Mittel zum Übertragen des x-Quadraturamplitudenmodulation-Fähigkeitssignals.

12. Mobiles Endgerät, umfassend eine Vorrichtung nach Anspruch 7.

13. Knoten, umfassend eine Vorrichtung nach Anspruch 7.

14. Zugangspunkt, umfassend eine Vorrichtung nach Anspruch 7.

15. Computerprogrammprodukt, das Anweisungen umfasst, die, wenn das Programm durch einen Computer ausgeführt wird, bewirken, dass der Computer das Verfahren nach den Ansprüchen 1 bis 6 ausführt.

Revendications

1. Procédé comprenant :
l'interprétation (6a) d'un bit d'indication de modulation en tant qu'indication de modulation par déplacement de phase en quadrature/modulation d'amplitude en quadrature si à la fois un équipement utilisateur et une cellule de desserte prennent en charge une modulation d'amplitude en quadrature à 64 états en fonction de la condition suivante :

si le bit d'indication de modulation indique une modulation par déplacement de phase en quadrature, l'interprétation (6b) de 7 bits d'informations d'ensemble de codes de canalisation dans une structure de partie 1 de canal de commande partagé à haut débit, HS-SCCH, comme étant interprétés à présent tels que définis dans la spécification 3 GPP version 5 de telle sorte que les trois premiers bits des bits d'informations d'ensemble de codes de canalisation représentent un indicateur de code de groupe et les quatre derniers bits des bits d'informations d'ensemble de codes de canalisation représentent une indication de décalage de code ; et
si le bit d'indication de modulation indique une modulation d'amplitude en quadrature, l'interprétation (6c) des 7 bits d'informations d'ensemble de codes de canalisation dans la structure de partie 1 de canal HS-SCCH de telle sorte que seuls six bits des bits d'informations d'ensemble de codes de canalisation sont interprétés comme étant des informations d'ensemble de codes et un bit des bits d'informations d'ensemble de codes de canalisation est interprété comme étant une sélection entre une modulation d'amplitude en quadrature à 16 états et une modulation d'amplitude en quadrature à 64 états.

2. Procédé selon la revendication 1, comprenant en outre le bit d'indication de modulation qui est $X_{ms,i}$, dans lequel, si $X_{ms,i} = 0$, la modulation est une modulation par déplacement de phase en quadrature et, si $X_{ms,i} = 1$, la modulation est une modulation d'amplitude en quadrature.

3. Procédé selon la revendication 2, comprenant en outre le codage des 7 bits d'informations d'ensemble de codes de canalisation $X_{ccs,1}$, $X_{ccs,2}$, $X_{ccs,3}$, $X_{ccs,4}$, $X_{ccs,5}$, $X_{ccs,6}$, $X_{ccs,7}$, en fonction de la condition suivante :

étant donné P codes, ou P multicodes, ou P codes et multicodes commençant au code O, et étant donné un numéro de canal de commande partagé à débit élevé, si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur et si $X_{ms,1} = 1$, le calcul d'un champ d'informations à l'aide d'une représentation binaire non signée de nombres entiers calculée par les expressions,
pour les trois premiers bits dont $x_{ccs,1}$ est le bit le plus significatif, MSB : $x_{ccs,1}, x_{ccs,2}, x_{ccs,3} = \min(P - 1,15 - P)$; ou si une modulation d'amplitude en quadrature à 64 états n'est pas configurée pour l'équipement utilisateur ou si une modulation d'amplitude en quadrature à 64 états est configurée et si $X_{ms,1} = 0$, alors pour les quatre derniers bits dont $x_{ccs,4}$ est le MSB :

$$x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,7} = |O - 1 - \lfloor P/8 \rfloor * 15| ;$$

sinon, si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur et si $X_{ms,1} = 1$, P et O répondront à $|O - 1 - \lfloor P/8 \rfloor * 15| \bmod 2 =$ (numéro de canal de commande partagé à haut débit) mod 2 et alors $x_{ccs,4}, x_{ccs,5}, x_{ccs,6}, x_{ccs,factice} = |O - 1 - \lfloor P/8 \rfloor * 15|$, où $x_{ccs,factice}$ est un bit factice qui n'est pas transmis sur le canal de commande partagé à haut débit, et $X_{ccs,7} =$
0 si une modulation d'amplitude en quadrature à 16 états est configurée pour l'équipement utilisateur ou $X_{ccs,7} =$ 1 si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur.

4. Procédé selon la revendication 3, dans lequel le numéro de canal de commande partagé à haut débit est donné par une position dans une liste d'informations de code de canalisation de canal de commande partagé à haut débit signalée par des couches supérieures.

5. Procédé selon la revendication 3, dans lequel le numéro de canal de commande partagé à haut débit est associé à l'indicateur de décalage de code et à l'indicateur de groupe de codes si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur et si $X_{ms,1} = 1$.

6. Procédé selon la revendication 3, comprenant en outre l'indication de la modulation d'un second flux de données dans une signalisation à entrées multiples et à sorties multiples dans laquelle la structure de canal de commande partagé à haut débit indique à l'équipement utilisateur une transmission de données d'accès aux paquets de données à haut débit parallèle distincte soit à simple flux, soit à double flux sur des canaux partagés de liaison descendante physique à haut débit dans lesquels un bit d'indicateur de rang dans la structure de partie 1 de canal HS-SCCH indique si un ou deux flux de données sont transmis.

7. Appareil comprenant :

des moyens pour interpréter un bit d'indication de modulation en tant qu'indication de modulation par déplacement de phase en quadrature/modulation d'amplitude en quadrature si à la fois un équipement utilisateur et une cellule de desserte dans un réseau de télécommunication cellulaire prennent en charge une modulation d'amplitude en quadrature à 64 états ;
des moyens, si le bit d'indication de modulation indique une modulation par déplacement de phase en quadrature, pour interpréter 7 bits d'informations d'ensemble de codes de canalisation dans une structure de partie 1 de canal de commande partagé à haut débit, HS-SCCH, comme étant interprétés à présent tels que définis dans la spécification 3 GPP version 5 de telle sorte que les trois premiers bits des bits d'informations d'ensemble de codes de canalisation représentent un indicateur de code de groupe et les quatre derniers bits des bits d'informations d'ensemble de codes de canalisation représentent l'indication de décalage de code ; et
des moyens, si le bit d'indication de modulation indique une modulation d'amplitude en quadrature, pour interpréter les 7 bits d'informations d'ensemble de codes de canalisation dans la structure de partie 1 de canal HS-SCCH de telle sorte que seuls six bits des bits d'informations d'ensemble de codes de canalisation sont interprétés comme étant des informations d'ensemble de codes et un bit des bits d'informations d'ensemble de codes de canalisation est interprété comme étant une sélection entre une modulation d'amplitude en quadrature

à 16 états et une modulation d'amplitude en quadrature à 64 états.

8. Appareil selon la revendication 7, comprenant en outre le bit d'identification de modulation qui est $X_{ms,1}$=1, dans lequel, si $X_{ms,i}$ = 0, la modulation est une modulation par déplacement de phase en quadrature et, si $X_{ms,i}$ = 1, la modulation est une modulation d'amplitude en quadrature.

9. Appareil selon la revendication 8, comprenant en outre :
des moyens pour coder les 7 bits d'informations d'ensemble de codes de canalisation $X_{ccs,1}$, $X_{ccs,2}$, $X_{ccs,3}$, $X_{ccs,4}$, $X_{ccs,5}$, $X_{ccs,6}$, $X_{ccs,7}$, en fonction de la condition suivante :

étant donné P codes, ou P multicodes, ou P multicodes et codes commençant au code O, et étant donné un numéro de canal de commande partagé à débit élevé, si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur et si $X_{ms,1}$ = 1, le calcul d'un champ d'informations à l'aide d'une représentation binaire non signée de nombres entiers calculée par les expressions,
pour les trois premiers bits dont $x_{ccs,1}$ est le bit le plus significatif, MSB : $x_{ccs,1}$, $x_{ccs,2}$, $x_{ccs,3}$ = min(P - 1,15 - P) ; ou si une modulation d'amplitude en quadrature à 64 états n'est pas configurée pour l'équipement utilisateur ou si une modulation d'amplitude en quadrature (QAM) à 64 états est configurée et si $X_{ms,1}$ = 0, alors pour les quatre derniers bits dont $x_{ccs,4}$ est le MSB :

$$x_{ccs,4},\ x_{ccs,5},\ x_{ccs,6},\ x_{ccs,7} = |O - 1 - \lfloor P/8 \rfloor * 15| \ ;$$

sinon, si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur et si $X_{ms,1}$ = 1, P et O répondront à |O - 1 - ⌊P/8⌋*1-5|mod 2 = (numéro de canal de commande partagé à haut débit)mod 2 et alors $x_{ccs,4}$, $x_{ccs,5}$, $x_{ccs,6}$, $x_{ccs,factice}$ = |O - 1 - ⌊P/8⌋*15|, où $x_{ccs,factice}$ est un bit factice qui n'est pas transmis sur le canal de commande partagé à haut débit, et $X_{ccs,7}$ = 0 si une modulation d'amplitude en quadrature à 16 états est configurée pour l'équipement utilisateur ou $X_{ccs,7}$ = 1 si une modulation d'amplitude en quadrature à 64 états est configurée pour l'équipement utilisateur.

10. Appareil selon la revendication 9, comprenant en outre des moyens pour préparer le signal de structure de partie 1 de canal HS-SCCH pour une transmission et des moyens pour fournir le signal de structure de partie 1 de canal HS-SCCH pour une transmission.

11. Appareil selon la revendication 9, comprenant en outre des moyens pour préparer un signal de capacité de modulation d'amplitude en quadrature à x états pour une transmission et des moyens pour fournir le signal de capacité de modulation d'amplitude en quadrature à x états pour une transmission et des moyens pour transmettre le signal de capacité de modulation d'amplitude en quadrature à x états.

12. Terminal mobile comprenant un appareil selon la revendication 7.

13. Noeud comprenant un appareil selon la revendication 7.

14. Point d'accès comprenant un appareil selon la revendication 7.

15. Produit-programme d'ordinateur comprenant des instructions qui, lorsque le programme est exécuté par un ordinateur, contraignent l'ordinateur à mettre en oeuvre le procédé selon les revendications 1 à 6.

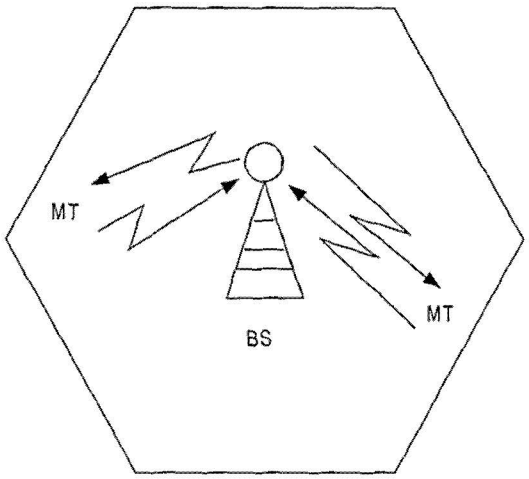
MT
MT
BS

FIG. 1

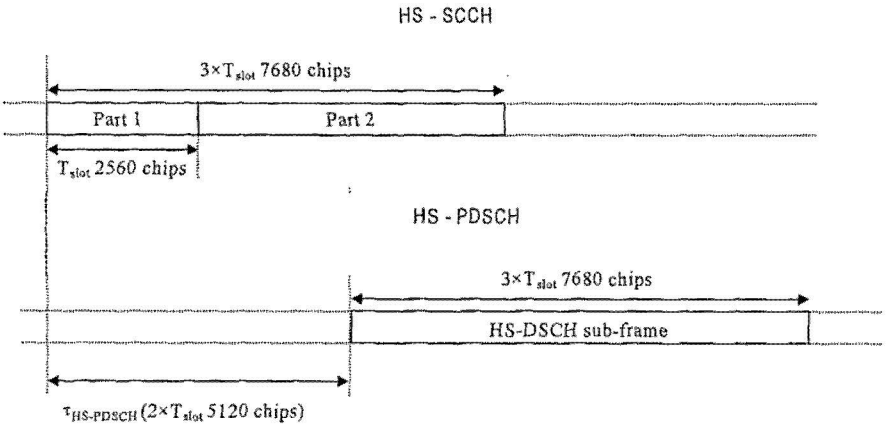
HS - SCCH
3×T slot 7680 chips
Part 1
Part 2
T slot 2560 chips
HS - PDSCH
3×T slot 7680 chips
HS-DSCH sub-frame
τ HS-PDSCH (2×T slot 5120 chips)

FIG. 2

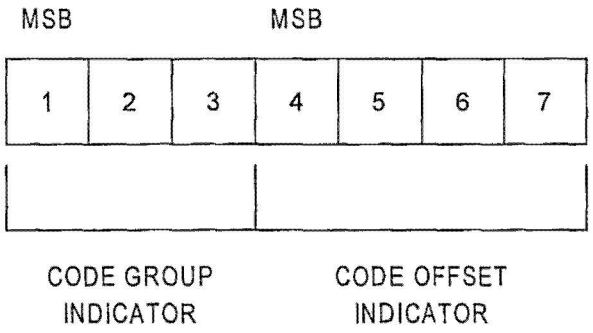

FIG. 3A

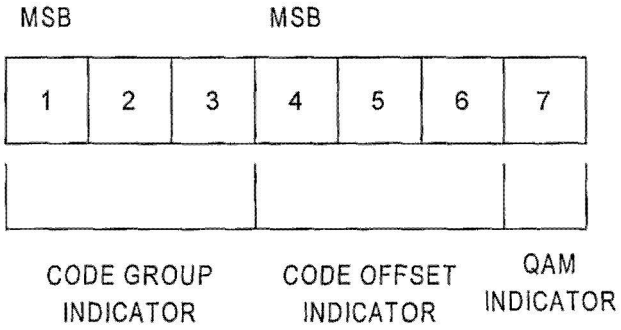

FIG. 3B

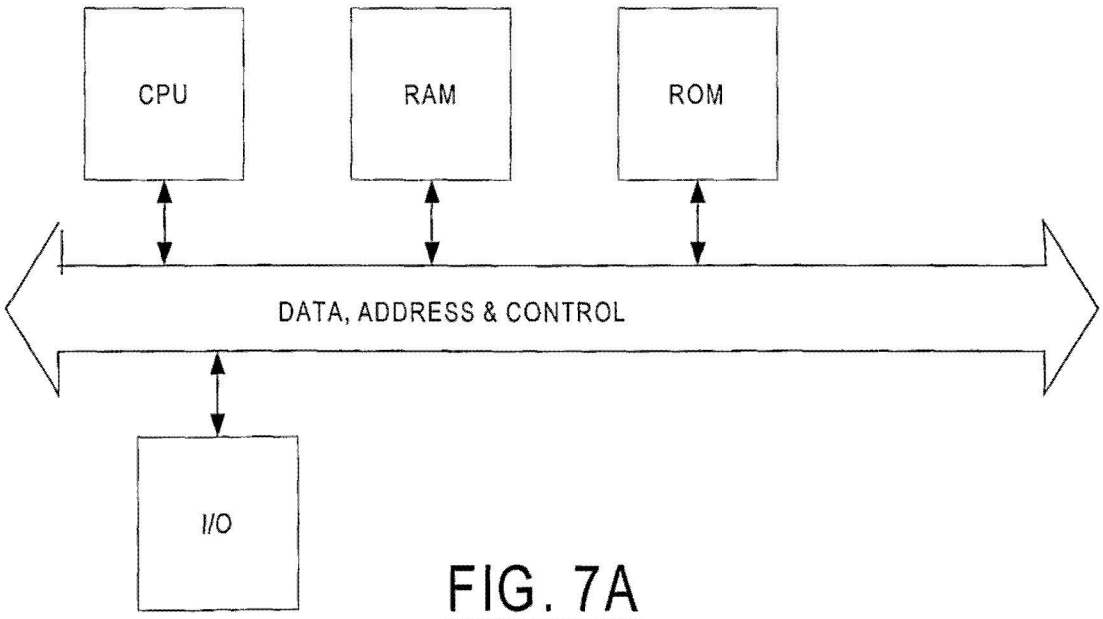

FIG. 7A

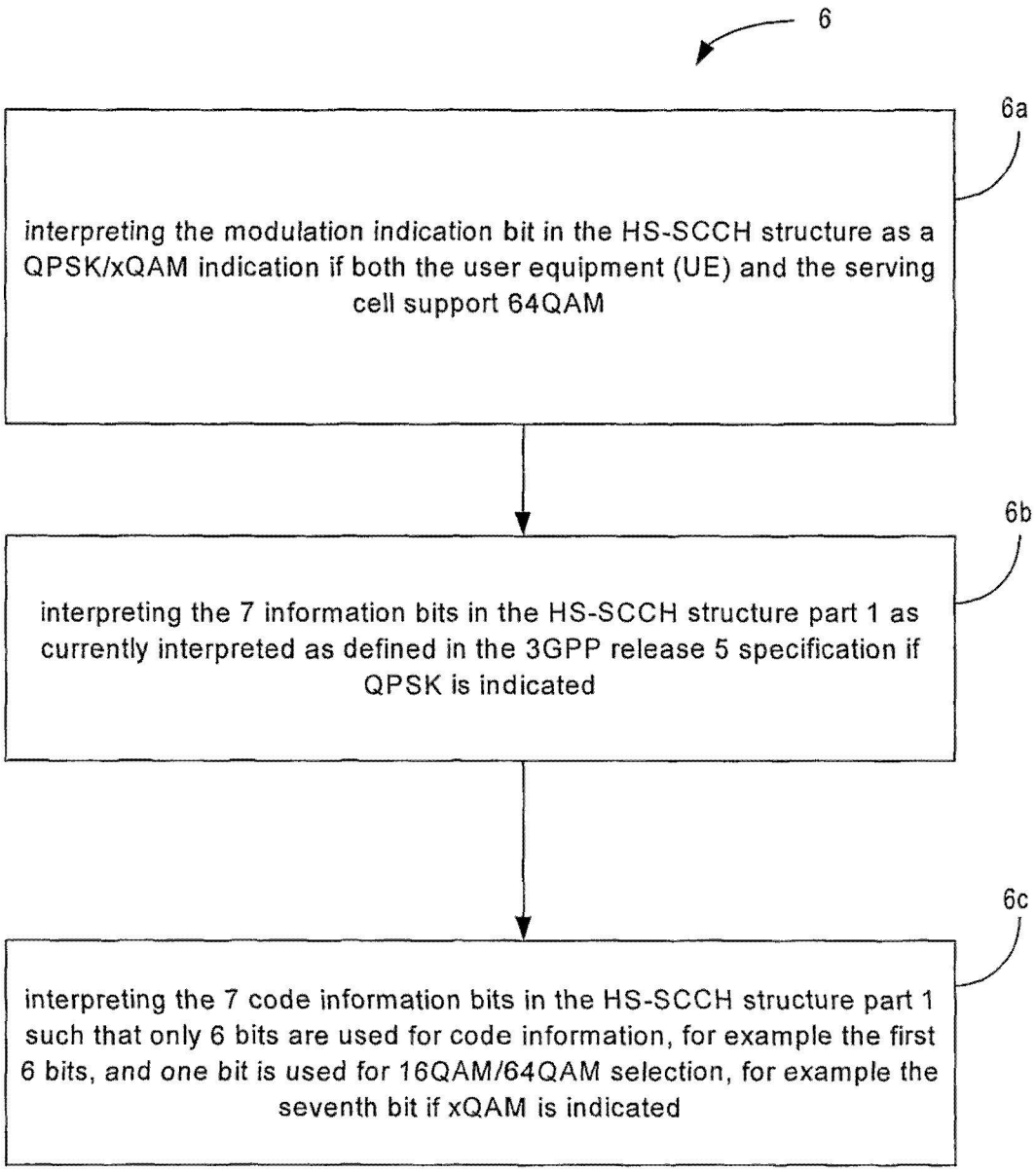
6
6a
interpreting the modulation indication bit in the HS-SCCH structure as a QPSK/xQAM indication if both the user equipment (UE) and the serving cell support 64QAM
6b
interpreting the 7 information bits in the HS-SCCH structure part 1 as currently interpreted as defined in the 3GPP release 5 specification if QPSK is indicated
6c
interpreting the 7 code information bits in the HS-SCCH structure part 1 such that only 6 bits are used for code information, for example the first 6 bits, and one bit is used for 16QAM/64QAM selection, for example the seventh bit if xQAM is indicated

FIG. 4A

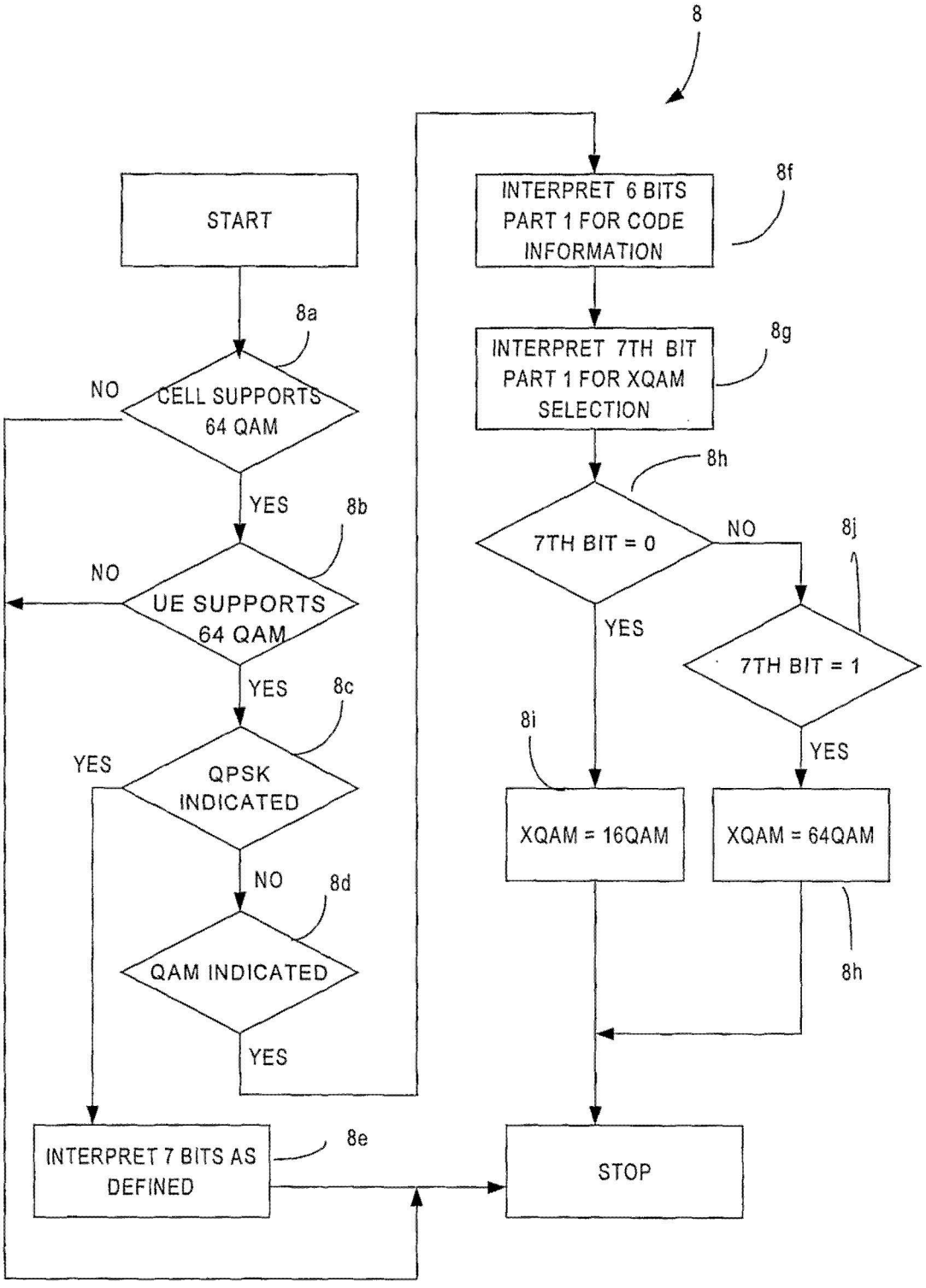
8
START
8a
CELL SUPPORTS 64 QAM
NO
YES
8b
UE SUPPORTS 64 QAM
NO
YES
8c
QPSK INDICATED
YES
NO
8d
QAM INDICATED
YES
8e
INTERPRET 7 BITS AS DEFINED
INTERPRET 6 BITS PART 1 FOR CODE INFORMATION
8f
INTERPRET 7TH BIT PART 1 FOR XQAM SELECTION
8g
8h
7TH BIT = 0
NO
8j
7TH BIT = 1
YES
YES
8i
XQAM = 16QAM
XQAM = 64QAM
8h
STOP

FIG. 4B

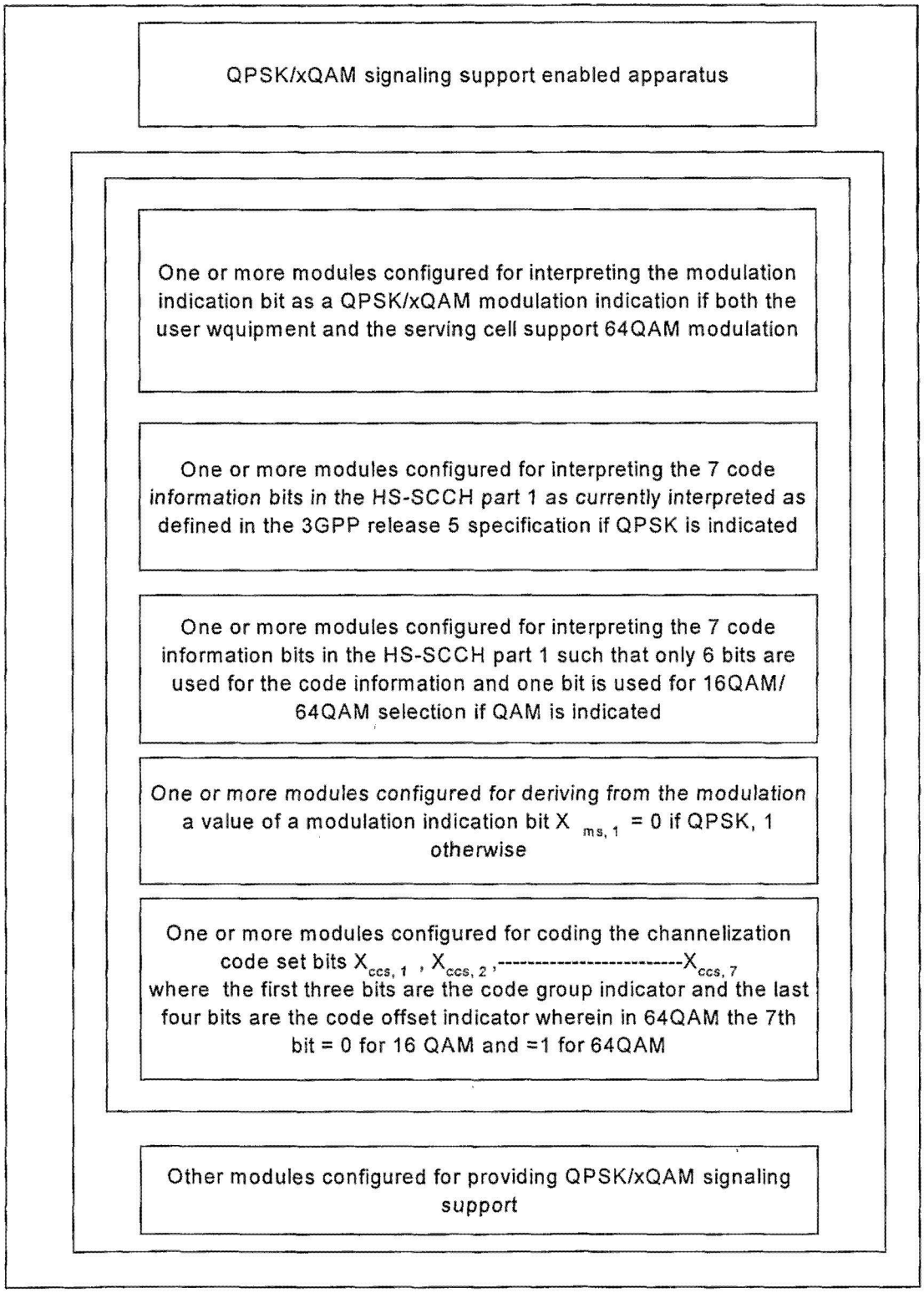
QPSK/xQAM signaling support enabled apparatus
One or more modules configured for interpreting the modulation indication bit as a QPSK/xQAM modulation indication if both the user wquipment and the serving cell support 64QAM modulation
One or more modules configured for interpreting the 7 code information bits in the HS-SCCH part 1 as currently interpreted as defined in the 3GPP release 5 specification if QPSK is indicated
One or more modules configured for interpreting the 7 code information bits in the HS-SCCH part 1 such that only 6 bits are used for the code information and one bit is used for 16QAM/ 64QAM selection if QAM is indicated
One or more modules configured for deriving from the modulation a value of a modulation indication bit $X_{ms,1}$ = 0 if QPSK, 1 otherwise
One or more modules configured for coding the channelization code set bits $X_{ccs,1}$, $X_{ccs,2}$,----------$X_{ccs,7}$ where the first three bits are the code group indicator and the last four bits are the code offset indicator wherein in 64QAM the 7th bit = 0 for 16 QAM and =1 for 64QAM
Other modules configured for providing QPSK/xQAM signaling support

FIG. 5

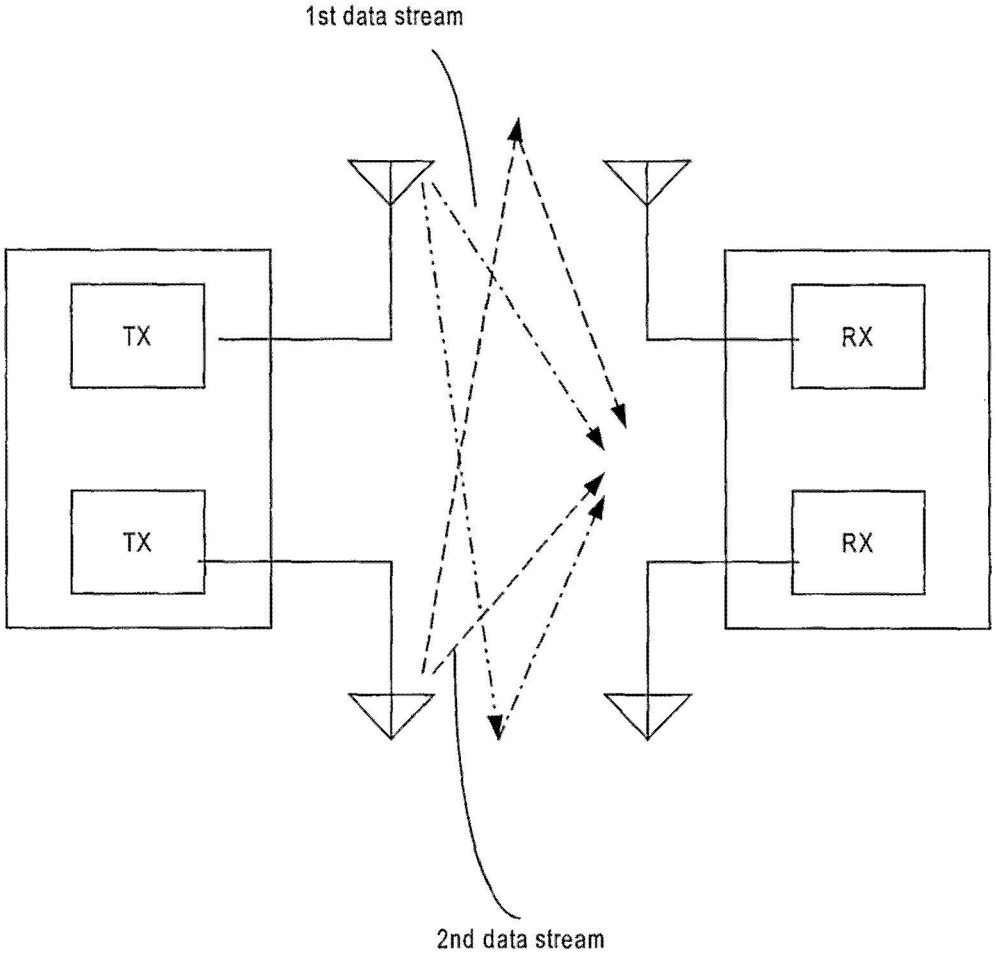
1st data stream
TX
TX
RX
RX
2nd data stream

FIG. 6A

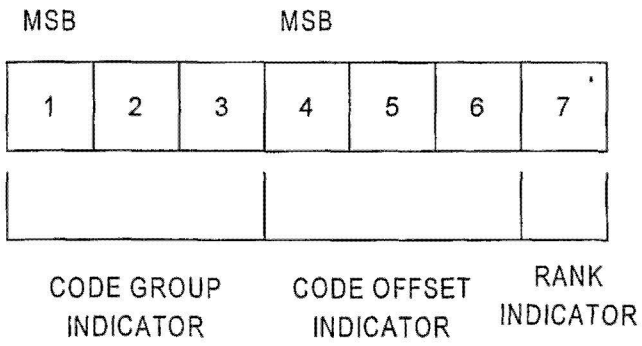
MSB
MSB
1
2
3
4
5
6
7
CODE GROUP INDICATOR
CODE OFFSET INDICATOR
RANK INDICATOR

FIG. 6B

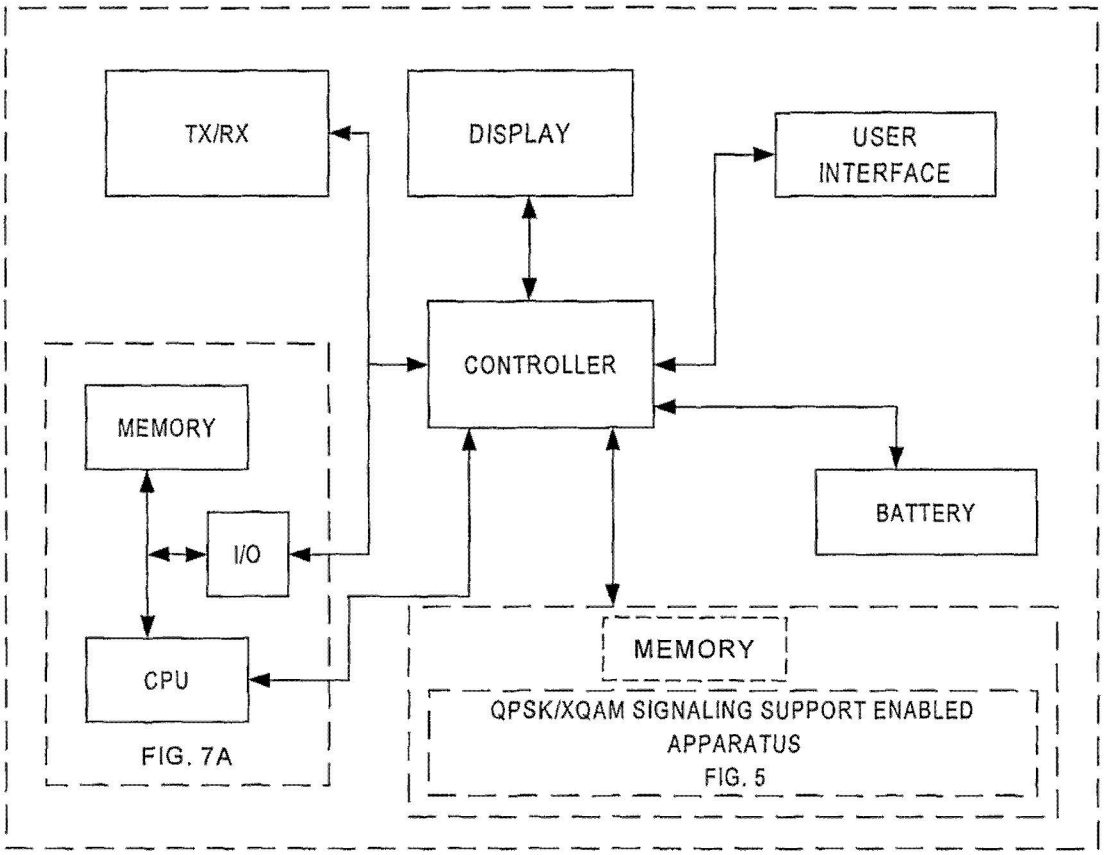
TX/RX
DISPLAY
USER INTERFACE
CONTROLLER
MEMORY
I/O
CPU
BATTERY
MEMORY
QPSK/XQAM SIGNALING SUPPORT ENABLED APPARATUS
FIG. 5
FIG. 7A

FIG. 7B

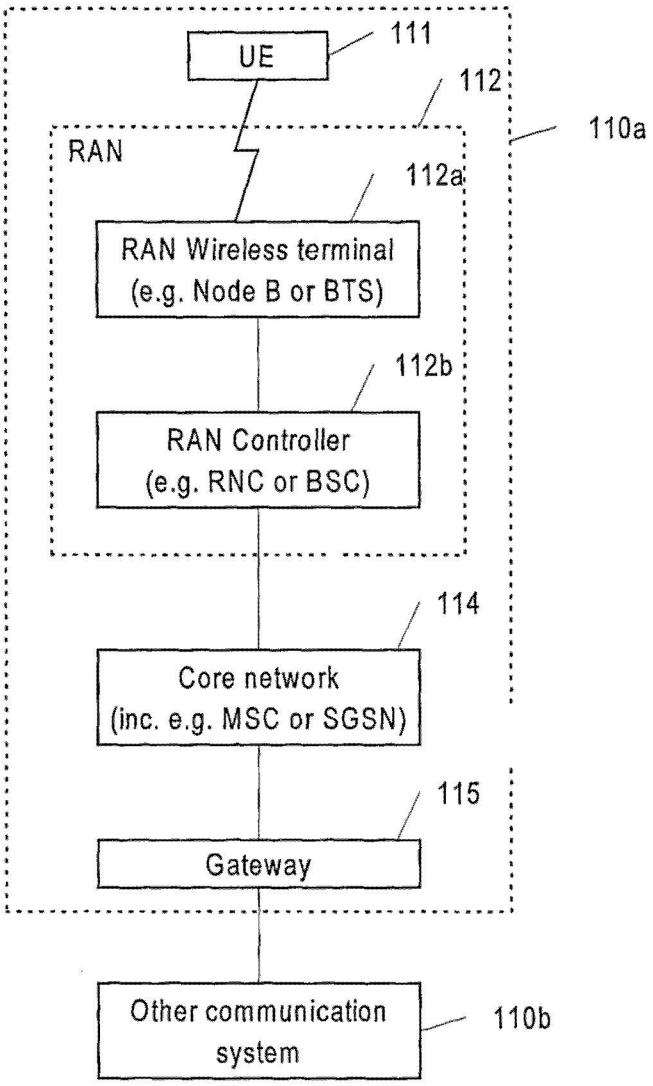
UE
111
112
110a
RAN
112a
RAN Wireless terminal
(e.g. Node B or BTS)
112b
RAN Controller
(e.g. RNC or BSC)
114
Core network
(inc. e.g. MSC or SGSN)
115
Gateway
Other communication
system
110b

FIG. 8

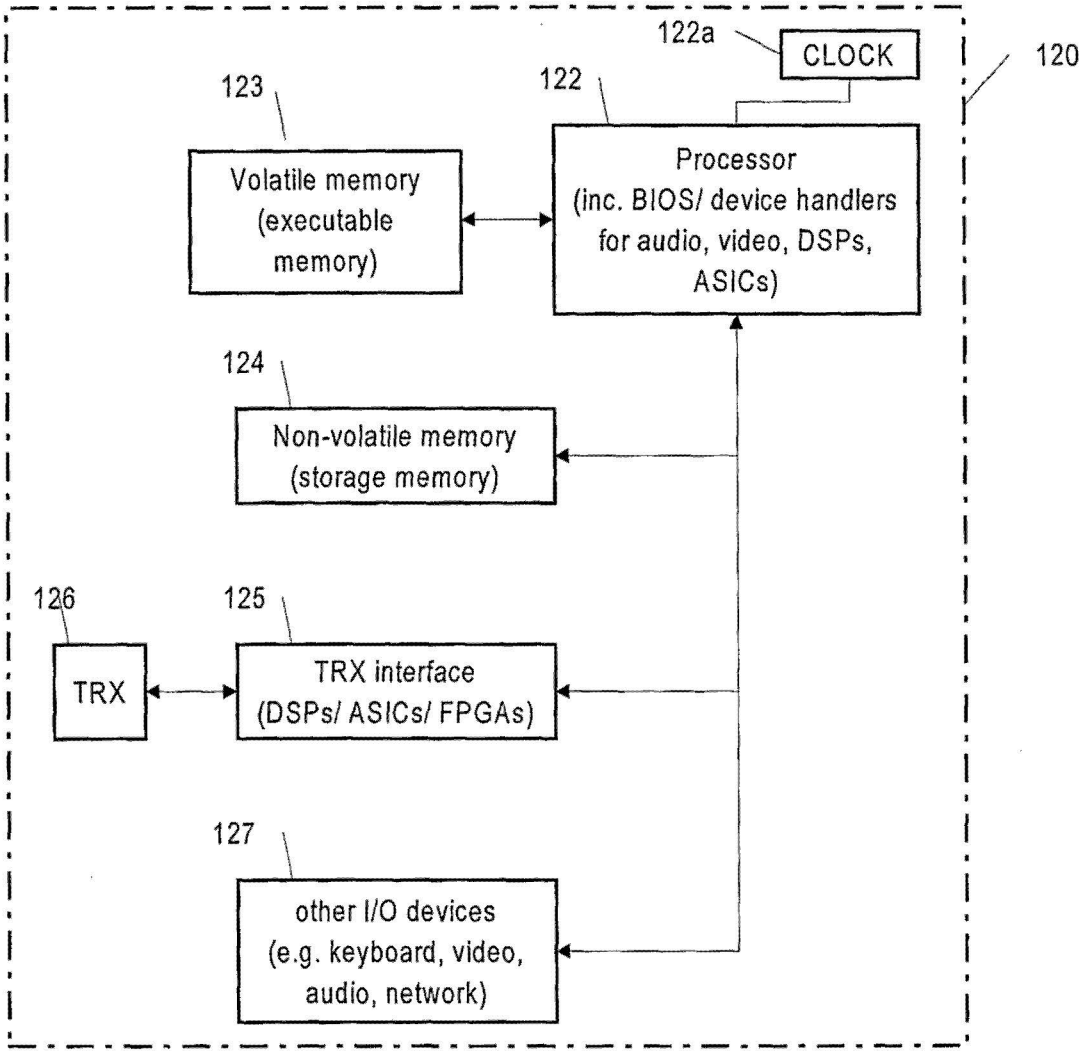
122a
CLOCK
120
123
122
Volatile memory (executable memory)
Processor (inc. BIOS/ device handlers for audio, video, DSPs, ASICs)
124
Non-volatile memory (storage memory)
126
125
TRX
TRX interface (DSPs/ ASICs/ FPGAs)
127
other I/O devices (e.g. keyboard, video, audio, network)

FIG. 9

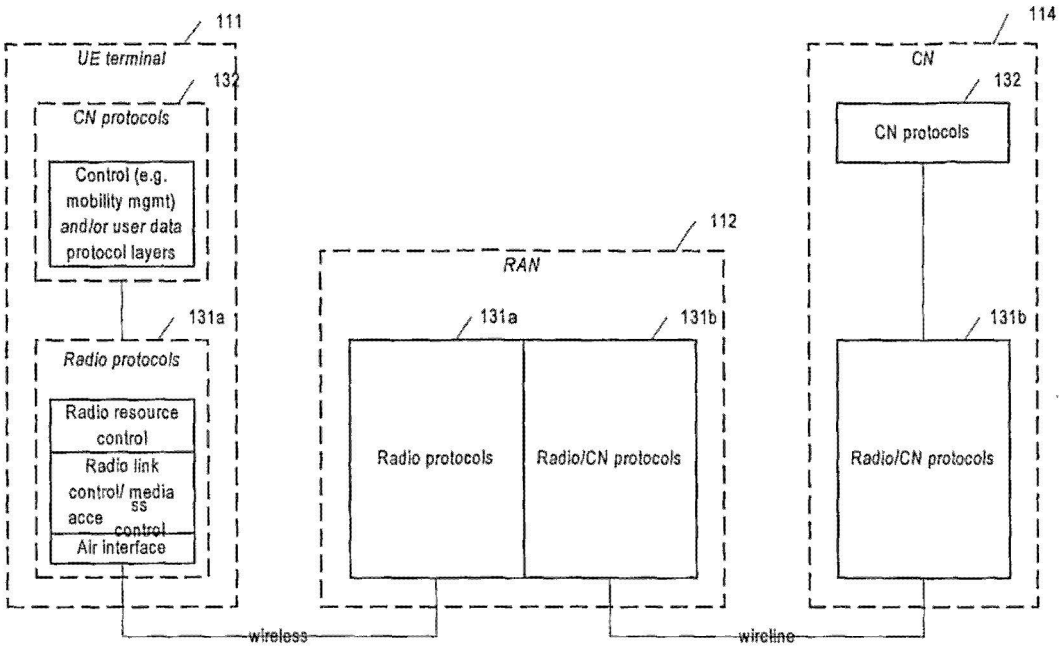
111
UE terminal
132
CN protocols
Control (e.g. mobility mgmt) and/or user data protocol layers
131a
Radio protocols
Radio resource control
Radio link control/ media acce ss control
Air interface
112
RAN
131a
131b
Radio protocols
Radio/CN protocols
114
CN
132
CN protocols
131b
Radio/CN protocols
wireless
wireline

FIG. 10

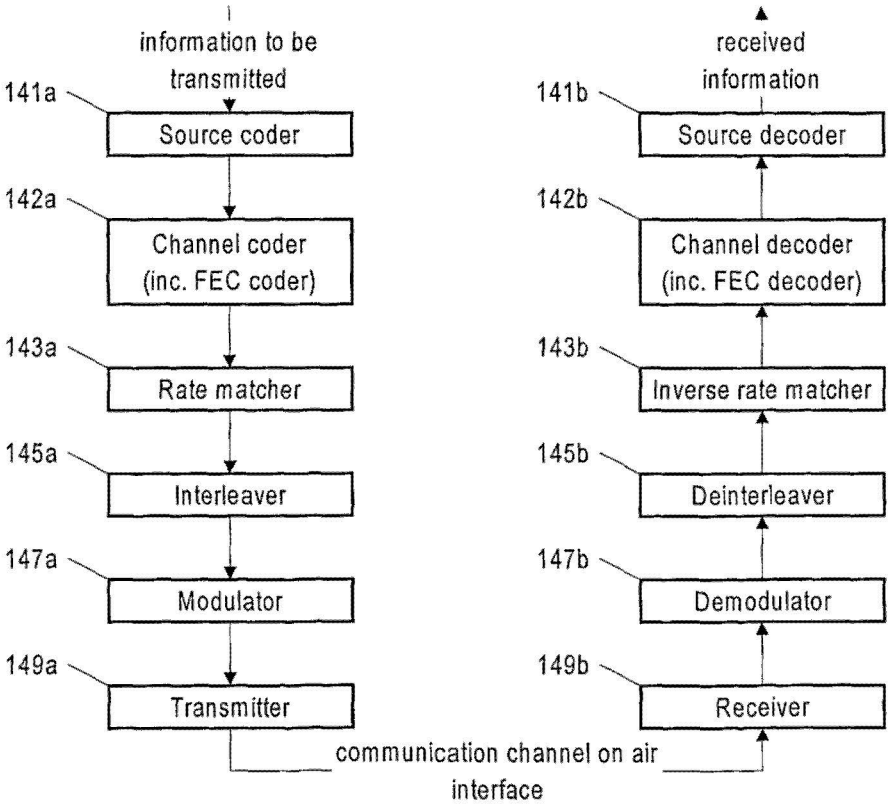
information to be transmitted
141a
Source coder
142a
Channel coder (inc. FEC coder)
143a
Rate matcher
145a
Interleaver
147a
Modulator
149a
Transmitter
received information
141b
Source decoder
142b
Channel decoder (inc. FEC decoder)
143b
Inverse rate matcher
145b
Deinterleaver
147b
Demodulator
149b
Receiver
communication channel on air interface

FIG. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20040028020 A **[0012]**

Non-patent literature cited in the description

- WCDMA Requirements and Practical Design. Wiley **[0006]**
- **ERICSSON'S.** Higher Order Modulation for HSPA-Impact on RANI specifications. *R1-062935 in 3GPP RANI meeting #46bis*, October 2006 **[0010]**

ANNEX B – CONDITIONAL AMENDMENT

Claims

Amendment to claim 1:

1. A method, comprising:

receiving a High-Speed-Shared-Control-Channel, HS-SCCH, part 1 comprising a High Speed Downlink Packet Access, HSDPA, modulation indication bit

interpreting (6a) ~~a~~ the HSDPA modulation indication bit as a quadrature phase shift keying/quadrature amplitude modulation indication of an HS-DSCH transmission if both a user equipment and a serving cell support 64 quadrature amplitude modulation according to the following condition:

if the HSDPA modulation indication bit indicates quadrature phase shift keying, interpreting (6b) 7 channelization code-set information bits in ~~a high-speed-shared-control-channel,~~ the HS-SCCH part 1 structure as currently interpreted as defined in the 3GPP release 5 specification such that the first three bits of the channelization code-set information bits represent a group code indicator and the last four bits of the channelization code-set information bits represent a code offset indication; and

if the HSDPA modulation indication bit indicates quadrature amplitude modulation, interpreting (6c) the 7 channelization code-set information bits in the HS-SCCH part 1 structure such that only 6 bits of the channelization code-set information bits are interpreted as code-set information and one bit of the channelization code-set information bits is interpreted as selection between 16 quadrature amplitude modulation and 64 quadrature amplitude modulation,

receiving and demodulating the HS-DSCH transmission according to the interpreted modulation.

Amendment to current claim 7 (to become renumbered claim 3):

7. An apparatus, comprising:

means for receiving a High-Speed-Shared-Control-Channel, HS-SCCH, part 1 comprising a High Speed Downlink Packet Access, HSDPA, modulation indication bit

means for interpreting ~~a~~ the HSDPA modulation indication bit as a quadrature phase shift keying/quadrature amplitude modulation indication of an HS-DSCH transmission if both a user equipment and a serving cell in a cellular telecommunications network support 64 quadrature amplitude modulation according to the following condition:

means for, if the HSDPA modulation indication bit indicates quadrature phase shift keying, interpreting 7 channelization code-set information bits in ~~a high-speed-shared-control-channel,~~ the HS-SCCH part 1 structure as currently interpreted as defined in the 3GPP release 5 specification such that the first three bits of the channelization code-set information bits represent a group code indicator and the last four bits of the channelization code-set information bits represent a code offset indication; and

means for, if the HSDPA modulation indication bit indicates quadrature amplitude modulation, interpreting the 7 channelization code-set information bits in the HS-SCCH part 1 structure such that only 6 bits of the channelization code-set information bits are interpreted as code-set information and one bit of the channelization code-set information bits is interpreted as selection between 16 quadrature amplitude modulation and 64 quadrature amplitude modulation,

means for receiving and demodulating the HS-DSCH transmission according to the interpreted modulation.