

PUCCH format 1 a/1 b resources for HARQ-ACK for time division duplex signalling based on an index of the first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in an uplink subframe, the index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and one or more configured parameters wherein a dynamic offset modifier is one of the one or more configured parameters, wherein the dynamic offset modifier is applied such that the dynamic offset modifier depends on a subframe index m , and wherein multiple sets of dynamic offset modifiers are defined to be a matrix C with $(M-1)$ columns and N rows, N corresponding to the number of options to perform dynamic switching, and M being a number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, and the subframe index m is used as one factor to determine the value of the dynamic offset modifier $k(n, m)$, where n is an index of dynamic switching option signalled as downlink control information DCI via EPDCCH.

A further aspect of the invention relates to an apparatus comprising at least one processor; and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to determine PUCCH format 1 a/1 b resources for HARQ-ACK for time division duplex signalling based on an index of the first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in an uplink subframe, the index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and one or more configured parameters wherein a dynamic offset modifier is one of the one or more configured parameters, wherein the apparatus is caused to apply the dynamic offset modifier such that the dynamic offset modifier depends on a subframe index m , and wherein multiple sets of dynamic offset modifiers are defined to be a matrix C with $(M-1)$ columns and N rows, N corresponding to the number of options to perform dynamic switching, and M being a number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, and the subframe index m is used as one factor to determine the value of the dynamic offset modifier $k(n, m)$, where n is an index of dynamic switching option.

A further aspect of the invention, a method is provided comprising receiving information on a configuration of an EPDCCH set, the configuration comprising a EPDCCH-set-specific PUCCH resources starting offset and at least one EPDCCH-set-specific parameter which is equal to or a multiple of a number of eCCEs in the EPDCCH set; determining a relative index of a DL subframe, an index of the first enhanced control channel element of the EPDCCH set carrying downlink assignment, and an index of a dynamic offset modifier; using the relative index of the DL subframe and the index of dynamic offset modifier to determine a value of the dynamic offset modifier; determining at least one PUCCH resource based on the received information, the index of the first enhanced control channel element of the EPDCCH set carrying downlink assignment, the determined relative index of the DL subframe and the determined value of dynamic offset modifier, and transmitting HARQ-ACK using the at least one determined PUCCH resource.

A still further aspect of the invention relates to a user terminal comprising at least one processor; and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the user terminal to apply PUCCH format 1 a/1 b resource mapping for EPDCCH scheduled PDSCH for time division duplex signalling based on an index of the first

enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in an uplink subframe, the index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and one or more configured parameters.

5 A still further aspect of the invention relates to a computer program product comprising program code means configured to perform any of the method steps when the program is run on a computer.

10 A still further aspect of the invention relates to a computer-readable storage medium comprising program code means configured to perform any of the method steps when executed on a computer.

BRIEF DESCRIPTION OF THE DRAWINGS

15 In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 illustrates a multi-SF PUCCH resource arrangement by following

20 Rel-8/9/10;

Figure 2 illustrates an exemplary multi-SF PUCCH resource arrangement

CLAIMS

1. A method for resource allocation in a communications system, **characterized** by
determining, in a network apparatus, PUCCH format 1a/1b resources for
5 HARQ-ACK for time division duplex signalling based on
an index of the first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in an uplink subframe,
the index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and
10 one or more configured parameters.
2. A method as claimed in claim 1, **characterized** by the one or more configured parameters comprising one or more of:
- a first semi-static user terminal-specific resource starting offset defined for an EPDCCH set,
 - 15 - a second user terminal-specific resource offset defined for each EPDCCH set,
 - a dynamic offset modifier.
3. A method as claimed in claim 1 or 2, **characterized** in that a multi-subframe PUCCH format 1a/1b resource allocation is carried out for HARQ-ACK
20 corresponding to PDSCH scheduled via EPDCCH.
4. A method as claimed in any of claims 1 to 3, **characterized** in that when $M=1$, the resource determination is independent of the second user terminal-specific resource offset.
5. A method as claimed in any of claims 1 to 4, **characterized** in
25 that for time division duplex signalling when $M>1$, the second user terminal-specific resource offset impacts resource allocation when PUCCH HARQ-ACK resources for multiple downlink subframes map into a single uplink subframe.
6. A method as claimed in any of claims 1 to 5, **characterized** in that the offset for each EPDCCH set applied in each downlink subframe is dependent
30 on the first semi-static user terminal-specific resource starting offset, second user terminal-specific resource offset, and m , where $m(0...M-1)$ is a relative index of the downlink subframe, M being the number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback.
7. A method as claimed in any of claims 1 to 6, **characterized** in
35 that the dynamic offset modifier k is dependent on an antenna port or a power control

command.

8. A method as claimed in any of claims 1 to 7, **characterized** in that the dynamic offset modifier is applied such that it is independent on a subframe index m , wherein the dynamic offset modifier is derived based on downlink control information DCI that EPDCCH is carrying.

9. A method as claimed in any of claims 1 to 8, **characterized** in that a dynamic offset modifier is applied such that the dynamic offset modifier depends on a subframe index m , wherein multiple sets of dynamic offset modifiers are defined to be a matrix C with $(M-1)$ columns and N rows, N corresponding to the number of options to perform dynamic switching, M being the number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, and the subframe index m is used as one factor to determine the value of the dynamic offset modifier $k(n, m)$, where n is an index of dynamic switching option signalled as downlink control information DCI via EPDCCH.

10. A method as claimed in claim 9, **characterized** in that the resource index of the ACK/NACK resource corresponding to the m -th subframe X_m is derived from the resource index of the first subframe X_0 as $X_0 + C(m)$, where $C(m)$ is a predefined constant number.

11. A method as claimed in claim 10, **characterized** in that the matrix C is configured via a protocol layer higher than the physical layer.

12. A method as claimed in any of claims 1 to 11, **characterized** in that the dynamic offset modifier k is an antenna port-specific offset associated with antenna port p , where p is the antenna port allocated to the first control channel element CCE of corresponding EPDCCH or other explicitly signalled or implicitly derived parameter.

13. A method as claimed in any of claims 1 to 12, **characterized** by scheduling the PUCCH format 1a/1b resources for EPDCCH for time division duplex signalling based on formula I:

$$(III) \quad n_{PUCCH}^{(1)} = N_{UE-PUCCH-TDD}^{(1)} * m + n_{eCCE} + N_{UE-PUCCH}^{(1)} + k,$$

where

$n_{PUCCH}^{(1)}$ is a PUCCH format 1a/1b resource to be allocated for a HARQ-ACK signal;

$N_{UE-PUCCH}^{(1)}$ is the first semi-static user terminal-specific resource starting offset defined for an EPDCCH set;

$N_{\text{UE-PUCCH-TDD}}^{(1)}$ is the second user terminal-specific resource offset defined for EPDCCH sets when $M > 1$, M being the number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, m being a relative index of a downlink subframe, wherein $0 \leq m \leq M-1$;

5 n_{eCCE} is an index of the first enhanced control channel element eCCE used for transmission of a corresponding EPDCCH downlink assignment in a downlink subframe $n-k_m$, where m is the relative index of the downlink subframes and $0 \leq m \leq M-1$;

k is a dynamic offset modifier.

10 14. An apparatus comprising at least one processor; and at least one memory including a computer program code, **characterized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to

15 determine PUCCH format 1a/1b resources for HARQ-ACK for time division duplex signalling based on
an index of the first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in an uplink subframe,
the index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and
20 one or more configured parameters.

15 15. An apparatus as claimed in claim 14, **characterized** in that the one or more configured parameters comprise one or more of:

- a first semi-static user terminal-specific resource starting offset defined for an EPDCCH set,
- 25 - a second user terminal-specific resource offset defined for each EPDCCH set,
- a dynamic offset modifier.

30 16. An apparatus as claimed in claim 14 or 15, **characterized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to carry out a multi-subframe PUCCH format 1a/1b resource allocation for HARQ-ACK corresponding to PDSCH scheduled via EPDCCH.

35 17. An apparatus as claimed in any of claims 14 to 16, **characterized** in that when $M=1$, the resource determination is independent of the second user terminal-specific resource offset.

~~18. An apparatus as claimed in any of claims 14 to 17, **character-**~~

ized in that for time division duplex signalling when $M > 1$, the second user terminal-specific resource offset impacts resource allocation when PUCCH HARQ-ACK resources for multiple downlink subframes map into a single uplink subframe.

19. An apparatus as claimed in any of claims 14 to 18, **character-**
 5 **ized** in that the offset for each EPDCCH set applied in each downlink subframe is dependent on the first semi-static user terminal-specific resource starting offset, second user terminal-specific resource offset, and m , where $m(0 \dots M-1)$ is a relative index of the downlink subframe, M being the number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback.

10 20. An apparatus as claimed in any of claims 14 to 19, **character-**
ized in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply the dynamic offset modifier k dependent on an antenna port or a power control command.

21. An apparatus as claimed in any of claims 14 to 20, **character-**
 15 **ized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply the dynamic offset modifier such that it is independent on a subframe index m , wherein the dynamic offset modifier is derived based on downlink control information DCI that EPDCCH is carrying.

20 22. An apparatus as claimed in any of claims 14 to 21, **character-**
ized in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply the dynamic offset modifier such that the dynamic offset modifier depends on a subframe index m , wherein multiple sets of dynamic offset modifiers are defined to be a matrix C with $(M-$
 25 $1)$ columns and N rows, N corresponding to the number of options to perform dynamic switching, M being the number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, and the subframe index m is used as one factor to determine the value of the dynamic offset modifier $k(n, m)$, where n is an index of dynamic switching option.

30 23. An apparatus as claimed in claim 22, **characterized** in that the resource index of the ACK/NACK resource corresponding to the m -th subframe X_m is derived from the resource index of the first subframe X_0 as $X_0 + C(m)$, where $C(m)$ is a predefined constant number.

35 24. An apparatus as claimed in claim 23, **characterized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to define the matrix C via a protocol layer

higher than the physical layer.

25. An apparatus as claimed in any of claims 14 to 24, **characterized** in that the dynamic offset modifier k is an antenna port-specific offset associated with antenna port p , where p is the antenna port allocated to the first control channel element CCE of corresponding EPDCCH or other explicitly signaled or implicitly derived parameter.

26. An apparatus as claimed in any of claims 14 to 25, **characterized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to set the parameter $N_{\text{UE-PUCCH-TDD}}^{(1)}$ as

the number of PUCCH resources corresponding to a first EPDCCH set + the number of PUCCH resources corresponding to a second EPDCCH set; or

the number of eCCEs in the first EPDCCH set + the number of eCCEs in the second EPDCCH set.

27. An apparatus as claimed in any of claims 14 to 26, **characterized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to schedule the PUCCH format 1a/1b resources for EPDCCH for time division duplex signalling based on formula I:

$$(IV) \quad n_{\text{PUCCH}}^{(1)} = N_{\text{UE-PUCCH-TDD}}^{(1)} * m + n_{\text{eCCE}} + N_{\text{UE-PUCCH}}^{(1)} + k,$$

where

$n_{\text{PUCCH}}^{(1)}$ is a PUCCH format 1a/1b resource to be allocated for a HARQ-

ACK signal;

$N_{\text{UE-PUCCH}}^{(1)}$ is the first semi-static user terminal-specific resource starting offset defined for an EPDCCH set;

$N_{\text{UE-PUCCH-TDD}}^{(1)}$ is the second user terminal-specific resource offset defined for EPDCCH sets when $M > 1$, M being the number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, m being a relative index of a downlink subframe, wherein $0 \leq m \leq M-1$;

n_{eCCE} is an index of the first enhanced control channel element eCCE used for transmission of a corresponding EPDCCH downlink assignment in a downlink subframe $n - k_m$, where m is the relative index of the downlink subframes

and $0 \leq m \leq M-1$;

k is a dynamic offset modifier.

28. A user terminal comprising at least one processor; and at least one memory including a computer program code, **characterized** in that the at least one memory and the computer program code are configured to, with the at least one processor, cause the user terminal to

5 apply PUCCH format 1a/1b resource mapping for EPDCCH scheduled PDSCH for time division duplex signalling based on

an index of the first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in an uplink subframe,

10 the index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and

one or more configured parameters.

29. A user terminal as claimed in claim 28, **characterized** by the one or more configured parameters comprising one or more of:

- 15
- a first semi-static user terminal-specific resource starting offset defined for an EPDCCH set,
 - a second user terminal-specific resource offset defined for each EPDCCH set,
 - a dynamic offset modifier.

20 30. A computer program product, **characterized** by comprising program code means configured to perform any of method steps of claims 1 to 13 when the program is run on a computer.

31. A computer-readable storage medium, **characterized** by comprising program code means configured to perform any of method steps of claims

25 1 to 13 when executed on a computer.

What is claimed is:

1. A method for resource allocation in a communications system, the method comprising:
 - determining, in a network apparatus, PUCCH format 1a/1b resources for HARQ-ACK for time division duplex signalling based on:
 - an index of a first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in a downlink subframe,
 - an index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and
 - one or more configured parameters, wherein a dynamic offset modifier is one of the one or more configured parameters, wherein the dynamic offset modifier is applied such that the dynamic offset modifier depends on a subframe index m , and wherein multiple sets of dynamic offset modifiers are defined to be a matrix C with $(M-1)$ columns and N rows, N corresponding to the number of options to perform dynamic switching, and M being a number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, and the subframe index m is used as one factor to determine the value of the dynamic offset modifier $k(n, m)$, where n is an index of dynamic switching option signalled as downlink control information DCI via EPDCCH.
2. The method as claimed in claim 1, wherein the one or more configured parameters comprise one or more of:
 - a first semi-static user terminal-specific resource starting offset defined for an EPDCCH set; and
 - a second user terminal-specific resource offset defined for each EPDCCH set.
3. The method as claimed in claim 1 or 2, wherein a multi-subframe PUCCH format 1a/1b resource allocation is carried out for HARQ-ACK corresponding to PDSCH scheduled via EPDCCH.
4. The method as claimed in claim 2, wherein when $M=1$, the resource determination is independent of the second user terminal-specific resource offset.

5. The method as claimed in claim 2, wherein for time division duplex signalling when $M > 1$, the second user terminal-specific resource offset impacts resource allocation when PUCCH HARQ-ACK resources for multiple downlink subframes map into a single uplink subframe.
6. The method as claimed in claim 2, wherein an offset for each EPDCCH set applied in each downlink subframe is dependent on the first semi-static user terminal-specific resource starting offset, second user terminal-specific resource offset, and m , where $m(0 \dots M-1)$ is a relative index of the downlink subframe, M being the number of downlink subframes associated with the uplink subframe for HARQ-ACK feedback.
7. The method as claimed in any of claims 1 to 6, wherein the dynamic offset modifier k is dependent on an antenna port or a power control command.
8. The method as claimed in any of claims 1 to 7, wherein the dynamic offset modifier is applied such that it is independent on a subframe index m , and wherein the dynamic offset modifier is derived based on downlink control information DCI that EPDCCH is carrying.
9. The method as claimed in claim in any of claims 1 to 8, wherein a resource index of an ACK/NACK resource corresponding to the m -th subframe X_m , is derived from a resource index of a first subframe X_0 as $X_0 + C(m)$, where $C(m)$ is a predefined constant number.
10. The method as claimed in claim 9, wherein the matrix C is configured via a protocol layer higher than the physical layer.
11. The method as claimed in any of claims 1 to 6, wherein the dynamic offset modifier k is an antenna port-specific offset associated with antenna port p , where p is the antenna port allocated to a first control channel element CCE of corresponding EPDCCH or other explicitly signalled or implicitly derived parameter.
12. The method as claimed in claim 2, further comprising scheduling the PUCCH format 1a/1b resources for EPDCCH for time division duplex signalling based on formula I:

$$(I) \quad n_{PUCCH}^{(1)} = N_{UE-PUCCH-TDD}^{(1)} * m + n_{eCCE} + N_{UE-PUCCH}^{(1)} + k,$$

where:

$n_{PUCCH}^{(1)}$ is the first semi-static user terminal-specific resource starting offset defined for an EPDCCH set;

$N_{UE-PUCCH-TDD}^{(1)}$ is the second user terminal-specific resource offset defined for EPDCCH sets when $M > 1$, M being the number of downlink subframes associated with the uplink subframe for HARQ-ACK feedback, m being a relative index of a downlink subframe, wherein $0 \leq m \leq M-1$;

n_{eCCE} is an index of the first enhanced control channel element eCCE used for transmission of a corresponding EPDCCH downlink assignment in a downlink subframe $n k_m$, where m is the relative index of the downlink subframes and $0 \leq m \leq M-1$; and

k is a dynamic offset modifier.

13. An apparatus comprising at least one processor and at least one memory including a computer program code, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to:

determine PUCCH format 1a/1b resources for HARQ-ACK for time division duplex signalling based on:

an index of a first enhanced control channel element used for transmission of a corresponding EPDCCH downlink assignment in a downlink subframe,

an index of the downlink subframe in which the EPDCCH downlink assignment is transmitted, and

one or more configured parameters, wherein a dynamic offset modifier is one of the one or more configured parameters, wherein the apparatus is caused to apply the dynamic offset modifier such that the dynamic offset modifier depends on a subframe index m , and wherein multiple sets of dynamic offset modifiers are defined to be a matrix C with $(M-1)$ columns and N rows, N corresponding to the number of options to perform dynamic switching, and M being a number of downlink subframes associated with an uplink subframe for HARQ-ACK feedback, and the subframe index m is used as one factor to determine the value of the dynamic offset modifier $k(n, m)$, where n is an index of dynamic switching option.

14. The apparatus as claimed in claim 13, wherein the one or more configured parameters comprise one or more of:

a first semi-static user terminal-specific resource starting offset defined for an EPDCCH set; and

a second user terminal-specific resource offset defined for each EPDCCH set.

15. The apparatus as claimed in claim 13 or 14, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to carry out a multi-subframe PUCCH format 1a/1b resource allocation for HARQ-ACK corresponding to PDSCH scheduled via EPDCCH.

16. The apparatus as claimed in claim 14, wherein when $M=1$, the resource determination is independent of the second user terminal-specific resource offset.

17. The apparatus as claimed in claim 14, wherein for time division duplex signalling when $M>1$, the second user terminal-specific resource offset impacts resource allocation when PUCCH HARQ-ACK resources for multiple downlink subframes map into a single uplink subframe.

18. The apparatus as claimed in claim 14, wherein an offset for each EPDCCH set applied in each downlink subframe is dependent on the first semi-static user terminal-specific resource starting offset, second user terminal-specific resource offset, and m , where $m(0...M-1)$ is a relative index of the downlink subframe, M being the number of downlink subframes associated with the uplink subframe for HARQ-ACK feedback.

19. The apparatus as claimed in any of claims 13 to 18, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply the dynamic offset modifier k dependent on an antenna port or a power control command.

20. The apparatus as claimed in any of claims 13 to 19, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to apply the dynamic offset modifier such that it is independent on a subframe index m , and wherein the dynamic offset modifier is derived based on downlink control information DCI that EPDCCH is carrying.

21. The apparatus as claimed in claim in any of claims 13 to 20, wherein a resource index of an ACK/NACK resource corresponding to the m -th subframe X_m , is derived from a resource index of a first subframe X_0 as $X_0 + C(m)$, where $C(m)$ is a predefined constant number.

22. The apparatus as claimed in claim 21, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to define the matrix C via a protocol layer higher than the physical layer.

23. The apparatus as claimed in any of claims 13 to 18, wherein the dynamic offset modifier k is an antenna port-specific offset associated with antenna port p , where p is the antenna port allocated to a first control channel element CCE of corresponding EPDCCH or other explicitly signaled or implicitly derived parameter.

24. The apparatus as claimed in any of claims 13 to 23, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to set a parameter $N_{UE-PUCCH-TDD}^{(1)}$ as:

a number of PUCCH resources corresponding to a first EPDCCH set +
a number of PUCCH resources corresponding to a second EPDCCH set; or
a number of eCCEs in the first EPDCCH set + a number of eCCEs in the second EPDCCH set.

25. The apparatus as claimed in claim 14, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the apparatus to schedule the PUCCH format 1a/1b resources for EPDCCH for time division duplex signalling based on formula II:

$$(II) \ n_{PUCCH}^{(1)} = N_{UE-PUCCH-TDD}^{(1)} * m + n_{eCCE} + N_{UE-PUCCH}^{(1)} + k,$$

where:

$n_{PUCCH}^{(1)}$ is a PUCCH format 1a/1b resource to be allocated for a HARQ-ACK signal;

$N_{UE-PUCCH}^{(1)}$ is the first semi-static user terminal-specific resource starting offset defined for an EPDCCH set;

$N_{UE-PUCCH-TDD}^{(1)}$ is the second user terminal-specific resource offset defined for EPDCCH sets when $M > 1$, M being the number of downlink subframes

associated with the uplink subframe for HARQ-ACK feedback, m being a relative index of a downlink subframe, wherein $0 \leq m \leq M-1$;

n_{eCCE} is an index of the first enhanced control channel element eCCE used for transmission of a corresponding EPDCCH downlink assignment in a downlink subframe $n k_m$, where m is the relative index of the downlink subframes and $0 \leq m \leq M-1$; and

k is a dynamic offset modifier.

26. A computer-readable storage medium having program code stored thereon, the program code when executed by a processor performing the method of any one of claims 1 to 12.

27. A method comprising:

receiving information on a configuration of an EPDCCH set, the configuration comprising a EPDCCH-set-specific PUCCH resources starting offset and at least one EPDCCH-set-specific parameter which is equal to or a multiple of a number of eCCEs in the EPDCCH set;

determining a relative index of a DL subframe, an index of the first enhanced control channel element of the EPDCCH set carrying downlink assignment, and an index of a dynamic offset modifier;

using the relative index of the DL subframe and the index of dynamic offset modifier to determine a value of the dynamic offset modifier;

determining at least one PUCCH resource based on the received information, the index of the first enhanced control channel element of the EPDCCH set carrying downlink assignment, the determined relative index of the DL subframe and the determined value of dynamic offset modifier, and

transmitting HARQ-ACK using the at least one determined PUCCH resource.

28. The method as claimed in claim 27, further comprising applying the at least one EPDCCH-set-specific parameter downlink-subframe specifically.

29. The method as claimed in claim 27 or 28, further comprising setting the relative index of the DL subframe 1 and deriving an index of the at least one PUCCH resource for a second subframe from a resource index of the at least one PUCCH resource of the first subframe.

30. The method as claimed in any one of claims 27 to 29, further comprising setting the at least one EPDCCH-set-specific parameter zero for making subframes overlapping.