

CLAIMS

WHAT IS CLAIMED IS:

1. A method for wireless communications by a user equipment, comprising:
receiving downlink control information (DCI) comprising one or more resource indicator (RI) bits configured to indicate to the user equipment a subset of resources available for transmitting uplink control information (UCI) in a physical uplink control channel (PUCCH) transmission, wherein the DCI is received on one or more resources of a first physical downlink control channel (PDCCH) transmission;
identifying resources within the subset indicated by the RI bits to transmit the UCI based on an implicit mapping of PDCCH resources to PUCCH resources and the one or more resources of the first PDCCH transmission; and
transmitting the UCI using the identified resources.
2. The method of claim 1, further comprising:
receiving multiple PDCCH transmissions on multiple component carriers (CCs) or across multiple slots, wherein the UCI acknowledges the multiple PDCCH transmissions.
3. The method of claim 2, wherein the first PDCCH transmission is a last transmission of the multiple PDCCH transmissions.
4. The method of claim 2, wherein the first PDCCH transmission has a smallest component carrier (CC) index of the multiple PDCCH transmissions.
5. The method of claim 2, wherein the UCI acknowledging the multiple PDCCH transmissions is sent in a same uplink (UL) slot.
6. The method of claim 1, wherein at least two of the plurality of subsets have different sizes.

7. The method of claim 1, wherein each of the plurality of subsets has the same size.
8. The method of claim 1, wherein the implicit mapping is based on a control channel element (CCE) index of the first PDCCH transmission.
9. The method of claim 1, wherein a number of RI bits is X , wherein a total number of PUCCH resources is Y , wherein a total number of subsets of the PUCCH resources is 2^X , wherein $(Y \bmod 2^X)$ of the total number of subsets consist of $(\text{floor}(Y/2^X)+1)$ PUCCH resources and any remaining of the total number of subsets consist of $(\text{floor}(Y/2^X))$ PUCCH resources.
10. A method for wireless communications by a user equipment, comprising:
 - receiving, from a base station, an uplink grant comprising one or more downlink assignment index (DAI) bits;
 - determining a number of bits to use to transmit an acknowledgement (ACK) based on the DAI bits; and
 - transmitting, to the base station, the ACK using the determined number of bits.
11. The method of claim 10, wherein transmitting the ACK comprises transmitting the ACK on a physical uplink shared channel (PUSCH).
12. The method of claim 11, wherein when the determined number of bits is 1 or 2 the ACK punctures the PUSCH, and wherein when the determined number of bits is greater than 2 the ACK is rate matched around the PUSCH.
13. The method of claim 10, wherein the user equipment and base station are configured with a semi-static HARQ-ACK codebook size, and wherein a number of DAI bits is one and the one DAI bit indicates whether or not to transmit the ACK.

14. A method for wireless communications by a network entity, comprising:
 - transmitting downlink control information (DCI) comprising one or more resource indicator (RI) bits configured to indicate to a user equipment a subset of resources available for transmitting uplink control information (UCI) in a physical uplink control channel (PUCCH) transmission, wherein the DCI is transmitted on one or more resources of a first physical downlink control channel (PDCCH) transmission;
 - identifying resources within the subset indicated by the RI bits to monitor for the UCI based on an implicit mapping of PDCCH resources to PUCCH resources and the one or more resources of the first PDCCH transmission; and
 - monitoring the identified resources for the UCI.
15. The method of claim 14, further comprising:
 - transmitting multiple PDCCH transmissions on multiple component carriers (CCs) or across multiple slots, wherein the UCI acknowledges the multiple PDCCH transmissions.
16. The method of claim 15, wherein the first PDCCH transmission is a last transmission of the multiple PDCCH transmissions.
17. The method of claim 15, wherein the first PDCCH transmission has a smallest component carrier (CC) index of the multiple PDCCH transmissions.
18. The method of claim 15, wherein the UCI acknowledging the multiple PDCCH transmissions is communicated in a same uplink (UL) slot.
19. The method of claim 14, wherein at least two of the plurality of subsets have different sizes.
20. The method of claim 14, wherein each of the plurality of subsets has the same size.

21. The method of claim 14, wherein the implicit mapping is based on a control channel element (CCE) index of the first PDCCH transmission.
22. The method of claim 14, wherein a number of RI bits is X , wherein a total number of PUCCH resources is Y , wherein a total number of subsets of the PUCCH resources is 2^X , wherein $(Y \bmod 2^X)$ of the total number of subsets consist of $(\text{floor}(Y/2^X)+1)$ PUCCH resources and any remaining of the total number of subsets consist of $(\text{floor}(Y/2^X))$ PUCCH resources.
23. A method for wireless communications by a network entity, comprising:
transmitting, to a user equipment, an uplink grant comprising one or more downlink assignment index (DAI) bits indicating a number of bits for the user equipment to use to transmit an acknowledgement (ACK) based on the DAI bits; and
receiving, from the user equipment, the ACK using the number of bits.
24. The method of claim 23, wherein receiving the ACK comprises receiving the ACK on a physical uplink shared channel (PUSCH).
25. The method of claim 24, wherein when the number of bits is 1 or 2 the ACK punctures the PUSCH, and wherein when the number of bits is greater than 2 the ACK is rate matched around the PUSCH.
26. The method of claim 23, wherein the user equipment and network entity are configured with a semi-static HARQ-ACK codebook size, and wherein a number of DAI bits is one and the one DAI bit indicates whether or not to transmit the ACK.
27. A user equipment comprising:
a memory; and
a processor coupled to the memory, wherein the processor is configured to:
receive downlink control information (DCI) comprising one or more resource indicator (RI) bits configured to indicate to the user equipment a subset of resources available for transmitting uplink control information (UCI) in a

physical uplink control channel (PUCCH) transmission, wherein the DCI is received on one or more resources of a first physical downlink control channel (PDCCH) transmission;

identify resources within the subset indicated by the RI bits to transmit the UCI based on an implicit mapping of PDCCH resources to PUCCH resources and the one or more resources of the first PDCCH transmission; and transmit the UCI using the identified resources.

28. The user equipment of claim 27, wherein the processor is further configured to: receive multiple PDCCH transmissions on multiple component carriers (CCs) or across multiple slots, wherein the UCI acknowledges the multiple PDCCH transmissions.
29. The user equipment of claim 28, wherein the first PDCCH transmission is a last transmission of the multiple PDCCH transmissions.
30. The user equipment of claim 28, wherein the first PDCCH transmission has a smallest component carrier (CC) index of the multiple PDCCH transmissions.
31. The user equipment of claim 28, wherein the UCI acknowledging the multiple PDCCH transmissions is sent in a same uplink (UL) slot.
32. The user equipment of claim 27, wherein at least two of the plurality of subsets have different sizes.
33. The user equipment of claim 27, wherein each of the plurality of subsets has the same size.
34. The user equipment of claim 27, wherein the implicit mapping is based on a control channel element (CCE) index of the first PDCCH transmission.

35. The user equipment of claim 27, wherein a number of RI bits is X , wherein a total number of PUCCH resources is Y , wherein a total number of subsets of the PUCCH resources is 2^X , wherein $(Y \bmod 2^X)$ of the total number of subsets consist of $(\text{floor}(Y/2^X)+1)$ PUCCH resources and any remaining of the total number of subsets consist of $(\text{floor}(Y/2^X))$ PUCCH resources.

36. A user equipment comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

receive, from a base station, an uplink grant comprising one or more downlink assignment index (DAI) bits;

determine a number of bits to use to transmit an acknowledgement (ACK) based on the DAI bits; and

transmit, to the base station, the ACK using the determined number of bits.

37. The user equipment of claim 36, wherein to transmit the ACK comprises to transmit the ACK on a physical uplink shared channel (PUSCH).

38. The user equipment of claim 37, wherein when the determined number of bits is 1 or 2 the ACK punctures the PUSCH, and wherein when the determined number of bits is greater than 2 the ACK is rate matched around the PUSCH.

39. The user equipment of claim 36, wherein the user equipment and base station are configured with a semi-static HARQ-ACK codebook size, and wherein a number of DAI bits is one and the one DAI bit indicates whether or not to transmit the ACK.

40. A network entity comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

transmit downlink control information (DCI) comprising one or more resource indicator (RI) bits configured to indicate to a user equipment a subset of resources available for transmitting uplink control information (UCI) in a physical uplink control channel (PUCCH) transmission, wherein the DCI is transmitted on one or more resources of a first physical downlink control channel (PDCCH) transmission;

identify resources within the subset indicated by the RI bits to monitor for the UCI based on an implicit mapping of PDCCH resources to PUCCH resources and the one or more resources of the first PDCCH transmission; and
monitor the identified resources for the UCI.

41. The network entity of claim 40, wherein the processor is further configured to:
transmit multiple PDCCH transmissions on multiple component carriers (CCs) or across multiple slots, wherein the UCI acknowledges the multiple PDCCH transmissions.
42. The network entity of claim 41, wherein the first PDCCH transmission is a last transmission of the multiple PDCCH transmissions.
43. The network entity of claim 41, wherein the first PDCCH transmission has a smallest component carrier (CC) index of the multiple PDCCH transmissions.
44. The network entity of claim 41, wherein the UCI acknowledging the multiple PDCCH transmissions is communicated in a same uplink (UL) slot.
45. The network entity of claim 40, wherein at least two of the plurality of subsets have different sizes.
46. The network entity of claim 40, wherein each of the plurality of subsets has the same size.

47. The network entity of claim 40, wherein the implicit mapping is based on a control channel element (CCE) index of the first PDCCH transmission.
48. The network entity of claim 40, wherein a number of RI bits is X , wherein a total number of PUCCH resources is Y , wherein a total number of subsets of the PUCCH resources is 2^X , wherein $(Y \bmod 2^X)$ of the total number of subsets consist of $(\text{floor}(Y/2^X)+1)$ PUCCH resources and any remaining of the total number of subsets consist of $(\text{floor}(Y/2^X))$ PUCCH resources.
49. A network entity comprising:
a memory; and
a processor coupled to the memory, wherein the processor is configured to:
transmit, to a user equipment, an uplink grant comprising one or more downlink assignment index (DAI) bits indicating a number of bits for the user equipment to use to transmit an acknowledgement (ACK) based on the DAI bits;
and
receive, from the user equipment, the ACK using the number of bits.
50. The network entity of claim 49, wherein to receive the ACK comprises to receive the ACK on a physical uplink shared channel (PUSCH).
51. The network entity of claim 50, wherein when the number of bits is 1 or 2 the ACK punctures the PUSCH, and wherein when the number of bits is greater than 2 the ACK is rate matched around the PUSCH.
52. The network entity of claim 49, wherein the user equipment and network entity are configured with a semi-static HARQ-ACK codebook size, and wherein a number of DAI bits is one and the one DAI bit indicates whether or not to transmit the ACK.