

SUMMARY:

[0006] One embodiment aspect is directed to a method including defining acknowledgement (Ack)/negative acknowledgement (Nack) resource offset (ARO) values in time division duplex (TDD) with a first set of values and a second set of values. The first set of values contains negative values and is used to offset hybrid automatic repeat request (HARQ) acknowledgment (ACK) resource determination so that HARQ-ACK is transmitted on physical uplink control channel (PUCCH) resources corresponding to another downlink subframe, and the second set of values contains values between -2 and $2-m$, when $m=0$, the ARO values are $\{0, -2, -1, 2\}$, when $m>0$, at least one of the first set of values allow for compressing hybrid automatic repeat request (HARQ) acknowledgments (ACKs) to a physical uplink control channel (PUCCH) resource region corresponding to downlink subframe $n < m$, where m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

[0007] According to an embodiment, when $m=0$, the ARO values are $\{0, -2, -1, 2\}$, where m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

[0008] In an embodiment, when $m>0$, at least one of the first set of values allow for compressing hybrid automatic repeat request (HARQ) acknowledgments (ACKs) to a physical uplink control channel (PUCCH) resource region corresponding to downlink subframe $n < m$, where m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

[0009] According to an embodiment, at least one of the first set of values results in hybrid automatic repeat request (HARQ) acknowledgments (ACKs) being transmitted on physical uplink control channel (PUCCH) resources corresponding to at least one of downlink subframe $n=0$ or downlink subframe $n=1$.

[0010] In an embodiment, at least one of the first set of values results in hybrid automatic repeat request (HARQ) acknowledgments (ACKs) being

[00013] Another ~~embodiment aspect~~ is directed to an apparatus including means for defining acknowledgement (Ack)/negative acknowledgement (Nack) resource offset (ARO) values in time division duplex (TDD) with a first set of values and a second set of values. The first set of values contains negative values and is used to offset hybrid automatic repeat request (HARQ) acknowledgment (ACK) resource determination so that HARQACK is transmitted on physical uplink control channel (PUCCH) resources corresponding to another downlink subframe, and the second set of values contains values between -2 and 2, wherein, when $m=0$, the ARO values are $\{0, -2, -1, 2\}$, wherein, when $m>0$, at least one of the first set of values allow for compressing hybrid automatic repeat request (HARQ) acknowledgments (ACKs) to a physical uplink control channel (PUCCH) resource region corresponding to downlink subframe $n < m$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

BRIEF DESCRIPTION OF THE DRAWINGS:

[00014] For proper understanding of the invention, reference should be made to the accompanying drawings, wherein:

[00015] Fig. 1 illustrates an example of a multi-subframe PUCCH resource arrangement, according to an embodiment;

[00016] Fig. 2 illustrates an example of multi-subframe PUCCH resource arrangement, according to another embodiment;

[00017] Fig. 3 illustrates one approach for achieving two distinct values for two ARO values, according to an embodiment;

[00018] Fig. 4 illustrates another approach for achieving two distinct values for two ARO values, according to an embodiment;

[00019] Fig. 5 illustrates another approach for achieving two distinct values for two ARO values, according to an embodiment; and

[00020] Fig. 6 illustrates an apparatus according to an embodiment.

DETAILED DESCRIPTION:

We Claim:

1. A method, comprising:

defining acknowledgement (Ack)/negative acknowledgement (Nack) resource offset (ARO) values in time division duplex (TDD) with a first set of values and a second set of values;

wherein the first set of values contains negative values and is used to offset hybrid automatic repeat request (HARQ) acknowledgment (ACK) resource determination so that HARQ-ACK is transmitted on physical uplink control channel (PUCCH) resources corresponding to another downlink subframe, and

wherein the second set of values contains values between -2 and 2,

wherein, when $m=0$, the ARO values are $\{0, -2, -1, 2\}$,

wherein, when $m>0$, at least one of the first set of values allow for compressing hybrid automatic repeat request (HARQ)

acknowledgments (ACKs) to a physical uplink control channel

(PUCCH) resource region corresponding to downlink subframe

$n < m$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

~~2. The method according to claim 1, wherein, when $m=0$, the ARO values are $\{0, -2, -1, 2\}$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).~~

~~The method according to claims 1 or 2, wherein, when $m>0$, at least one of the first set of values allow for compressing hybrid automatic repeat request (HARQ) acknowledgments (ACKs) to a physical uplink control channel (PUCCH) resource region corresponding to downlink subframe $n < m$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).~~

~~3.2~~ The method according to ~~any one of claims 1-3~~, wherein at least one of the first set of values results in hybrid automatic repeat request (HARQ) acknowledgments (ACKs) being transmitted on physical uplink control channel (PUCCH) resources corresponding to at least one of downlink

subframe $n=0$ or downlink subframe $n=1$.

5. 3. The method according to any one of claims 1-24, wherein at least one of the first set of values results in hybrid automatic repeat request (HARQ) acknowledgments (ACKs) being transmitted on physical uplink control channel (PUCCH) resources corresponding to downlink subframe n^{m-1} , wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

6. 4. An apparatus, comprising:

means for defining acknowledgement (Ack)/negative acknowledgement (Nack) resource offset (ARO) values in time division duplex (TDD) with a first set of values and a second set of values;

wherein the first set of values contains negative values and is used to offset hybrid automatic repeat request (HARQ) acknowledgment (ACK) resource determination so that HARQ-ACK is transmitted on physical uplink control channel (PUCCH) resources corresponding to another downlink subframe, and

wherein the second set of values contains values between -2 and 2,

wherein, when $m=0$, the ARO values are $\{0, -2, -1, 2\}$,

wherein, when $m>0$, at least one of the first set of values allow for

compressing hybrid automatic repeat request (HARQ)

acknowledgments (ACKs) to a physical uplink control channel

(PUCCH) resource region corresponding to downlink subframe

$n < m$, wherein m is the relative index of the downlink subframe of

the physical downlink shared channel (PDSCH) scheduled by

enhanced physical downlink control channel (EPDCCH).

~~7. The apparatus according to claim 6, wherein, when $m=0$, the ARO values are $\{0, -2, 4, 2\}$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).~~

~~8. The apparatus according to claims 6 or 7, wherein, when $m > 0$, at least one of the first set of values allow for compressing hybrid automatic repeat request (HARQ) acknowledgments (ACKs) to a physical uplink control channel (PUCCH) resource region corresponding to downlink subframe~~

~~$n < m$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).~~

95. The apparatus according to ~~any one of claims 46-8~~, wherein at least one of the first set of values results in hybrid automatic repeat request (HARQ) acknowledgments (ACKs) being transmitted on physical uplink control channel (PUCCH) resources corresponding to at least one of downlink subframe n^O or downlink subframe $n=1$.

~~106.~~ The apparatus according to any one of claims ~~4-56-9~~, wherein at least one of the first set of values results in hybrid automatic repeat request (HARQ) acknowledgments (ACKs) being transmitted on physical uplink control channel (PUCCH) resources corresponding to downlink subframe $n=m-1$, wherein m is the relative index of the downlink subframe of the physical downlink shared channel (PDSCH) scheduled by enhanced physical downlink control channel (EPDCCH).

~~744.~~ A computer program product, embodied on a computer readable medium, the computer program configured to control a processor to perform a method according to any one of claims ~~1-35~~.