CLAIMS

1. A method of high-efficiency wireless frequency division multiplexing, comprising: receiving, at a first wireless device, a reference signal from an associated access point, the reference signal indicative of a time of joint transmission with at least a second wireless device and a deferral time for third party devices, the reference signal comprising one or more station information fields, a frame check sequence (FCS), and one or more padding bits between a final station information field and the FCS, the reference signal only being sent on a primary channel with an indication that only idle channels are to be used; and transmitting a first communication to the associated access point based on the reference signal, the first communication utilizing a first subset of wireless frequencies and being concurrent with a second communication from the second wireless device, the second communication utilizing a second subset of wireless frequencies, the second subset of wireless frequencies excluding the first subset of wireless frequencies.

2. The method of claim 1, further comprising transmitting the reference signal in response to reception of a ready-to-send (RTX) frame at the associated access point, the reference signal comprising a ready-to-send (RTX) frame comprising one or more of: a frame control field, a duration field, a source address field, a destination address field, and an information payload comprising one or more of the following indications: a requested transmission time, the size of the queues for transmission, a quality-of-service (QoS) indication for the requested transmission, and a requested transmission bandwidth.

3. The method of claim 1, the reference signal comprising a clear-to-send (CTS) comprising a frame including a high throughput control (HTC) field with an indication reverse decision grant (RDG)=1.

4. The method of claim 1, the reference signal comprising a frame including a high throughput control (HTC) field with an indication reverse decision grant (RDG)=1.

5. The method of claim 1, the reference signal comprising at least a portion of a power save multi-poll (PSMP) frame, a PSMP-UTT start offset within a STA info field identifying the start time for uplink frequency division multiple access (UL FDMA) transmissions, a PSMP-UTT duration identifies the duration of the UL FDMA transmission, and a STA ID field comprising an identifier of STAs allowed to transmit.

6. The method of claim 1, the reference signal further comprising a frame control field, a duration field, a receive address field, a transmit address field, and a length field.

7. The method of claim 1, the reference signal including an indication of the first subset of wireless frequencies.

8. The method of claim 1, further comprising detecting an interference level on one or more

wireless frequencies and determining the first subset of wireless frequencies based on the interference level.

9. The method of claim 1, further comprising determining the first subset of wireless frequencies based on a tone interleaved channel with frequency hopping.

10. The method of claim 1, the reference signal including an indication of the first subset of wireless frequencies, and the method further comprising transmitting the indication of the first subset of wireless frequencies to one or more devices not associated with the associated access point.

11. The method of claim 1, the reference signal comprising an indication of devices that are eligible to transmit at a particular time.

12. The method of claim 1, the reference signal comprising an indication of a power level at which at least one device should transmit.

13. The method of claim 1, the reference signal comprising an assignment of channels to at least the first wireless device.

14. The method of claim 1, the reference signal comprising an indication of a transmission time of at least the first wireless device.

15. The method of claim 1, the reference signal comprising a clear-to-send frame (CTS).

16. The method of claim 1, the reference signal comprising a clear-to-send frame (CTS) and an extended payload comprising one or more payload elements.

17. The method of claim 1, the reference signal comprising a clear-to-send frame (CTS) comprising a high-throughput control (HTC) field indicating one or more target devices.

18. The method of claim 1, the reference signal comprising an aggregated media access control protocol data unit (A-MPDU) comprising a clear-to-send frame (CTS) and one or more payload elements.

19. The method of claim 1, further comprising transmitting to the associated access point a quality-of-service (QoS) field indicating that the first device is ready to send data.

20. The method of claim 1, further comprising transmitting to the associated access point a power-save poll (PS-Poll) frame indicating that the first device is ready to send data.

21. The method of claim 1, wherein the first subset of wireless frequencies comprises a 20 or 40 or 80 MHz channel according to an Institute of Electrical and Electronics Engineers (IEEE)

802.11 standard.

22. The method of claim 1, wherein the first and second subset of wireless frequencies are within an operating bandwidth of the associated access point.

23. The method of claim 1, wherein the first and second communications start at the time of joint transmission indicated by the reference signal, within a margin of transmission time error.

24. The method of claim 1, wherein the first and second communications start at different times.

25. The method of claim 1, wherein the first and second communications end at the time of joint transmission indicated by the reference signal, within a margin of transmission time error.

26. The method of claim 1, wherein the first and second communications end at different times.

27. The method of claim 1, the reference signal being sent by the associated access point according to a sense multiple access (CSMA) mechanism.

28. The method of claim 1, the reference signal being sent by the associated access point at a time previously scheduled with at least the first device via management signaling.

29. The method of claim 1, the reference signal comprising management signaling indicating one or more future times of joint transmission.

30. The method of claim 1, wherein the reference signal is sent at least on a primary channel.

31. The method of claim 1, wherein the reference signal is sent on a primary channel and on all or a portion of secondary channels that are idle for a sensing time before the transmission.

32. The method of claim 1, wherein the reference signal is sent on channels compatible with the first and second devices.

33. The method of claim 1, wherein at least the first device indicates to the associated access point a channel use capability.

34. The method of claim 1, wherein the reference signal is sent on idle channels only.

35. A first wireless device configured to perform high-efficiency wireless frequency division multiplexing, comprising: a receiver configured to receive a reference signal from an associated access point, the reference signal indicative of a time of joint transmission with at least a second wireless device and a deferral time for third party devices, the reference signal comprising one or more station information fields, a frame check sequence (FCS), and one or more padding bits between a final station information field and the FCS, the reference signal only being sent on a

primary channel with an indication that only idle channels are to be used; and a transmitter configured to transmit a first communication to the associated access point based on the reference signal, the first communication utilizing a first subset of wireless frequencies and being concurrent with a second communication from the second wireless device, the second communication utilizing a second subset of wireless frequencies, the second subset of wireless frequencies excluding the first subset of wireless frequencies.

36. The device of claim 35, the transmitter being further configured to transmit the reference signal in response to reception of a ready-to-send (RTX) frame at the associated access point, the reference signal comprising a ready-to-send (RTX) frame comprising one or more of: a frame control field, a duration field, a source address field, a destination address field, and an information payload comprising one or more of the following indications: a requested transmission time, the size of the queues for transmission, a quality-of-service (QoS) indication for the requested transmission, and a requested transmission bandwidth.

37. The device of claim 35, the reference signal comprising a clear-to-send (CTS) frame comprising a frame including a high throughput control (HTC) field with an indication reverse decision grant (RDG)=1.

38. The device of claim 35, the reference signal comprising a frame including a high throughput control (HTC) field with an indication reverse decision grant (RDG)=1.

39. The device of claim 35, the reference signal comprising at least a portion of a power save multi-poll (PSMP) frame, a PSMP-UTT start offset within a STA info field identifying the start time for uplink frequency division multiple access (UL FDMA) transmissions, a PSMP-UTT duration identifies the duration of the UL FDMA transmission, and a STA ID field comprising an identifier of STAs allowed to transmit.

40. The device of claim 35, the reference signal further comprising a frame control field, a duration field, a receive address field, a transmit address field, and a length field.

41. The device of claim 35, the reference signal including an indication of the first subset of wireless frequencies.

42. The device of claim 35, further comprising a processor configured to detect an interference level on one or more wireless frequencies and determining the first subset of wireless frequencies based on the interference level.

43. The device of claim 35, further comprising a processor configured to determine the first subset of wireless frequencies based on a tone interleaved channel with frequency hopping.

44. The device of claim 35, the reference signal including an indication of the first subset of wireless frequencies, and the transmitter being further configured to transmit the indication of the

first subset of wireless frequencies to one or more devices not associated with the associated access point.

45. The device of claim 35, the reference signal comprising an indication of devices that are eligible to transmit at a particular time.

46. The device of claim 35, the reference signal comprising an indication of a power level at which at least one device should transmit.

47. The device of claim 35, the reference signal comprising an assignment of channels to at least the first wireless device.

48. The device of claim 35, the reference signal comprising an indication of a transmission time of at least the first wireless device.

49. The device of claim 35, the reference signal comprising a clear-to-send frame (CTS).

50. The device of claim 35, the reference signal comprising a clear-to-send frame (CTS) and an extended payload comprising one or more payload elements.

51. The device of claim 35, the reference signal comprising a clear-to-send frame (CTS) comprising a high-throughput control (HTC) field indicating one or more target devices.

52. The device of claim 35, the reference signal comprising an aggregated media access control protocol data unit (A-MPDU) comprising a clear-to-send frame (CTS) and one or more payload elements.

53. The device of claim 35, the transmitter being further configured to transmit to the associated access point a quality-of-service (QoS) field indicating that the first device is ready to send data.

54. The device of claim 35, the transmitter being further configured to transmit to the associated access point a power-save poll (PS-Poll) frame indicating that the first device is ready to send data.

55. The device of claim 35, wherein the first subset of wireless frequencies comprises a 20 or 40 or 80 MHz channel according to an Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard.

56. The device of claim 35, wherein the first and second subset of wireless frequencies are within an operating bandwidth of the associated access point.

57. The device of claim 35, wherein the first and second communications start at the time of joint transmission indicated by the reference signal, within a margin of transmission time error.

58. The device of claim 35, wherein the first and second communications start at different times.

59. The device of claim 35, wherein the first and second communications end at the time of joint transmission indicated by the reference signal, within a margin of transmission time error.

60. The device of claim 35, wherein the first and second communications end at different times.

61. The device of claim 35, the reference signal being sent by the associated access point according to a sense multiple access (CSMA) mechanism.

62. The device of claim 35, the reference signal being sent by the associated access point at a time previously scheduled with at least the first device via management signaling.

63. The device of claim 35, the reference signal comprising management signaling indicating one or more future times of joint transmission.

64. The device of claim 35, wherein the reference signal is sent at least on a primary channel.

65. The device of claim 35, wherein the reference signal is sent on a primary channel and on all or a portion of secondary channels that are idle for a sensing time before the transmission.

66. The device of claim 35, wherein the reference signal is sent on channels compatible with the first and second devices.

67. The device of claim 35, wherein at least the first device indicates to the associated access point a channel use capability.

68. The device of claim 35, wherein the reference signal is sent on idle channels only.

69. An apparatus for high-efficiency wireless frequency division multiplexing, comprising: means for receiving, at a first wireless device, a reference signal from an associated access point, the reference signal indicative of a time of joint transmission with at least a second wireless device and a deferral time for third party devices, the reference signal comprising one or more station information fields, a frame check sequence (FCS), and one or more padding bits between a final station information field and the FCS, the reference signal only being sent on a primary channel with an indication that only idle channels are to be used; and means for transmitting a first communication to the associated access point based on the reference signal, the first communication utilizing a first subset of wireless frequencies and being concurrent with a second communication from the second wireless device, the second communication utilizing a second subset of wireless frequencies, the second subset of wireless frequencies excluding the first subset of wireless frequencies.

70. A non-transitory computer-readable medium comprising code that, when executed, causes an apparatus to: receive, at a first wireless device, a reference signal from an associated access point, the reference signal indicative of a time of joint transmission with at least a second wireless device and a deferral time for third party devices, the reference signal comprising one or more station information fields, a frame check sequence (FCS), and one or more padding bits between a final station information field and the FCS, the reference signal only being sent on a primary channel with an indication that only idle channels are to be used; and transmit a first communication to the associated access point based on the reference signal, the first communication utilizing a first subset of wireless frequencies and being concurrent with a second communication from the second wireless device, the second communication utilizing a second subset of wireless frequencies, the second subset of wireless frequencies excluding the first subset of wireless frequencies.