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(73) Patenthaver: **Nokia Technologies Oy, Karaportti 3, 02610 Espoo, Finland**

(72) Opfinder: **KAIKKONEN, Jorma, Taskilantie 27 D 15, 90580 Oulu, Finland**
LAMPINEN, Marko, Tiedokaari 5 B 10, 90570 Oulu, Finland

(74) Fuldmægtig i Danmark: **RWS Group, Europa House, Chiltern Park, Chiltern Hill, Chalfont St Peter, Bucks SL9 9FG, Storbritannien**

(54) Benævnelse: **APPARAT, FREMGANGSMÅDE OG COMPUTERPROGRAMPRODUCT MED HYBRID ARQ FEEDBACK FOR HSDPA MIMO**

(56) Fremdragne publikationer:
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PHILIPS,QUALCOMM,NORTEL,ERICSSON,MOTOROLA, TI,LUCENT,NOKIA,T-MOBILE,ARRAYCOMM: "Agreements on details in support of MIMO (FDD) for Rel-7, 3GPP TSG RAN WG1 #46, R1-062437" 3RD GENERATION PARTNERSHIP PROJECT (3GPP); TECHNICAL SPECIFICATION GROUP (TSG) RADIO ACCESS NETWORK (RAN); WORKINGGROUP 1 (WG1), XX, XX, no. 46, 28 August 2006 (2006-08-28), pages 1-3, XP002478852

DESCRIPTION

TECHNICAL FIELD:

[0001] The exemplary and non-limiting embodiments of this invention relate generally to wireless communication systems, methods, devices and computer program products and, more specifically, relate to techniques that provide feedback related to hybrid automatic repeat request.

BACKGROUND:

[0002] The following abbreviations are herewith defined:

3GPP
: third generation partnership project

ACK
: acknowledge

ARQ
: automatic repeat request.

CQI
: channel quality indication

DL
: downlink (Node-B to UE)

DTX
: discontinuous transmission

FDD
: frequency division duplex

HARQ
: hybrid ARQ

HSDPA
: high speed downlink packet access

HS-DPCCH
: high speed dedicated physical control channel

HS-DSCH
: high speed downlink shared channel

HS-PDSCH
: high speed physical downlink shared channel

HS-SCCH
: shared control channel for HS-DSCH

MCS
: modulation and coding scheme

MIMO
: multiple input multiple output

NACK
: not acknowledge, negative acknowledge

Node-B
: base station

UE
: user equipment

UL
: uplink (UE to Node-B)

UMTS
: universal mobile telephony system

UTRA
: UMTS terrestrial radio access

[0003] 3GPP RAN1 meeting #45 8.-12.5.2006 agreed to recommend specifying a 2x2 (dual transmit - dual receive antenna - dual code word) MIMO technique for HSDPA.

[0004] As is known in the art, MIMO only provides gains in good channel conditions, and thus a single stream transmission should be applied when the channel conditions are less than what will provide an adequate MIMO dual-stream transmission.

[0005] In addition to dual stream transmission the selected MIMO scheme was determined to be a dual code word system. This implies that each of the streams should have independent HARQ operation.

[0006] The HSDPA delivers downlink HARQ feedback (ACK/NACKs) in the UL on a HS-DPCCH physical channel for use by a Node-B packet scheduler. Based on the provided feedback Node-B the scheduler makes decisions whether to perform re-transmissions for the failed transmission or whether to transmit a new packet for each stream separately.

[0007] Referring to 3GPP TS25.212, V7.1.0 (2006-06), 3rd generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (Release 7), section 4.7.1.1 describes the HARQ feedback as a 1-bit indication (ACK/NACK) that is (10,1) repetition coded.

[0008] Referring to 3GPP TS25.211, V7.0.0 (2006-03), 3rd generation Partnership Project; Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 7), section 5.2.1.2 "HS-DPCCH" defines the HS-DPCCH channel structure for delivering the coded bits to the Node-B in the UL.

[0009] As is described in section 5.2.1.2, the frame structure of the HS-DPCCH is defined in Figure 2A (shown herein also as Figure 2A). The HS-DPCCH carries uplink feedback signaling related to downlink HS-DSCH transmission. The HS-DSCH-related feedback signaling consists of Hybrid-ARQ Acknowledgment (HARQ-ACK) and Channel-Quality Indication (CQI). Each sub-frame of length 2 ms (3*2560 chips) consists of 3 slots, each of length 2560 chips. The HARQ-ACK is carried in the first slot of the HS-DPCCH sub-frame. The CQI is carried in the second and third slot of a HS-DPCCH sub-frame. There is at most one HS-DPCCH on each radio link. The HS-DPCCH can only exist together with an uplink DPCCH. The timing of the HS-DPCCH relative to the uplink DPCCH is shown in section 7.7 of 3GPP TS25.211.

[0010] The spreading factor of the HS-DPCCH is 256. i.e., there are 10 bits per uplink HS-DPCCH slot. The slot format for the uplink HS-DPCCH is defined in Table 5A, shown herein as Figure 2B.

[0011] There is at least one inherent potential problem in the functioning of HARQ signaling. More specifically, the HS-DSCH transmission to a UE is indicated on the HS-SCCH. The HS-SCCH signaling for MIMO also indicates the number of applied streams. If the number of streams is detected incorrectly by the UE due to some reception error, the HARQ feedback in UL will reflect this reception error. In this case the UE would provide the HARQ feedback assuming wrong number of streams/code words. The Node-B might not have a means to detect such errors correctly unless the encoding of the HARQ feedback is designed to support that.

[0012] For example, if independent HS-SCCH signaling is provided for each HS-PDSCH (e.g., for each stream), the UE may detect only one HS-SCCH correctly. In such a case the UE would report a single ACK/NACK based on the detected stream.

[0013] If the Node-B is unable to detect this situation where the UE erroneously assumes only a single stream being transmitted, then unnecessary higher layer re-transmissions may occur since a detection miss would be erroneously interpreted as an ACK.

[0014] R1-062031, "HS-DPCCH in support of D-TxAA", August 28th-September 1st, Qualcomm Europe, makes a proposal that assumes two independent ACK/NACKs (for each stream), or only a single ACK/NACK. However, no indication on the number of streams received is provided.

[0015] Reference can also be made to 3GPP TSG-RAN WG1, MIMO R7, Teleconference, September 27th, 2006, R1-MIMOR7-QCOM-09, ACK/NACK coding, Qualcomm Europe, which suggests the use of two separate (5,1) repetition block codes on the first ten bits of a HS-DPCCH TTI, and possibly interleaving the two blocks of (5,1) repetition codes.

[0016] US2006093065 discloses a method for communicating a plurality of data streams between a transmitting device, having multiple transmit antennas, and a receiving device. The method comprises determining a set of power weightings, efficiently quantizing the power weightings, and providing the set of power weightings to the transmitting device. The transmitter may also

implicitly signal the number of data streams which the receiver should feedback information for the amount of feedback requested. US2006093065 also discloses a means of determining the best codebook weights by combining the maximum power and maximum capacity criteria.

[0017] US2003079169 discloses a method of providing an automatic repeat request (ARQ) that employs a selective repeat, enabling a transmitting medium access control (MAC) entity at a transmitting station to retransmit those MAC data whose previous transmissions have failed. The MAC data is organized into fixed-sized ARQ blocks, with said ARQ blocks being the building blocks of MAC service data units (MSDUs) or MSDU fragments. The transmitting MAC entity assigns a local number and a global number to each ARQ block to be transmitted and identifies ARQ blocks contained in a transmitted MAC protocol data unit (MPDU) by including into the MPDU the local and global numbers of the first ARQ block in that MPDU. A receiving MAC entity at a receiving station determines and acknowledges the reception status of the ARQ blocks received or anticipated.

SUMMARY OF THE EXEMPLARY EMBODIMENTS OF THIS INVENTION

[0018] The foregoing and other problems are overcome, and other benefits are realized by the use of the exemplary embodiments of this invention.

[0019] According to one embodiment of the present invention, there is provided a method as claimed in claim 1.

[0020] According to another embodiment of the present invention, there is provided a memory medium as claimed in claim 4.

[0021] According to another embodiment of the present invention, there is provided an apparatus as claimed in claim 7.

[0022] According to another embodiment of the present invention, there is provided a method as claimed in claim 10.

[0023] According to another embodiment of the present invention, there is provided an apparatus as claimed in claim 13.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In the attached Drawing Figures:

Figure 1 shows a simplified block diagram of various electronic devices that are suitable for use in practicing the exemplary embodiments of this invention.

Figure 2A reproduces Figure 2A of 3GPP TS25.211, V7.0.0 (2006-03), and shows the frame structure for the uplink HS-DPCCH.

Figure 2B reproduces Table 5A of 3GPP TS25.211, V7.0.0 (2006-03), and shows the fields of the HS-DPCCH.

Figure 3 is a logic flow diagram that is descriptive of the operation of a method, and a computer program product, of the UE shown in Figure 1.

Figure 4 is a logic flow diagram that is descriptive of the operation of a method, and a computer program product, of the Node-B shown in Figure 1.

DETAILED DESCRIPTION

[0025] Reference is made first to Figure 1 for illustrating a simplified block diagram of various electronic devices that are suitable for use in practicing the exemplary embodiments of this invention. In Figure 1 a wireless network 1 is adapted for communication with a UE 10 via a Node B (base station) 12. The network 1 may include a network control element NCE 14. The UE 10 includes a data processor (DP) 10A, a memory (MEM) 10B that stores a program (PROG) 10C, and a suitable radio frequency (RF) transceiver 10D for bidirectional wireless communications with the Node B 12, which also includes a DP 12A, a MEM 12B that stores a PROG 12C, and a suitable RF transceiver 12D. The wireless link transmissions between the UE 10 and the Node-B 12 are assumed to conform to the 2x2 multi-antenna MIMO scheme, and thus there may actually be multiple transmit and receive

antennas at each end of the link. The Node B 12 is coupled via a data path 13 to the NCE 14 that also includes a DP 14A and a MEM 14B storing an associated PROG 14C. The PROGs 10C and 12C are assumed to include program instructions that, when executed by the associated DP, enable the electronic device to operate in accordance with the exemplary embodiments of this invention, as will be discussed below in greater detail.

[0026] Relatedly, also shown in Figure 1 is a HARQ unit 10E at the UE 10 and a packet scheduler (PS) unit 12D and HARQ information decoder 12F at the Node-B 12. These units operate in accordance with the exemplary embodiments of this invention, as will be discussed below in greater detail.

[0027] In general, the exemplary embodiments of this invention may be implemented by computer software executable by the DP 10A of the UE 10 and the DP 12A of the Node-B 12, or by hardware, or by a combination of software and hardware.

[0028] In general, the various embodiments of the UE 10 can include, but are not limited to, cellular telephones, personal digital assistants (PDAs) having wireless communication capabilities, portable computers having wireless communication capabilities, image capture devices such as digital cameras having wireless communication capabilities, gaming devices having wireless communication capabilities, music storage and playback appliances having wireless communication capabilities, Internet appliances permitting wireless Internet access and browsing, as well as portable units or terminals that incorporate combinations of such functions.

[0029] The MEMs 10B, 12B and 14B may be of any type suitable to the local technical environment and may be implemented using any suitable data storage technology, such as semiconductor-based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory. The DPs 10A, 12A and 14A may be of any type suitable to the local technical environment, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs) and processors based on a multi-core processor architecture, as non-limiting examples.

[0030] In accordance with the exemplary embodiments of this invention certain information that specifies the number of streams received (and actually detected) by the UE 10 is included in the HARQ feedback to the Node-B 12. This beneficially enables the Node-B 12 to unambiguously distinguish dual stream ACK/NACK signaling from only single stream ACK/NACK signaling in accordance with the encoding of the HARQ feedback information.

[0031] To achieve this it is preferred that the UL HARQ feedback is encoded by the HARQ unit 10E in such a way that the single stream and dual stream cases can be decoded unambiguously at the Node-B 12 by the decoder 12F, such as by the use of separate code words, single stream and dual stream cases.

[0032] As one non-limiting example of providing the HARQ feedback with code word information, effectively six code words are selected from a 10-bit long sequence to produce a code. The information fields are: A, N, AA, AN, NA, NN, i.e., all possible combinations of single stream (the first two fields) and dual stream (the remaining four fields) ACK (A) and NACK (N).

[0033] To further refine the code structure, the codewords may be selected so that the probability of occurrence of undesired error events is reduced by, for example, optimizing the Hamming distances between the code words.

[0034] As another non-limiting example of providing the HARQ feedback with code word information, the ACK and NACK indications for each stream are encoded by, for example, a (5,1) block code or repetition code, and DTX is used on an unused part of the message, i.e., if only single stream is received. That is, the other information field would be subject to DTX if UE 10 assumes that it has been only allocated a single stream. In this case, and by example, the code words may be: AX, NX, AA, AN, NA, NN where X indicates DTX in the bit field.

[0035] With regard to the foregoing note that one suitable and non-limiting generation matrix may be simply: G=(11111). The repetition code may be quite simple, such as by repeating either the 1 or 0. The use of block and repetition codes, and codecs therefor, *per se* is well known, and not further described herein.

[0036] As should be appreciated, by thus indicating the number of detected streams/code words in the HARQ feedback more reliable HARQ feedback signaling can be provided, thereby reducing or eliminating an occurrence of higher layer re-transmissions to the UE 10.

[0037] Based on the foregoing it should be apparent that the exemplary embodiments of this invention provide methods, apparatus and computer program product(s) to indicate a number of detected streams in HARQ feedback to the Node-B 12.

[0038] Referring now to Figure 3, a method and computer program product executed by a first device operates in response to a DL transmission from a second device to generate HARQ feedback information (Block 3A), to encode the HARQ feedback information to comprise (at least) an indication of a number of streams received in the DL transmission (Block 3B), and to transmit the encoded HARQ feedback information to the second device (Block 3C).

[0039] In the method and computer program product, there are a maximum of two streams, and where encoding the HARQ feedback information comprises selecting a code word from a plurality of code words, e.g., from six code words: A, N, AA, AN, NA, NN, thereby providing all possible combinations of single stream and two stream ACK (A) and NACK (N) information.

[0040] In the method and computer program product, there are a maximum of two streams, and where encoding the HARQ feedback information comprises using one of a (5,1) block code or a repetition code, and using DTX on an unused part of the message to provide the code word: AX, NX, AA, AN, NA, NN providing all possible combinations of single stream and two stream ACK (A) and NACK (N) information, where X indicates DTX in the bit field.

[0041] In the method and computer program product of the previous three paragraphs, where the DL transmission is received from a HS-DSCH by a UE, and where the encoded HARQ feedback information is sent to a Node-B on a HS-DPCCH.

[0042] In the method and computer program product of the previous four paragraphs, where a wireless link between the first and second devices comprises a 2x2 MIMO wireless link.

[0043] Also disclosed is a first device comprising a HARQ unit operable in response to a reception of DL transmission from a second device to generate HARQ feedback information that is encoded to comprise an indication of a number of streams received in the DL transmission. The HARQ unit has an output coupled to a transmitter for providing the encoded HARQ feedback information for transmission to the second device.

[0044] In the first device of the previous paragraph there are a maximum of two streams, and the HARQ feedback information is encoded by selecting a code word from a plurality of code words: A, N, AA, AN, NA, NN, providing all possible combinations of single stream and two stream ACK (A) and NACK (N) information.

[0045] In the first device there are a maximum of two streams, and the HARQ feedback information is encoded using one of a (5,1) block code or a repetition code, and by using DTX on an unused part of the message to provide the code word: AX, NX, AA, AN, NA, NN providing all possible combinations of single stream and two stream ACK (A) and NACK (N) information, where X indicates DTX in the bit field.

[0046] In the first device of the previous three paragraphs, the DL transmission is received from a HS-DSCH, and the encoded HARQ feedback information is sent to a Node-B on a HS-DPCCH.

[0047] In the first device of the previous four paragraphs, a wireless link between the first and second devices comprises a 2x2 MIMO wireless link.

[0048] Referring now to Figure 4, a method and computer program product executed by a first device operates to receive encoded HARQ feedback information from a second device (Block 4A), to decode the received encoded HARQ feedback information (Block 4B), and to determine from the encoding of the HARQ feedback information at least a number of streams that were received in a DL transmission that was previously transmitted to the second device (Block 4C).

[0049] In the method and computer program product of the previous paragraph there are a maximum of two streams, and where the received HARQ feedback information is encoded by selecting a code word from a plurality of code words: A, N, AA, AN, NA, NN, providing all possible combinations of single stream and two stream ACK (A) and NACK (N) information.

[0050] In the method and computer program product, there are a maximum of two streams, and where the received HARQ feedback information is encoded using one of a (5,1) block code or a repetition code, and is sent using DTX on an unused part of the message to provide the code word: AX, NX, AA, AN, NA, NN providing all possible combinations of single stream and two stream ACK (A) and NACK (N) information, where X indicates DTX in the bit field.

[0051] In the method and computer program product of the previous three paragraphs, where the DL transmission is received from a HS-DSCH by a UE, and where the encoded HARQ feedback information is received by a Node-B on a HS-DPCCH.

[0052] In the method and computer program product of the previous four paragraphs, where a wireless link between the first and second devices comprises a 2x2 MIMO wireless link.

[0053] Also disclosed is a Node-B that comprises a receiver to receive encoded HARQ feedback information from a UE, a decoder to decode the received encoded HARQ feedback information, and a determination unit to determine from the encoding of the HARQ feedback information at least a number of streams that were received in a DL transmission that was previously transmitted to the UE (Block 4C).

[0054] The various blocks shown in Figure 3 and 4 may be viewed as method steps, and/or as operations that result from operation of computer program code, and/or as a plurality of coupled logic circuit elements constructed to carry out the associated function(s).

[0055] The encoded code word in these various embodiments includes information on the number of code words (and the number of received streams) and HARQ ACK/NACK, and one code word is transmitted from the allowed set of code words.

[0056] In general, the various exemplary embodiments may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. For example, some aspects may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device, although the invention is not limited thereto. While various aspects of the exemplary embodiments of this invention may be illustrated and described as block diagrams, flow charts, or using some other pictorial representation, it is well understood that these blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

[0057] As such, it should be appreciated that at least some aspects of the exemplary embodiments of the inventions may be practiced in various components such as integrated circuit chips and modules. The design of integrated circuits is by and large a highly automated process. Complex and powerful software tools are available for converting a logic level design into a semiconductor circuit design ready to be fabricated on a semiconductor substrate. Such software tools can automatically route conductors and locate components on a semiconductor substrate using well established rules of design, as well as libraries of pre-stored design modules. Once the design for a semiconductor circuit has been completed, the resultant design, in a standardized electronic format (e.g., Opus, GDSII, or the like) may be transmitted to a semiconductor fabrication facility for fabrication as one or more integrated circuit devices.

[0058] It should be noted that the terms "connected," "coupled," or any variant thereof, mean any connection or coupling, either direct or indirect, between two or more elements, and may encompass the presence of one or more intermediate elements between two elements that are "connected" or "coupled" together. The coupling or connection between the elements can be physical, logical, or a combination thereof. As employed herein two elements may be considered to be "connected" or "coupled" together by the use of one or more wires, cables and/or printed electrical connections, as well as by the use of electromagnetic energy, such as electromagnetic energy having wavelengths in the radio frequency region, the microwave region and the optical (both visible and invisible) region, as several non-limiting and non-exhaustive examples.

[0059] Various modifications and adaptations to the foregoing exemplary embodiments of this invention may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings. However, any and all modifications will still fall within the scope of the non-limiting and exemplary embodiments of this invention.

[0060] Furthermore, some of the features of the various non-limiting and exemplary embodiments of this invention may be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles, teachings and exemplary embodiments of this invention, and not in limitation thereof.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

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Non-patent literature cited in the description

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- 3GPP TS25.211, 2006, [0024] [0024]

Patentkrav

1. Fremgangsmåde til transmission, hvilken fremgangsmåde omfatter:

at generere en hybrid, automatisk gentagelsesanmodningsfeedback-information på en første indretning (10) som svar på en downlink-transmission på en eller flere multiple-input-multiple-outputstrømme fra en anden indretning (12);

at kode den hybride, automatiske gentagelsesanmodningsfeedback-information, således at den omfatter en indikation af antallet af multiple-input-multiple-outputstrømme, der er modtaget i downlinktransmissionen; og

at transmittere den hybride, automatiske gentagelsesanmodningsfeedbackinformation til den anden indretning (12).

2. Fremgangsmåden ifølge krav 1, hvor der er to strømme, og hvor kodningen af den hybride, automatiske gentagelsesanmodningsfeedback-information omfatter udvælgelse af et kodeord fra et antal kodeord: A, N, AA, AN, NA, NN, og derved indbefattende alle mulige kombinationer af enkeltstrøms- og tostrømsacknowledgeinformation (A) og negativ- acknowledgeinformation (N).

3. Fremgangsmåden ifølge krav 1, hvor der er to strømme, og hvor kodningen af den hybride, automatiske gentagelsesanmodningsfeedback-information omfatter anvendelse af enten en (5,1) blokkode eller en gentagelseskode, og anvendelse af diskontinuert transmission DTX på en ubrugt del af en besked for at tilvejebringe kodeordet: AX, NX, AA, AN, NA, NN, og derved indbefattende alle mulige kombinationer af enkeltstrøms- og tostrømsacknowledgeinformation (A) og negativ- acknowledgeinformation (N), hvor X angiver DTX i et bitfelt.

4. Hukommelsesmedium (10B), der lagrer computerprograminstruktioner (10C), hvis eksekvering, når den

køres på en dataprocessor (10A), resulterer i operationer, der omfatter:

at generere en hybrid, automatisk gentagelsesanmodningsfeedback-information på en første indretning (10) som svar på en downlink-transmission på en eller flere multiple-input-multiple-outputstrømme fra en anden indretning (12);

at kode den hybride, automatiske gentagelsesanmodningsfeedback-information, således at den omfatter en indikation af antallet af multiple-input-multiple-outputstrømme modtaget i downlinktransmissionen; og

at transmittere den hybride, automatiske gentagelsesanmodningsfeedbackinformation til den anden indretning (12).

5. Hukommelsesmedium (10B) ifølge krav 4, hvor downlinktransmissionen modtages fra en højhastighedsdownlinkdelt kanal, og hvor operationen af transmissionen af den hybride, automatiske gentagelsesanmodningsfeedbackinformation til den anden indretning anvender en højhastighedsdedikeret fysisk kontrolkanal.

6. Hukommelsesmedium (10B) ifølge krav 4, hvor en trådløs forbindelse mellem den første (10) og anden (12) indretning omfatter et 2x2 multiple-input-multiple-output trådløst link.

7. Apparat (10) til transmission, omfattende:

en modtager (10D), der kan konfigureres til at modtage en downlink-transmission på en eller flere multiple-input-multiple-output-strømme fra en indretning (12);

en feedbackgenerator, der kan konfigureres til at generere en hybrid, automatisk gentagelsesanmodningsfeedback-information som svar på den modtagne downlinktransmission;

en koder, der kan konfigureres til at kode den genererede hybride, automatiske gentagelsesanmodningsfeedbackinformation, således at den omfatter en indikation af antallet af multiple-input-multiple-output-strømme, der er modtaget i

downlinktransmissionen; og
en transmitter (10D), der kan konfigureres til at transmittere den kodede hybride, automatiske gentagelsesanmodningsfeedbackinformation til indretningen (12).

8. Apparatet ifølge krav 7, hvor der er to strømme, og hvor den nævnte koder vælger et kodeord fra et antal kodeord: A, N, AA, AN, NA, NN, hvorved der tilvejebringes alle mulige kombinationer af enkeltstrøms- og tostrømsacknowledgeinformation (A) og negativacknowledgeinformation (N).

9. Apparatet ifølge krav 7, hvor en eller flere af modtageren (10D), feedbackgeneratoren, koderen og transmitteren (10D) er udformet i mindst et integreret kredsløb.

10. Fremgangsmåde til modtagelse, omfattende:
at transmittere én eller flere multiple-input-multiple-output-strømme i en downlinktransmission fra en første indretning (12) til en anden indretning (10);
at modtage kodet hybrid, automatisk gentagelsesanmodningsfeedback-information fra den anden indretning (10);
at kode den modtagne hybride, automatiske gentagelsesanmodningsfeedbackinformation i den første indretning (12); og
at bestemme ud fra kodningen af den hybride, automatiske gentagelsesanmodningsfeedbackinformation mindst et antal multiple-input-multiple-output strømme som rent faktisk blev modtaget af den første indretning (12) fra downlinktransmissionen.

11. Fremgangsmåden ifølge krav 10, hvor en trådløs forbindelse mellem den første indretning (12) og den anden indretning (10) omfatter et 2x2 multiple-input-multiple-output trådløst link.

12. Fremgangsmåden ifølge krav 10, eksekveret mindst delvist ved operation af en dataprocessor (12A) på computerprograminstruktioner (12C), der er lagret i et hukommelsesmedium (12B), som omfatter en del af en basisstation (12).

13. Apparat (12) til modtagelse, omfattende:
en transmitter (12D), der kan konfigureres til at transmittere en eller flere multiple-input-multiple-output-strømme i en downlinktransmission til en modtagerindretning (10);
en modtager (12D), der kan konfigureres til at modtage kodet hybrid, automatisk gentagelsesanmodningsfeedbackinformation fra modtagerenheden (10);
en afkoder, der kan konfigureres til at afkode den modtagne kodede hybride, automatiske gentagelsesanmodningsfeedbackinformation; og
en dataprocessor (12A), der er koblet til afkoderen og som kan konfigureres ved eksekvering af computerprograminstruktioner (12C) til at bestemme, fra kodningen af den hybride, automatiske gentagelsesanmodningsfeedbackinformation, mindst et antal multiple-input-multiple-output-strømme, der faktisk blev modtaget af modtagerindretningen (10) fra downlinktransmissionen.

14. Apparatet (12) ifølge krav 13, hvor downlinktransmission transmitteres via en højhastighedsdownlinkdelt kanal, hvor den kodede hybride, automatiske gentagelsesanmodningsfeedbackinformation modtages fra en højhastighedsdedikeret fysisk kontrolkanal, hvor en trådløs forbindelse mellem apparatet (12) og modtagerindretningen (10) omfatter et 2x2 multiple-input-multiple-output trådløst link, hvor der er to strømme, hvor den hybride, automatiske gentagelsesanmodningsfeedbackinformation modtages kodet af et kodeord valgt blandt et antal kodeord: A, N, AA, AN, NA, NN, og hvor dataprocessoren (12A) antager alle mulige kombinationer af enkeltstrøms- og tostrømsacknowledgeinformation (A) og

negativacknowledgeinformation (N).

15. Apparatet (12) ifølge krav 13, hvor downlinktransmissionen transmitteres via en højhastighedsdownlinkdelt kanal, hvor den kodede hybride, automatiske gentagelsesanmodningsfeedbackinformation modtages fra en højhastighedsdedikeret fysisk kontrolkanal, hvor en trådløs forbindelse mellem apparatet (12) og modtagerindretningen (10) omfatter et 2x2 multiple-input-multiple-output trådløst link, hvor der er to strømme, hvor den hybride, automatiske gentagelsesanmodningsfeedbackinformation modtages kodet under anvendelse af en af en (5,1) blokkode eller en gentagelseskode, hvor diskontinuert transmission DTX bruges på en ubrugt del af en besked, for at tilvejebringe kodeordet: AX, NX, AA, AN, NA, NN, og hvor dataprocessoren (12A) antager alle mulige kombinationer af enkeltstrøms- og tostrømsacknowledgeinformation (A) og negativacknowledgeinformation (N), hvor X angiver DTX i en bitfelt.

DRAWINGS

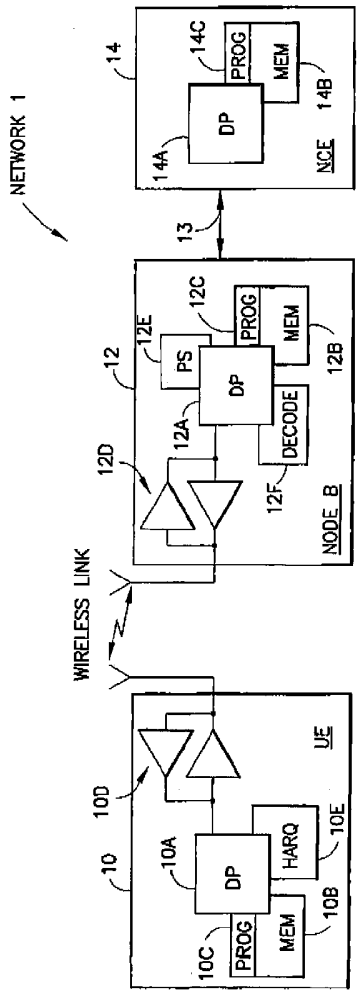


FIG.1

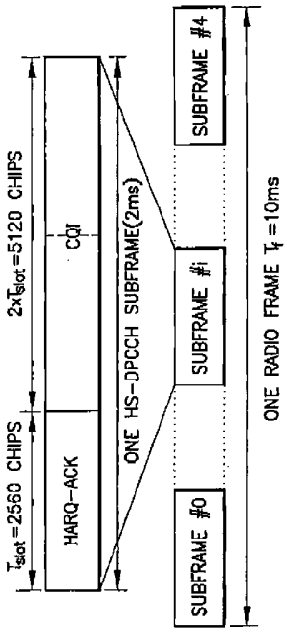


FIG.2A

SLOT FORMAT #i	CHANNEL BIT RATE(kbps)	CHANNEL SYMBOL RATE(ksps)	SF	BITS/ SUBFRAME	BITS/ SLOT	TRANSMITTED SLOTS PER SUBFRAME
0	15	15	256	30	10	3

FIG.2B

FIG.3

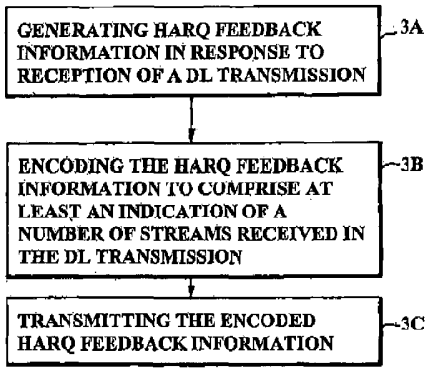
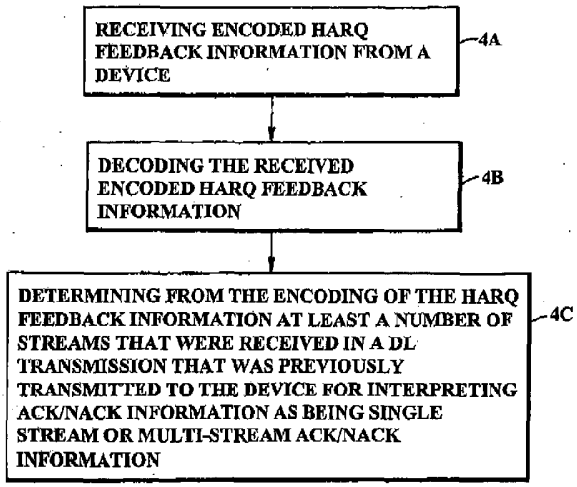

GENERATING HARQ FEEDBACK INFORMATION IN RESPONSE TO RECEPTION OF A DL TRANSMISSION
3A
ENCODING THE HARQ FEEDBACK INFORMATION TO COMPRISE AT LEAST AN INDICATION OF A NUMBER OF STREAMS RECEIVED IN THE DL TRANSMISSION
3B
TRANSMITTING THE ENCODED HARQ FEEDBACK INFORMATION
3C

FIG.4


RECEIVING ENCODED HARQ FEEDBACK INFORMATION FROM A DEVICE
4A
DECODING THE RECEIVED ENCODED HARQ FEEDBACK INFORMATION
4B
DETERMINING FROM THE ENCODING OF THE HARQ FEEDBACK INFORMATION AT LEAST A NUMBER OF STREAMS THAT WERE RECEIVED IN A DL TRANSMISSION THAT WAS PREVIOUSLY TRANSMITTED TO THE DEVICE FOR INTERPRETING ACK/NACK INFORMATION AS BEING SINGLE STREAM OR MULTI-STREAM ACK/NACK INFORMATION
4C