CLAIMS

1. A multiuser (MU) multiple antenna system (MU-MAS) comprising:

one or more centralized units communicatively coupled to multiple distributed transceiver stations or antennas via a network

the network consisting of wireline or wireless links or a combination of both, employed as a backhaul communication channel;

the centralized unit transforming the N data streams into M precoded data streams, each precoded data stream being a combination of some or all N data streams;

the M precoded data streams being sent over the network to the distributed transceiver stations;

the distributed transceiver stations simultaneously sending the precoded data streams over wireless links to at least one client device such that at least one client device receives at least one of the original N data streams.

2. The system as in claim 1 wherein the plurality of distributed antennas transmit radio frequency (RF) signals to create locations in space with zero RF energy.

3. The system as in claim 1 wherein the wherein the MU-MAS removes interference between adjacent clusters and comprises:

a first MU-MAS cluster for communicating with a first client device over a MU-MAS communication channel;

the first client device for detecting signal strength from the first MU-MAS cluster;

a second MU-MAS cluster for generating signals which interfere with the MU-MAS communication channel, wherein the first client device detects interference signal strength from the second MU-MAS cluster;

if the signal strength from the first MU-MAS cluster reaches a specified value relative to the value of the interference signal strength from the second MU-MAS

cluster, then the first client device generates channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster and transmits the CSI to a base transceiver station (BTS) in the second MU-MAS cluster; and

the BTS implementing MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation to avoid RF interference at the first client device.

4. The system as in claim 1 wherein the MU-MAS adjusts communication with a first client device as the first client device moves from a first MU-MAS cluster to a second MU-MAS cluster, the system comprising:

the first client device detecting signal strength between the first client device and the first MU-MAS cluster ("S1") and between the first client device and the second MU-MAS cluster ("S2");

when the first client device is within a first specified zone in which S2 is sufficiently low with respect to S1, then implementing conventional MU-MAS precoding on at least one of the base transceiver stations (BTSs) in the first MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of client devices including the first client device, and implementing conventional MU-MAS precoding on the BTSs in the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of client devices not including the first client device;

when the first client device is within a second specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a first threshold being reached, then generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster, wherein a BTS of the second MU-MAS cluster uses the CSI to implement MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation to avoid RF interference at the first client device;

when the first client device is within a third specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a second threshold being reached, then implementing conventional MU-MAS precoding on the BTSs in the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of client devices including the first client device and generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the first MU-MAS cluster, wherein a BTS of the first MU-MAS cluster uses the CSI to implement MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation to avoid RF interference at the first client device; and

when the first client device is within a fourth specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a third threshold being reached, then implementing conventional MU-MAS precoding on at least one of the base transceiver stations (BTSs) in the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of client devices including the first client device, and implementing conventional MU-MAS precoding on the BTSs in the first MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to the first plurality of client devices not including the first client device.

5. The system as in claim 1 wherein the MU-MAS adjusts communication with a first client device and comprises:

a MU-MAS network having a plurality of antennas sending RF energy to the client device;

the client device and/or one or more base station transceivers (BTSs) of the MU-MAS network estimating a current velocity of the client device; and

one or more of the BTSs assigning the client device to a particular MU-MAS network based on the estimated velocity of the client device.

6. The system as in claim 1 wherein the MU-MAS adjusts communication with a first client device and comprises:

applying MU-MAS weights to one or more data streams to generate one or more MU-MAS precoded data streams;

receiving input channel quality information (CQI) and/or channel state information (CSI) related to communication channels over which the MU-MAS precoded data streams are to be transmitted;

determining a power scaling factor based on the CQI and/or CSI; and

applying the power scaling factor to each of the MU-MAS precoded data streams.

7. The system as in claim 1 wherein the MU-MAS adjusts communication with a first client device and comprises:

receiving channel state information (CSI) and/or channel quality information (CQI);

selecting groups of MU-MAS antennas within the same cluster based on the CSI or CQI; and

applying MU-MAS weights to generate one or more MU-MAS precoded data streams within each group based on the CSI and/or CQI.

8. The system as in claim 1 wherein the MU-MAS communicates with a plurality of client devices and comprises:

determining channel state information (CSI) defining a channel state between each of a first plurality of MU-MAS antennas and each of the client devices;

using the CSI to determine MU-MAS precoding weights for each of the channels between each of the first plurality of MU-MAS antennas and the antennas of each of the client devices;

using the CSI and MU-MAS precoding weights to determine link quality metrics defining link quality between each of the first plurality of MU-MAS antennas and the antennas of each of the client devices;

using the link-quality metrics, to determine modulation coding schemes (MCSs) for different client devices; and

transmitting precoded data streams from each of the first plurality of MU-MAS antennas to each of the individual client devices using the determined MCSs for those client devices.

9. The system as in claim 1 wherein the MU-MAS performs precoding interpolation and employs orthogonal frequency-division multiplexing (OFDM) and MU-MAS precoding to communicate with a plurality of client devices comprising, the system comprising a processor for processing program code to perform the operations of:

selecting a first subset of ODFM tones to determine a first subset of precoding weights;

deriving a second subset of precoding weights for a second subset of ODFM tones by interpolating between the first subset of precoding weights; and

using a combination of the first subset of precoding weights and the second subset of precoding weights to precode a data stream prior to transmitting the data stream to a client device.

10. The system as in claim 1 wherein the MU-MAS comprises:

a plurality of wireless client devices;

a plurality of base transceiver stations (BTSs) having a plurality of MU-MAS antennas for establishing multiple concurrent communication channels with the plurality of client devices;

wherein either the BTSs and/or the wireless client devices measure link quality of the communication channels there between and use the link quality measurements to define a client device cluster;

the BTSs and/or the wireless client devices further measuring channel state information (CSI) between each client device and each MU-MAS antenna within a defined client device cluster and precoding data transmissions between the MU-MAS antennas within the client device cluster and the client devices reachable by those MU-MAS antennas based on the measured CSI.

11. The system as in claim 1 using block diagonalization precoding

12. The system as in claim 2 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

13. The system as in claim 2 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

14. The system as in claim 2 wherein the transmitting antennas are multiuser (MU) multiple antenna system (MU-MAS) antennas, the locations with zero RF energy correspond to the location of the client devices and MU-MAS precoding is used to create points of zero RF energy to the client devices.

15. The system as in claim 2 wherein points of zero RF energy are created to remove interference between adjacent MU-MAS clusters.

16. The system as in claim 3 further comprising:

the first client device determining whether the specified value of the signal strength from the first MU-MAS cluster reaches the specified value relative to the value of the interference signal strength from the second MU-MAS cluster by estimating a signal-to-interference-plus-noise ratio (SINR) at the first client device, the SINR based on a ratio of the signal strength detected by the first client device

from the first MU-MAS cluster and the interference signal strength detected by the first client device from the second MU-MAS cluster; and

the first client device generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster when the SINR moves below a specified threshold.

17. The system as in claim 3 further comprising:

a plurality of base station transceivers (BTSs) within the first MU-MAS cluster;

the BTSs of the first MU-MAS cluster implementing conventional MU-MAS precoding to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of client devices including the first client device;

the BTSs of the second MU-MAS cluster implementing conventional MU-MAS precoding to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of client devices, the conventional MU-MAS precoding implemented concurrently with the IMCI cancellation precoding.

18. The system as in claim 3 wherein detecting interference signal strength at the first client device from a second MU-MAS cluster comprises measuring signal strength during designated periods of silence from the MU-MAS antennas of the first MU-MAS cluster.

19. The system as in claim 18 wherein the designated periods of silence are designated based on a predetermined transmission frame structure.

20. The systems as in claim 3 wherein the first MU-MAS cluster and the second MU-MAS cluster comprise multicarrier orthogonal frequency-division multiplexing (OFDM) systems, the system further comprising:

the first client device determining whether the specified value of the signal strength from the first MU-MAS cluster reaches the specified value relative to the

value of the interference signal strength from the second MU-MAS cluster by estimating a signal-to-interference ratio (SIR) or signal-to-interference-plus-noise ratio (SINR) at the first client device, the SIR based on a ratio of the signal strength detected by the first client device from the first MU-MAS cluster and the interference signal strength detected by the first client device from the second MU-MAS cluster, the SINR based on a ratio of the signal strength detected by the first client device from the first MU-MAS cluster and the interference signal strength and noise signal strength detected by the first client device from the second MU-MAS cluster, wherein the SIR or SINR is estimated from null tones of the ODFM system.

21. The system as in claim 3 wherein if the signal strength from the first MU-MAS cluster reaches a specified value relative to the value of the interference signal strength from the second MU-MAS cluster, then the first client device using training signals from the second MU-MAS cluster to generate the channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster.

22. The system as in claim 3 wherein implementing MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation at the BTS in the second MU-MAS cluster comprises precoding and transmitting radio frequency (RF) signals to create zero RF energy at the location of the first client device.

23. The system as in claim 4 further comprising:

the first client device and/or the BTSs calculating the signal-to-interference-plus-noise ratio (SINR) and/or the signal-to-interference ratio (SIR) for S1 and S2; and

defining the first, second and third thresholds based on values of SIR and/or SINR.

24. The system as in claim 4 further comprising:

the first client device and/or the BTSs adjusting each of the first through third threshold values dynamically to implement a hysteresis loop in response to the first client device moving between zones to avoid repetitive switches between each of the zones based on the relative values of S1 and S2.

25. The system as in claim 4 wherein a determination as to the zone in which the client device currently resides is made by the client device.

26. The system as in claim 4 wherein a determination as to the zone in which the client device currently resides is made by a BTS in the first MU-MAS cluster and/or the second MU-MAS cluster.

27. The system as in claim 4 implemented with a finite state machine, the finite state machine implemented as a processor executing sequences of instructions.

28. The system as in claim 5 wherein the RF energy is used to estimate a current velocity for the client device by estimating Doppler shift.

29. The system as in claim 28 wherein the Doppler shift is calculated using the RF energy reflected from the antennas to the client device and back to the antennas using blind estimation techniques.

30. The system as in claim 28 wherein the RF energy consists of training signals and the Doppler shift is calculated using the training signals.

31. The system as in claim 5 wherein if the client device's velocity is above a specified threshold, then assigning the client device to a first MU-MAS network capable of communicating with high velocity client devices and if the client device's velocity is

below the specified threshold, then assigning the client device to a second MU-MAS network.

32. The system as in claim 31 wherein the first MU-MAS network comprises a plurality of base station transceivers (BTSs) connected through a BTS network having a first average latency and wherein the second MU-MAS network comprises a plurality of BTSs connected through a BTS network having a second average latency, the second average latency lower than the first average latency.

33. The system as in claim 6 wherein applying the power scaling factor to each of the MU-MAS precoded data streams comprises multiplying the power scaling factor to each of the MU-MAS precoded data streams.

34. The system as in claim 6 wherein the CQI comprises an average signal to noise ratio (SNR) or received signal strength indicator (RSSI) for each of the communication channels.

35. The system as in claim 6 wherein the power scaling factor is applied to each of the data streams sent to every MU-MAS antenna and is dynamically adjusted such that an instantaneous per-MU-MAS antenna transmit power may rise above predefined maximum permissible exposure (MPE) limits but the average per-MU-MAS antenna power is maintained below the MPE limits.

36. The system as in claim 7 wherein applying the MU-MAS weights to generate each of the MU-MAS precoded data streams comprises multiplying the MU-MAS weights to each of the MU-MAS precoded data streams.

37. The system as in claim 7 wherein the CQI comprises an average signal to noise ratio (SNR) or received signal strength indicator (RSSI) for each of the communication channels.

38. The method as in claim 7 wherein the power scaling factor is applied to each of the data streams sent to every MU-MAS antenna and is dynamically adjusted such that an instantaneous per-MU-MAS antenna transmit power may rise above predefined maximum permissible exposure (MPE) limits but the average per-MU-MAS antenna power is maintained below the MPE limits.

39. The system as in claim 8 wherein, in a system which employs orthogonal frequency-division multiplexing (OFDM), the link quality metric comprises an average signal-to-noise ratio over all OFDM tones.

40. The system as in claim 8 wherein the link quality metric is a frequency response of the effective channels between the first plurality of antennas and the antennas of the client devices.

41. The system as in claim 8 wherein, in a system which employs orthogonal frequency-division multiplexing (OFDM), the system further comprising: based on the link-quality metrics, determining the different OFDM tones to be used to communicate with each of the different client devices.

42. The system as in claim 8 further comprising:
transmitting an indication of the MCSs to be used for communication to each of the respective client devices.

43. The system as in claim 8 wherein, in a system which employs orthogonal frequency-division multiplexing (OFDM), the method further comprising:
transmitting an indication of the different tones to be used for communication to each of the respective client devices.

44. The system as in claim 8 further comprising adjusting the MCSs based on detected temporal variations of channel gain.

45. The system as in claim 8 wherein the MCSs are recalculated every fraction of channel coherence time.

46. The system as in claim 1 wherein the MU-MAS antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

47. The system in claim 9 wherein singular value decomposition (SVD) is performed on the first subset of OFDM tones to determine the first subset of precoding weights;

48. The system as in claim 10 wherein the link quality is measured as a signal-to-noise ratio (SNR) or signal-to-interference-plus-noise ratio (SINR).

49. The system as in claim 48 wherein the MU-MAS antennas transmit training signals and the client devices estimate the received signal quality based on that training.

50. The system as in claim 10 wherein using the link quality measurements to define a user-cluster comprises identifying a subset of the antennas having non-zero link-quality metrics to the target user.

51. The system as in claim 10 wherein once the user-clusters are selected, the CSI from all transmitters within the user-cluster to every client device is made available to all BTSs within the user-cluster.

52. The system as in claim 51 wherein the CSI information is shared across all BTSs via a base station network (BSN).

53. The system as in claim 10 wherein uplink/downlink (UL/DL) channel reciprocity is exploited to derive the CSI from training over the UL channel for time division duplex (TDD) systems.

54. The system as in claim 10 wherein feedback channels from all client devices to the BTSs are employed in frequency division duplex (FDD) systems.

55. The system as in claim 54 wherein, to reduce the amount of feedback, only the CSI corresponding to the non-zero entries of the link-quality matrix are fed back.

56. The system as in claim 10 wherein singular value decomposition (SVD) of the effective channel matrix $\widetilde{\mathbf{H}}_k$ is computed and the precoding weight $\mathbf{w}_k$ for the target client device *k* is defined as the right singular vector corresponding to the null subspace of $\widetilde{\mathbf{H}}_k$.

57. The system as in claim 10 wherein if the number of transmitters is greater than the number of client devices, and the SVD decomposes the effective channel matrix as $\widetilde{\mathbf{H}}_k = \mathbf{V}_k \mathbf{\Sigma}_k {\mathbf{U}_k}^H$, the MU-MAS precoding weight for client device *k* is given by

$$\mathbf{w}_k = \mathbf{U}_0 \left({\mathbf{U}_0}^H \cdot {\mathbf{h}_k}^T\right)$$

where $\mathbf{U}_0$ is the matrix with columns being the singular vectors of the null subspace of $\widetilde{\mathbf{H}}_k$.

58. A method implemented within a multiuser (MU) multiple antenna system (MU-MAS) comprising:

communicatively coupling one or more centralized units to multiple distributed transceiver stations or antennas via a network, the network consisting of wireline

or wireless links or a combination of both, employed as a backhaul communication channel;

transforming the N data streams into M precoded data streams at the centralized unit, each precoded data stream being a combination of some or all N data streams;

transmitting the M precoded data streams over the network to the distributed transceiver stations; and

simultaneously transmitting the precoded data streams from the distributed transceiver stations over wireless links to at least one client device such that at least one client device receives at least one of the original N data streams.

59. The method as in claim 58 wherein the plurality of distributed antennas transmit radio frequency (RF) signals to create locations in space with zero RF energy.

60. The method as in claim 58 wherein the MU-MAS removes interference between adjacent clusters, the method further comprising:

communicating with a first client device from a first MU-MAS cluster over a MU-MAS communication channel;

detecting signal strength at a first client device from the first MU-MAS cluster;

generating signals at a second MU-MAS cluster which interfere with the MU-MAS communication channel, wherein the first client device detects interference signal strength from the second MU-MAS cluster;

wherein if the signal strength from the first MU-MAS cluster reaches a specified value relative to the value of the interference signal strength from the second MU-MAS cluster, then generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster and transmitting the CSI to a base transceiver station (BTS) in the second MU-MAS cluster; and

implementing MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation at the BTS to avoid RF interference at the first client device.

61. The method as in claim 58 wherein the MU-MAS adjusts communication with a first client device as the first client device moves from a first MU-MAS cluster to a second MU-MAS cluster, the method further comprising:

detecting signal strength between the first client device and the first MU-MAS cluster ("S1") and between the first client device and the second MU-MAS cluster ("S2");

implementing conventional MU-MAS precoding on at least one of the base transceiver stations (BTSs) in the first MU-MAS cluster when the first client device is within a first specified zone in which S2 is sufficiently low with respect to S1 to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of client devices including the first client device, and

implementing conventional MU-MAS precoding on the BTSs in the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of client devices not including the first client device;

generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster when the first client device is within a second specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a first threshold being reached, wherein a BTS of the second MU-MAS cluster uses the CSI to implement MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation to avoid RF interference at the first client device;

implementing conventional MU-MAS precoding on the BTSs in the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of client devices including the first client device when the first client device is within a third specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a second threshold being reached, and

generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the first MU-MAS cluster, wherein a BTS of the first MU-MAS cluster uses the CSI to implement MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation to avoid RF interference at the first client device; and

implementing conventional MU-MAS precoding on at least one of the base transceiver stations (BTSs) in the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of client devices including the first client device when the first client device is within a fourth specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a third threshold being reached, and

implementing conventional MU-MAS precoding on the BTSs in the first MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to the first plurality of client devices not including the first client device.

62. The method as in claim 58 wherein the MU-MAS adjusts communication with a first client device, the method further comprising:

sending RF energy to the client device from a MU-MAS network having a plurality of antennas;

estimating a current velocity of the client device by the client device and/or one or more base station transceivers (BTSs) of the MU-MAS network; and

assigning the client device to a particular MU-MAS network by one or more of the BTSs based on the estimated velocity of the client device.

63. The method as in claim 58 wherein the MU-MAS adjusts communication with a first client device, the method further comprising:

applying MU-MAS weights to one or more data streams to generate one or more MU-MAS precoded data streams;

receiving input channel quality information (CQI) and/or channel state information (CSI) related to communication channels over which the MU-MAS precoded data streams are to be transmitted;

determining a power scaling factor based on the CQI and/or CSI; and

applying the power scaling factor to each of the MU-MAS precoded data streams.

64. The method as in claim 58 wherein the MU-MAS adjusts communication with a first client device, the method further comprising:

receiving channel state information (CSI) and/or channel quality information (CQI);

selecting groups of MU-MAS antennas within the same cluster based on the CSI or CQI; and

applying MU-MAS weights to generate one or more MU-MAS precoded data streams within each group based on the CSI and/or CQI.

65. The method as in claim 58 wherein the MU-MAS communicates with a plurality of client devices, the method further comprising:

determining channel state information (CSI) defining a channel state between each of a first plurality of MU-MAS antennas and each of the client devices;

using the CSI to determine MU-MAS precoding weights for each of the channels between each of the first plurality of MU-MAS antennas and the antennas of each of the client devices;

using the CSI and MU-MAS precoding weights to determine link quality metrics defining link quality between each of the first plurality of MU-MAS antennas and the antennas of each of the client devices;

using the link-quality metrics, to determine modulation coding schemes (MCSs) for different client devices; and

transmitting precoded data streams from each of the first plurality of MU-MAS antennas to each of the individual client devices using the determined MCSs for those client devices.

66. The method as in claim 58 wherein the MU-MAS performs precoding interpolation and employs orthogonal frequency-division multiplexing (OFDM) and MU-MAS precoding to communicate with a plurality of client devices, the method further comprising:

selecting a first subset of ODFM tones to determine a first subset of precoding weights;

deriving a second subset of precoding weights for a second subset of ODFM tones by interpolating between the first subset of precoding weights; and

using a combination of the first subset of precoding weights and the second subset of precoding weights to precode a data stream prior to transmitting the data stream to a client device.

67. The method as in claim 58 wherein the MU-MAS comprises a plurality of wireless client devices and a plurality of base transceiver stations (BTSs) having a plurality of MU-MAS antennas for establishing multiple concurrent communication channels with the plurality of client devices, the method further comprising:

measuring link quality of the communication channels between the BTSs and/or the wireless client devices and using the link quality measurements to define a client device cluster;

measuring channel state information (CSI) between each client device and each MU-MAS antenna within a defined client device cluster and precoding data transmissions between the MU-MAS antennas within the client device cluster and the client devices reachable by those MU-MAS antennas based on the measured CSI.

68. The method as in claim 58 using block diagonalization precoding

69. The method as in claim 59 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

70. The method as in claim 59 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

71. The method as in claim 59 wherein the transmitting antennas are multiuser (MU) multiple antenna system (MU-MAS) antennas, the locations with zero RF energy correspond to the location of the client devices and MU-MAS precoding is used to create points of zero RF energy to the client devices.

72. The method as in claim 59 wherein points of zero RF energy are created to remove interference between adjacent MU-MAS clusters.

73. The method as in claim 60 further comprising:

determining whether the specified value of the signal strength from the first MU-MAS cluster reaches the specified value relative to the value of the interference signal strength from the second MU-MAS cluster by estimating a signal-to-interference-plus-noise ratio (SINR) at the first client device, the SINR based on a ratio of the signal strength detected by the first client device from the first MU-MAS cluster and the interference signal strength detected by the first client device from the second MU-MAS cluster; and

generating channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster when the SINR moves below a specified threshold.

74. The method as in claim 60 further comprising:

implementing conventional MU-MAS precoding at a plurality of base station transceivers (BTSs) within the first MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of client devices including the first client device;

implementing conventional MU-MAS precoding at the BTSs of the second MU-MAS cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of client devices, the conventional MU-MAS precoding implemented concurrently with the IMCI cancellation precoding.

75. The method as in claim 60 wherein detecting interference signal strength at the first client device from a second MU-MAS cluster comprises measuring signal strength during designated periods of silence from the MU-MAS antennas of the first MU-MAS cluster.

76. The method as in claim 75 wherein the periods of silence are designated based on a predetermined transmission frame structure.

77. The method as in claim 60 wherein the first MU-MAS cluster and the second MU-MAS cluster comprise multicarrier orthogonal frequency-division multiplexing (OFDM) systems, the method further comprising:

determining by the first client device whether the specified value of the signal strength from the first MU-MAS cluster reaches the specified value relative to the value of the interference signal strength from the second MU-MAS cluster by estimating a signal-to-interference ratio (SIR) or signal-to-interference-plus-noise ratio (SINR) at the first client device, the SIR based on a ratio of the signal strength detected by the first client device from the first MU-MAS cluster and the interference signal strength detected by the first client device from the second MU-MAS cluster, the SINR based on a ratio of the signal strength detected by the first client device from the first MU-MAS cluster and the interference signal strength and noise signal strength detected by the first client device from the

second MU-MAS cluster, wherein the SIR or SINR is estimated from null tones of the ODFM system.

78. The method as in claim 60 wherein if the signal strength from the first MU-MAS cluster reaches a specified value relative to the value of the interference signal strength from the second MU-MAS cluster, then the first client device using training signals from the second MU-MAS cluster to generate the channel state information (CSI) defining channel state between one or more antennas of the first client device and one or more antennas of the second MU-MAS cluster.

79. The method as in claim 60 wherein implementing MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation at the BTS in the second MU-MAS cluster comprises precoding and transmitting radio frequency (RF) signals to create zero RF energy at the location of the first client device.

80. The method as in claim 61 further comprising:

calculating the signal-to-interference-plus-noise ratio (SINR) and/or the signal-to-interference ratio (SIR) for S1 and S2; and

defining the first, second and third thresholds based on values of SIR and/or SINR.

81. The method as in claim 61 further comprising:

adjusting each of the first through third threshold values dynamically to implement a hysteresis loop in response to the first client device moving between zones to avoid repetitive switches between each of the zones based on the relative values of S1 and S2.

82. The method as in claim 61 wherein a determination as to the zone in which the client device currently resides is made by the client device.

83. The method as in claim 61 wherein a determination as to the zone in which the client device currently resides is made by a BTS in the first MU-MAS cluster and/or the second MU-MAS cluster.

84. The method as in claim 61 implemented with a finite state machine, the finite state machine implemented as a processor executing sequences of instructions.

85. The method as in claim 62 wherein the RF energy is used to estimate a current velocity for the client device by estimating Doppler shift.

86. The method as in claim 85 wherein the Doppler shift is calculated using the RF energy reflected from the antennas to the client device and back to the antennas using blind estimation techniques.

87. The method as in claim 85 wherein the RF energy consists of training signals and the Doppler shift is calculated using the training signals.

88. The method as in claim 62 wherein if the client device's velocity is above a specified threshold, then the method further comprising assigning the client device to a first MU-MAS network capable of communicating with high velocity client devices and if the client device's velocity is below the specified threshold, then assigning the client device to a second MU-MAS network.

89. The method as in claim 88 wherein the first MU-MAS network comprises a plurality of base station transceivers (BTSs) connected through a BTS network having a first average latency and wherein the second MU-MAS network comprises a plurality of BTSs connected through a BTS network having a second average latency, the second average latency lower than the first average latency.

90. The method as in claim 63 wherein applying the power scaling factor to each of the MU-MAS precoded data streams comprises multiplying the power scaling factor to each of the MU-MAS precoded data streams.

91. The method as in claim 63 wherein the CQI comprises an average signal to noise ratio (SNR) or received signal strength indicator (RSSI) for each of the communication channels.

92. The method as in claim 63 wherein the power scaling factor is applied to each of the data streams sent to every MU-MAS antenna and is dynamically adjusted such that an instantaneous per-MU-MAS antenna transmit power may rise above predefined maximum permissible exposure (MPE) limits but the average per-MU-MAS antenna power is maintained below the MPE limits.

93. The method as in claim 64 wherein applying the MU-MAS weights to generate each of the MU-MAS precoded data streams comprises multiplying the MU-MAS weights to each of the MU-MAS precoded data streams.

94. The method as in claim 64 wherein the CQI comprises an average signal to noise ratio (SNR) or received signal strength indicator (RSSI) for each of the communication channels.

95. The method as in claim 64 wherein the power scaling factor is applied to each of the data streams sent to every MU-MAS antenna and is dynamically adjusted such that an instantaneous per-MU-MAS antenna transmit power may rise above predefined maximum permissible exposure (MPE) limits but the average per-MU-MAS antenna power is maintained below the MPE limits.

96. The method as in claim 65 further comprising employing orthogonal frequency-division multiplexing (OFDM), wherein the link quality metric comprises an average signal-to-noise ratio over all OFDM tones.

97. The method as in claim 65 wherein the link quality metric is a frequency response of the effective channels between the first plurality of antennas and the antennas of the client devices.

98. The method as in claim 65 further comprising employing orthogonal frequency-division multiplexing (OFDM) and, based on the link-quality metrics, determining the different OFDM tones to be used to communicate with each of the different client devices.

99. The method as in claim 65 further comprising:

transmitting an indication of the MCSs to be used for communication to each of the respective client devices.

100. The method as in claim 65 further comprising employing orthogonal frequency-division multiplexing (OFDM) and

transmitting an indication of the different tones to be used for communication to each of the respective client devices.

101. The method as in claim 65 further comprising adjusting the MCSs based on detected temporal variations of channel gain.

102. The method as in claim 65 wherein the MCSs are recalculated every fraction of channel coherence time.

103. The method as in claim 58 wherein the MU-MAS antennas are aware of the channel state information between the transmitters and the receivers, and the

transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

104. The method in claim 66 wherein singular value decomposition (SVD) is performed on the first subset of OFDM tones to determine the first subset of precoding weights.

105. The method as in claim 67 wherein the link quality is measured as a signal-to-noise ratio (SNR) or signal-to-interference-plus-noise ratio (SINR).

106. The method as in claim 105 wherein the MU-MAS antennas transmit training signals and the client devices estimate the received signal quality based on that training.

107. The method as in claim 67 wherein using the link quality measurements to define a user-cluster comprises identifying a subset of the antennas having non-zero link-quality metrics to the target user.

108. The method as in claim 67 wherein once the user-clusters are selected, the CSI from all transmitters within the user-cluster to every client device is made available to all BTSs within the user-cluster.

109. The method as in claim 108 wherein the CSI information is shared across all BTSs via a base station network (BSN).

110. The method as in claim 67 wherein uplink/downlink (UL/DL) channel reciprocity is exploited to derive the CSI from training over the UL channel for time division duplex (TDD) systems.

111. The method as in claim 67 wherein feedback channels from all client devices to the BTSs are employed in frequency division duplex (FDD) systems.

112. The method as in claim 111 wherein, to reduce the amount of feedback, only the CSI corresponding to the non-zero entries of the link-quality matrix are fed back.

113. The method as in claim 67 wherein singular value decomposition (SVD) of the effective channel matrix $\widetilde{\mathbf{H}}_{\mathbf{k}}$ is computed and the precoding weight $\mathbf{w}_k$ for the target client device *k* is defined as the right singular vector corresponding to the null subspace of $\widetilde{\mathbf{H}}_k$.

114. The method as in claim 67 wherein if the number of transmitters is greater than the number of client devices, and the SVD decomposes the effective channel matrix as $\widetilde{\mathbf{H}}_k = \mathbf{V}_k \mathbf{\Sigma}_k {\mathbf{U}_k}^H$, the MU-MAS precoding weight for client device *k* is given by

$$\mathbf{w}_k = \mathbf{U}_o \left({\mathbf{U}_o}^H \cdot {\mathbf{h}_k}^T\right)$$

where $\mathbf{U}_o$ is the matrix with columns being the singular vectors of the null subspace of $\widetilde{\mathbf{H}}_k$.

CLAIMS

1. A method comprising:

measuring link quality between a target user and a plurality of distributed-input distributed-output (DIDO) distributed antennas of base transceiver stations (BTSs);

using the link quality measurements to define a user cluster;

measuring channel state information (CSI) between each user and each DIDO antenna within a defined user cluster; and

precoding data transmissions between the DIDO antennas within the user cluster and the users reachable by those DIDO antennas based on the measured CSI.

2. The method as in claim 1 wherein the link quality is measured as a signal-to-noise ratio (SNR) or signal-to-interference-plus-noise ratio (SINR).

3. The method as in claim 2 wherein the DIDO distributed antennas or the users transmit training signals and the users or the DIDO distributed antennas estimate the received signal quality based on that training.

4. The method as in claim 1 wherein using the link quality measurements to define a user cluster comprises identifying a subset of the antennas having non-zero link-quality metrics to the target user.

5. The method as in claim 1 further comprising:

implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at the BTSs in an interfering DIDO cluster to avoid RF interference at the target user if the target user is located within a zone in which the target user is transmitting and receiving data streams to and from the antennas in user cluster and is also detecting radio frequency (RF) signals transmitted from the antennas in the interfering DIDO cluster.

6. The method as in claim 5 wherein the antennas in the interfering DIDO cluster transmit radio frequency (RF) signals to create locations in space with zero RF energy, including the space occupied by the user target.

7. The method as in claim 6 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

8. The method as in claim 6 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

9. The method as in claim 8 using block diagonalization precoding.

10. The method as in claim 6 wherein the locations with zero RF energy correspond to the location of DIDO users and DIDO precoding is used to create points of zero RF energy to the users.

11. The method as in claim 1 wherein once the user clusters are selected, the CSI from all transmitters within the user-cluster to every user is made available to all BTSs within the user cluster.

12. The method as in claim 11 wherein the CSI information is shared across all BTSs via a base station network (BSN).

13. The method as in claim 12 wherein UL/DL channel reciprocity is exploited to derive the CSI from training over the UL channel for TDD systems.

14. The method as in claim 12 wherein feedback channels from all users to the BTSs are employed in In FDD systems.

15. The method as in claim 14 wherein, to reduce the amount of feedback, only the CSI corresponding to the non-zero entries of the link-quality matrix are fed back.

16. The method as in claim 1 wherein singular value decomposition (SVD) of the effective channel matrix $\tilde{\mathbf{H}}_\mathbf{k}$ is computed and the precoding weight $\mathbf{w}_k$ for the target user k is defined as the right sigular vector corresponding to the null subspace of $\tilde{\mathbf{H}}_k$.

17. The method as in claim 1 wherein if the number of transmitters is greater than the number of users, and the SVD decomposes the effective channel matrix as $\tilde{\mathbf{H}}_k = \mathbf{V}_k \mathbf{\Sigma}_k {\mathbf{U}_k}^H$, the DIDO precoding weight for user k is given by

$$\mathbf{w}_k = \mathbf{U}_o \left({\mathbf{U}_o}^H \cdot {\mathbf{h}_k}^T \right)$$

where $\mathbf{U}_o$ is the matrix with columns being the singular vectors of the null subspace of $\tilde{\mathbf{H}}_k$.

18. A system for coordinating transmissions in distributed wireless systems comprising:

a plurality of wireless users;

a plurality of base transceiver stations (BTSs) having a plurality of antennas for establishing multiple concurrent distributed-input distributed-output (DIDO) communication channels with the plurality of users;

wherein either the BTSs and/or the wireless users measure link quality of the communication channels therebetween and use the link quality measurements to define a user cluster;

the BTSs and/or the wireless users further measuring channel state information (CSI) between each user and each DIDO antenna within a defined user cluster and precoding data transmissions between the DIDO antennas within the user cluster and the users reachable by those DIDO antennas based on the measured CSI.

19. The system as in claim 18 wherein the link quality is measured as a signal-to-noise ratio (SNR) or signal-to-interference-plus-noise ratio (SINR).

20. The system as in claim 19 wherein the DIDO distributed antennas transmit training signals and the users estimate the received signal quality based on that training.

21. The system as in claim 18 wherein using the link quality measurements to define a user cluster comprises identifying a subset of the antennas having non-zero link-quality metrics to the target user.

22. The system as in claim 18 wherein the BTSs implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation in an interfering DIDO cluster to avoid RF interference at the target user if the target user is located within a zone in which the target user is transmitting and receiving data streams to and from the antennas in user cluster and is also detecting radio frequency (RF) signals transmitted from the antennas in the interfering DIDO cluster.

23. The system as in claim 22 wherein the antennas in the interfering DIDO cluster transmit radio frequency (RF) signals to create locations in space with zero RF energy, including the space occupied by the user target.

24. The system as in claim 23 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

25. The system as in claim 23 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

26. The system as in claim 25 using block diagonalization precoding.

27. The system as in claim 23 wherein the locations with zero RF energy correspond to the location of DIDO users and DIDO precoding is used to create points of zero RF energy to the users.

28. The system as in claim 18 wherein once the user clusters are selected, the CSI from all transmitters within the user-cluster to every user is made available to all BTSs within the user cluster.

29. The system as in claim 28 wherein the CSI information is shared across all BTSs via a base station network (BSN).

30. The system as in claim 29 wherein UL/DL channel reciprocity is exploited to derive the CSI from training over the UL channel for TDD systems.

31. The system as in claim 29 wherein feedback channels from all users to the BTSs are employed in In FDD systems.

32. The system as in claim 31 wherein, to reduce the amount of feedback, only the CSI corresponding to the non-zero entries of the link-quality matrix are fed back.

33. The system as in claim 18 wherein singular value decomposition (SVD) of the effective channel matrix $\widetilde{\mathbf{H}}_{\mathbf{k}}$ is computed and the precoding weight $\mathbf{w}_k$ for the target user k is defined as the right sigular vector corresponding to the null subspace of $\widetilde{\mathbf{H}}_k$.

34. The system as in claim 18 wherein if the number of transmitters is greater than the number of users, and the SVD decomposes the effective channel matrix as $\tilde{\mathbf{H}}_k = \mathbf{V}_k \mathbf{\Sigma}_k \mathbf{U}_k{}^H$, the DIDO precoding weight for user *k* is given by

$$\mathbf{w}_k = \mathbf{U}_0 (\mathbf{U}_0{}^H \cdot \mathbf{h}_k{}^T)$$

where $\mathbf{U}_0$ is the matrix with columns being the singular vectors of the null subspace of $\tilde{\mathbf{H}}_k$.

35. A system comprising a plurality of distributed transmitting antennas that transmit radio frequency (RF) signals to create locations in space with zero RF energy.

36. The system as in claim 35 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

37. The system as in claim 35 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

38. The system as in claim 37 using block diagonalization precoding.

39. The system as in claim 35 wherein the transmitting antennas are DIDO distributed antennas, the locations with zero RF energy correspond to the location of DIDO clients and DIDO precoding is used to create points of zero RF energy to the clients.

40. The system as in claim 39 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.

41. The system as in claim 40 further comprising:

a main DIDO cluster having at least one base transceiver station (BTS) connected to a first plurality of antennas for communicating with a target client, wherein the BTSs in the main DIDO cluster implement DIDO precoding to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of DIDO clients including the target client; and

one or more interfering DIDO clusters, each interfering DIDO cluster having at least one BTS connected to a second plurality of antennas communicating with a second plurality of DIDO clients, wherein the BTSs in the interfering DIDO cluster implement DIDO precoding to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of DIDO clients;

wherein when the target client is located within a zone in which the target client is transmitting and receiving data streams to and from the antennas in the main DIDO cluster, respectively, and is also detecting RF signals transmitted from the antennas in the interfering DIDO cluster, the BTSs in the interfering DIDO cluster implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the target client.

42. The system as in claim 41 wherein implementing DIDO precoding with IDCI cancellation comprises creating zero RF energy towards the direction of the target client.

43. The system as in claim 41 wherein the BTSs in the main DIDO cluster compute DIDO precoding weights to pre-cancel inter-client interference with the first plurality of DIDO clients in the main DIDO cluster.

44. The system as in claim 43 wherein the BTSs in the main DIDO cluster implement block diagonalization (BD) precoding to pre-cancel the inter-client interference with the first plurality of DIDO clients.

45. The system as in claim 41 wherein the BTSs in the interfering DIDO cluster compute DIDO precoding weights to pre-cancel inter-client interference with second plurality of DIDO clients serviced by the interfering DIDO cluster and compute additional DIDO precoding weights for IDCI cancellation to avoid RF interference at the target client.

46. The system as in claim 45 wherein the BTSs in the interfering DIDO cluster implement block diagonalization (BD) precoding to both pre-cancel the inter-client interference with the second plurality of DIDO clients and to perform IDCI cancellation to avoid RF interference at the target client.

47. The system as in claim 41 wherein the BTSs in the interfering DIDO cluster implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the target client only if the signal-to-interference ratio (SIR) computed from signal strength detected by the target client from the main DIDO cluster and interference signal strength detected by the target client from the interfering DIDO cluster is below a specified threshold.

48. A machine-implemented method comprising:

transmitting radio frequency (RF) signals from a plurality of antennas to create locations in space with zero RF energy.

49. The method as in claim 48 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

50. The method as in claim 48 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

51. The method as in claim 50 using block diagonalization precoding.

52. The method as in claim 48 wherein the transmitting antennas are DIDO distributed antennas, the locations with zero RF energy correspond to the location of DIDO clients and DIDO precoding is used to create points of zero RF energy to the clients.

53. The method as in claim 52 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.

54. The method as in claim 48 further comprising:

associating a target client with a main DIDO cluster having at least one base transceiver station (BTS) connected to a first plurality of antennas,

implementing DIDO precoding on the BTSs in the main DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of DIDO clients including the target client;

associating a second plurality of DIDO clients with an interfering DIDO cluster having at least one BTS connected to a second plurality of antennas;

implementing DIDO precoding on the BTSs in the interfering DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of DIDO clients; and

implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at the BTSs in the interfering DIDO cluster to avoid RF interference at the target client if the target client is located within a zone in which the target client is transmitting and receiving data streams to and from the antennas in the main DIDO cluster, respectively, and is also detecting RF signals transmitted from the antennas in the interfering DIDO cluster.

55. The method as in claim 54 wherein implementing DIDO precoding with IDCI cancellation comprises creating zero RF energy towards the direction of the target client.

56. The method as in claim 54wherein the BTSs in the main DIDO cluster compute DIDO precoding weights to pre-cancel inter-client interference with the first plurality of DIDO clients in the main DIDO cluster.

57. The method as in claim 56 wherein the BTSs in the main DIDO cluster implement block diagonalization (BD) precoding to pre-cancel the inter-client interference with the first plurality of DIDO clients.

58. The method as in claim 54 wherein the BTSs in the interfering DIDO cluster compute DIDO precoding weights to pre-cancel inter-client interference with second plurality of DIDO clients serviced by the interfering DIDO cluster and compute additional DIDO precoding weights for IDCI cancellation to avoid RF interference at the target client.

59. The method as in claim 58 wherein the BTSs in the interfering DIDO cluster implement block diagonalization (BD) precoding to both pre-cancel the inter-client interference with the second plurality of DIDO clients and to perform IDCI cancellation to avoid RF interference at the target client.

60. The method as in claim 54 wherein the BTSs in the interfering DIDO cluster implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the target client only if the signal-to-interference ratio (SIR) computed from signal strength detected by the target client from the main DIDO cluster and interference signal strength

detected by the target client from the interfering DIDO cluster is below a specified threshold.

61. A machine-implemented method for removing interference between adjacent distributed-input-distributed-output (DIDO) clusters comprising:

detecting signal strength at a first client from a main DIDO cluster;

detecting interference signal strength at the first client from an interfering DIDO cluster;

if the signal strength from the main DIDO cluster reaches a specified value relative to the value of the interference signal strength from the interfering DIDO cluster, then generating channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster;

transmitting the CSI from the first client to a base transceiver station (BTS) in the interfering DIDO cluster; and

implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at the BTS in the interfering DIDO cluster to avoid RF interference at the first client.

62. The method as in claim 61 further comprising:

determining whether the specified value of the signal strength from the main DIDO cluster reaches the specified value relative to the value of the interference signal strength from the interfering DIDO cluster by estimating a signal-to-interference ratio (SIR) at the first client, the SIR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference signal strength detected by the first client from the interfering DIDO cluster; and

generating channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster when the SIR moves below a specified threshold.

63. The method as in claim 61 further comprising:

determining whether the specified value of the signal strength from the main DIDO cluster reaches the specified value relative to the value of the interference signal strength from the interfering DIDO cluster by estimating a

signal-to-interference-plus noise ratio (SINR) at the first client, the SINR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference signal strength and noise signal strength detected by the first client from the interfering DIDO cluster; and

generating channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster when the SINR moves below a specified threshold.

64. The method as in claim 61 further comprising:

implementing conventional DIDO precoding on BTSs of the main DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of DIDO clients including the first client;

implementing conventional DIDO precoding on BTSs of the interfering DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of DIDO clients, the conventional DIDO precoding implemented concurrently with the IDCI cancellation precoding.

65. The method as in claim 61 wherein detecting interference signal strength at the first client from an interfering DIDO cluster comprises measuring signal strength during designated periods of silence from the DIDO antennas of the main DIDO cluster.

66. The method as in claim 65 wherein the designated periods of silence are designated based on a predetermined transmission frame structure.

67. The methods as in claim 61 wherein the main DIDO cluster and the interfering DIDO cluster comprise multicarrier orthogonal frequency-division multiplexing (OFDM) systems, the method further comprising:

determining whether the specified value of the signal strength from the main DIDO cluster reaches the specified value relative to the value of the interference signal strength from the interfering DIDO cluster by estimating a signal-to-interference ratio (SIR) or signal-to-interference-plus-noise ratio (SINR) at the first client, the SIR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference

signal strength detected by the first client from the interfering DIDO cluster, the SINR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference signal strength and noise signal strength detected by the first client from the interfering DIDO cluster, wherein the SIR or SINR is estimated from null tones of the ODFM system.

68. The method as in claim 61 wherein if the signal strength from the main DIDO cluster reaches a specified value relative to the value of the interference signal strength from the interfering DIDO cluster, then using training signals from the interfering DIDO cluster to generate the channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster.

69. The method as in claim 61 wherein implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at the BTS in the interfering DIDO cluster comprises precoding and transmitting radio frequency (RF) signals to create zero RF energy at the location of the first client.

70. The method as in claim 69 wherein M distributed transmitting antennas in the interfering cluster create up to (M-1) points of zero RF energy.

71. The method as in claim 69 wherein the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

72. The method as in claim 71 using block diagonalization precoding.

73. A system for removing interference between adjacent distributed-input-distributed-output (DIDO) clusters comprising:

a main DIDO cluster for communicating with a first client over a DIDO communication channel;

the first client for detecting signal strength from the main DIDO cluster;

an interfering DIDO cluster for generating signals which interfere with the DIDO communication channel, wherein the first client detects interference signal strength from the interfering DIDO cluster;

if the signal strength from the main DIDO cluster reaches a specified value relative to the value of the interference signal strength from the interfering DIDO cluster, then the first client generates channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster and transmits the CSI to a base transceiver station (BTS) in the interfering DIDO cluster; and

the BTS implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the first client.

74. The system as in claim 73 further comprising:

the first client determining whether the specified value of the signal strength from the main DIDO cluster reaches the specified value relative to the value of the interference signal strength from the interfering DIDO cluster by estimating a signal-to-interference ratio (SIR) at the first client, the SIR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference signal strength detected by the first client from the interfering DIDO cluster; and

the first client generating channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster when the SIR moves below a specified threshold.

75. The system as in claim 73 further comprising:

the first client determining whether the specified value of the signal strength from the main DIDO cluster reaches the specified value relative to the value of the interference signal strength from the interfering DIDO cluster by estimating a signal-to-interference-plus noise ratio (SINR) at the first client, the SINR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference signal strength and noise signal strength detected by the first client from the interfering DIDO cluster; and

the first client generating channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster when the SINR moves below a specified threshold.

76. The system as in claim 73 further comprising:

a plurality of base station transceivers (BTSs) within the main DIDO cluster;

the BTSs of the main DIDO cluster implementing conventional DIDO precoding to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of DIDO clients including the first client;

the BTSs of the interfering DIDO cluster implementing conventional DIDO precoding to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of DIDO clients, the conventional DIDO precoding implemented concurrently with the IDCI cancellation precoding.

77. The system as in claim 73 wherein detecting interference signal strength at the first client from an interfering DIDO cluster comprises measuring signal strength during designated periods of silence from the DIDO antennas of the main DIDO cluster.

78. The system as in claim 77 wherein the designated periods of silence are designated based on a predetermined transmission frame structure.

79. The systems as in claim 73 wherein the main DIDO cluster and the interfering DIDO cluster comprise multicarrier orthogonal frequency-division multiplexing (OFDM) systems, the system further comprising:

the first client determining whether the specified value of the signal strength from the main DIDO cluster reaches the specified value relative to the value of the interference signal strength from the interfering DIDO cluster by estimating a signal-to-interference ratio (SIR) or signal-to-interference-plus-noise ratio (SINR) at the first client, the SIR based on a ratio of the signal strength detected by the first client from the main DIDO cluster and the interference signal strength detected by the first client from the interfering DIDO cluster, the SINR based on a ratio of the signal strength

detected by the first client from the main DIDO cluster and the interference signal strength and noise signal strength detected by the first client from the interfering DIDO cluster, wherein the SIR or SINR is estimated from null tones of the ODFM system.

80. The system as in claim 73 wherein if the signal strength from the main DIDO cluster reaches a specified value relative to the value of the interference signal strength from the interfering DIDO cluster, then the first client using training signals from the interfering DIDO cluster to generate the channel state information (CSI) defining channel state between one or more antennas of the first client and one or more antennas of the interfering DIDO cluster.

81. The system as in claim 73 wherein implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at the BTS in the interfering DIDO cluster comprises precoding and transmitting radio frequency (RF) signals to create zero RF energy at the location of the first client.

82. The system as in claim 81 wherein M distributed transmitting antennas in the interfering cluster create up to (M-1) points of zero RF energy.

83. The system as in claim 81 wherein the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

84. The system as in claim 83 using block diagonalization precoding.

85. A machine-implemented method for adjusting communication with a first distributed-input-distributed-output (DIDO) client as the first DIDO client moves from a first DIDO cluster to a second DIDO cluster, the method comprising:

detecting signal strength between the first DIDO client and the first DIDO cluster ("S1") and between the first DIDO client and the second DIDO cluster ("S2");

when the first DIDO client is within a first specified zone in which S2 is sufficiently low with respect to S1, then implementing conventional DIDO

precoding on at least one of the base transceiver stations (BTSs) in the first DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of DIDO clients including the first client, and implementing conventional DIDO precoding on the BTSs in the second DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of DIDO clients not including the first client;

when the first DIDO client is within a second specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a first threshold being reached, then generating channel state information (CSI) defining channel state between one or more antennas of the first DIDO client and one or more antennas of the second DIDO cluster, wherein a BTS of the second DIDO cluster uses the CSI to implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the first DIDO client;

when the first DIDO client is within a third specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a second threshold being reached, then implementing conventional DIDO precoding on the BTSs in the second DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of DIDO clients including the first client and generating channel state information (CSI) defining channel state between one or more antennas of the first DIDO client and one or more antennas of the first DIDO cluster, wherein a BTS of the first DIDO cluster uses the CSI to implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the first client; and

when the first DIDO client is within a fourth specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a third threshold being reached, then implementing conventional DIDO precoding on at least one of the base transceiver stations (BTSs) in the second DIDO cluster to transmit

simultaneous non-interfering data streams within the same frequency band to the second plurality of DIDO clients including the first client, and implementing conventional DIDO precoding on the BTSs in the first DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to the first plurality of DIDO clients not including the first client.

86. The method as in claim 85 further comprising:

calculating the signal-to-interference-plus-noise ratio (SINR) and/or the signal-to-interference ratio (SIR) for S1 and S2; and

defining the first, second and third thresholds based on values of SIR and/or SINR.

87. The method as in claim 85 further comprising:

adjusting each of the first through third threshold values dynamically to implement a hysteresis loop in response to the first DIDO client moving between zones to avoid repetitive switches between each of the zones based on the relative values of S1 and S2.

88. The method as in claim 85 wherein a determination as to the zone in which the DIDO client currently resides is made by the DIDO client.

89. The method as in claim 85 wherein a determination as to the zone in which the DIDO client currently resides is made by a BTS in the first DIDO cluster and/or the second DIDO cluster.

90. The method as in claim 85 implemented with a finite state machine, the finite state machine implemented as a processor executing sequences of instructions.

91. The method as in claim 85 wherein implementing DIDO precoding with IDCI cancellation to avoid RF interference at the first DIDO client comprises a plurality of transmitting radio frequency (RF) signals to create locations in space with zero RF energy.

92. The method as in claim 91 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

93. The method as in claim 91 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state

information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

94. The method as in claim 93 using block diagonalization precoding.

95. A system for adjusting communication with a first distributed-input-distributed-output (DIDO) client as the first DIDO client moves from a first DIDO cluster to a second DIDO cluster, the method comprising:

the first DIDO client detecting signal strength between the first DIDO client and the first DIDO cluster ("S1") and between the first DIDO client and the second DIDO cluster ("S2");

when the first DIDO client is within a first specified zone in which S2 is sufficiently low with respect to S1, then implementing conventional DIDO precoding on at least one of the base transceiver stations (BTSs) in the first DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a first plurality of DIDO clients including the first client, and implementing conventional DIDO precoding on the BTSs in the second DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to a second plurality of DIDO clients not including the first client;

when the first DIDO client is within a second specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a first threshold being reached, then generating channel state information (CSI) defining channel state between one or more antennas of the first DIDO client and one or more antennas of the second DIDO cluster, wherein a BTS of the second DIDO cluster uses the CSI to implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the first DIDO client;

when the first DIDO client is within a third specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a second threshold being reached, then implementing conventional DIDO precoding on the BTSs in the second DIDO cluster to transmit simultaneous non-interfering

data streams within the same frequency band to the second plurality of DIDO clients including the first client and generating channel state information (CSI) defining channel state between one or more antennas of the first DIDO client and one or more antennas of the first DIDO cluster, wherein a BTS of the first DIDO cluster uses the CSI to implement DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to avoid RF interference at the first client; and

when the first DIDO client is within a fourth specified zone in which S2 has increased relative to S1 and/or S1 has decreased relative to S2 such that the relative values of S2 and S1 have resulted in a third threshold being reached, then implementing conventional DIDO precoding on at least one of the base transceiver stations (BTSs) in the second DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to the second plurality of DIDO clients including the first client, and implementing conventional DIDO precoding on the BTSs in the first DIDO cluster to transmit simultaneous non-interfering data streams within the same frequency band to the first plurality of DIDO clients not including the first client.

96. The system as in claim 95 further comprising:

the first client and/or the BTSs calculating the signal-to-interference-plus-noise ratio (SINR) and/or the signal-to-interference ratio (SIR) for S1 and S2; and

defining the first, second and third thresholds based on values of SIR and/or SINR.

97. The system as in claim 95 further comprising:

the first DIDO client and/or the BTSs adjusting each of the first through third threshold values dynamically to implement a hysteresis loop in response to the first DIDO client moving between zones to avoid repetitive switches between each of the zones based on the relative values of S1 and S2.

98. The system as in claim 95 wherein a determination as to the zone in which the DIDO client currently resides is made by the DIDO client.

99. The system as in claim 95 wherein a determination as to the zone in which the DIDO client currently resides is made by a BTS in the first DIDO cluster and/or the second DIDO cluster.

100. The system as in claim 95 implemented with a finite state machine, the finite state machine implemented as a processor executing sequences of instructions.

101. The system as in claim 95 wherein implementing DIDO precoding with IDCI cancellation to avoid RF interference at the first DIDO client comprises a plurality of transmitting radio frequency (RF) signals to create locations in space with zero RF energy.

102. The system as in claim 101 wherein M distributed transmitting antennas create up to (M-1) points of zero RF energy.

103. The system as in claim 101 wherein the locations of zero RF energy are receivers, the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

104. The system as in claim 103 using block diagonalization precoding.

105. A machine-implemented method for adjusting communication with a first distributed-input-distributed-output (DIDO) client comprising:

sending RF energy to the DIDO client from one or more antennas of a DIDO network;

estimating a current velocity of the DIDO client; and

assigning the client to a particular DIDO network based on the estimated velocity of the client.

106. The method as in claim 105 wherein the RF energy is used to estimate a current velocity for the client by estimating Doppler shift.

107. The method as in claim 106 wherein the Doppler shift is calculated using the RF energy reflected from the antennas to the client and back to the antennas using blind estimation techniques.

108. The method as in claim 106 wherein the RF energy consists of training signals and the Doppler shift is calculated using the training signals.

109. The method as in claim 106 wherein if the DIDO client's velocity is above a specified threshold, then assigning the DIDO client to a first DIDO network capable of communicating with high velocity DIDO clients and if the client's velocity is below the specified threshold, then assigning the DIDO client to a second DIDO network.

110. The method as in claim 109 wherein the first DIDO network comprises a plurality of base station transceivers (BTSs) connected through a BTS network having a first average latency and wherein the second DIDO network comprises a plurality of BTSs connected through a BTS network having a second average latency, the second average latency lower than the first average latency.

111. The method as in claim 105 further comprising implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at one or more of the BTSs in an interfering DIDO cluster to create zero RF energy at the location of the DIDO client.

112. The method as in claim 111 wherein M distributed transmitting antennas in the interfering DIDO cluster create up to (M-1) points of zero RF energy.

113. The method as in claim 111 wherein the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

114. The method as in claim 113 using block diagonalization precoding.

115. A system for adjusting communication with a first distributed-input-distributed-output (DIDO) client comprising:

a DIDO network having a plurality of antennas sending RF energy to the DIDO client;

the DIDO client and/or one or more base station transceivers (BTSs) of the DIDO network estimating a current velocity of the DIDO client; and

one or more of the BTSs assigning the client to a particular DIDO network based on the estimated velocity of the client.

116. The system as in claim 115 wherein the RF energy is used to estimate a current velocity for the client by estimating Doppler shift.

117. The system as in claim 116 wherein the Doppler shift is calculated using the RF energy reflected from the antennas to the client and back to the antennas using blind estimation techniques.

118. The system as in claim 116 wherein the RF energy consists of training signals and the Doppler shift is calculated using the training signals.

119. The system as in claim 115 wherein if the DIDO client's velocity is above a specified threshold, then assigning the DIDO client to a first DIDO network capable of communicating with high velocity DIDO clients and if the client's velocity is below the specified threshold, then assigning the DIDO client to a second DIDO network.

120. The system as in claim 119 wherein the first DIDO network comprises a plurality of base station transceivers (BTSs) connected through a BTS network having a first average latency and wherein the second DIDO network comprises a plurality of BTSs connected through a BTS network having a second average latency, the second average latency lower than the first average latency.

121. The system as in claim 115 further comprising implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation at one or more of the BTSs in an interfering DIDO cluster to create zero RF energy at the location of the DIDO client.

122. The system as in claim 121 wherein M distributed transmitting antennas in the interfering DIDO cluster create up to (M-1) points of zero RF energy.

123. The system as in claim 121 wherein the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine the interfering signals to be simultaneously transmitted.

124. The system as in claim 121 using block diagonalization precoding.

125. A machine-implemented method for adjusting communication with a first distributed-input-distributed-output (DIDO) client comprising:

applying DIDO weights to one or more data streams to generate one or more DIDO precoded data streams;

receiving input channel quality information (CQI) and/or channel state information (CSI) related to DIDO communication channels over which the DIDO precoded data streams are to be transmitted;

determining a power scaling factor based on the CQI and/or CSI; and

applying the power scaling factor to each of the DIDO precoded data streams.

126. The method as in claim 125 wherein applying the power scaling factor to each of the DIDO precoded data streams comprises multiplying the power scaling factor to each of the DIDO precoded data streams.

127. The method as in claim 125 wherein the CQI comprises an average signal to noise ratio (SNR) or RSSI for each of the DIDO communication channels.

128. The method as in claim 125 wherein the power scaling factor is applied to each of the data streams sent to every DIDO antenna and is dynamically adjusted such that an instantaneous per-DIDO antenna transmit power may rise above predefined maximum permissible exposure (MPE) limits but the average per-DIDO antenna power is maintained below the MPE limits.

129. The method as in claim 125 further comprising implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to transmit from a plurality of transmitting antennas and create zero RF energy at the location of the first DIDO client.

130. The method as in claim 129 further comprising transmitting from M distributed transmitting antennas to create up to (M-1) points of zero RF energy.

131. The method as in claim 129 wherein the wherein the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

132. The method as in claim 131 using block diagonalization precoding.

133. The method as in claim 129 wherein the transmitting antennas are DIDO distributed antennas, the locations with zero RF energy correspond to

the location of DIDO clients and DIDO precoding is used to create points of zero RF energy to the clients.

134. The method as in claim 133 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.

135. A machine-implemented method for adjusting communication with a first distributed-input-distributed-output (DIDO) client comprising:

receiving channel state information (CSI) and/or channel quality information (CQI);

selecting groups of DIDO antennas within the same cluster based on the CSI or CQI; and

applying DIDO weights to generate one or more DIDO precoded data streams within each group based on the CSI and/or CQI.

136. The method as in claim 135 wherein applying the DIDO weights generate each of the DIDO precoded data streams comprises multiplying the DIDO weights to each of the DIDO precoded data streams.

137. The method as in claim 135 wherein the CQI comprises an average signal to noise ratio (SNR) or RSSI for each of the DIDO communication channels.

138. The method as in claim 135 wherein the power scaling factor is applied to each of the data streams sent to every DIDO antenna and is dynamically adjusted such that an instantaneous per-DIDO antenna transmit power may rise above predefined maximum permissible exposure (MPE) limits but the average per-DIDO antenna power is maintained below the MPE limits.

139. The method as in claim 135 further comprising implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to transmit from a plurality of transmitting antennas and create zero RF energy at the location of the first DIDO client.

140. The method as in claim 135 further comprising transmitting from M distributed transmitting antennas to create up to (M-1) points of zero RF energy.

141. The method as in claim 139 wherein the wherein the transmitting antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

142. The method as in claim 141 using block diagonalization precoding.

143. The method as in claim 129 wherein the transmitting antennas are DIDO distributed antennas, the locations with zero RF energy correspond to the location of DIDO clients and DIDO precoding is used to create points of zero RF energy to the clients.

144. The method as in claim 143 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.

145. A machine-implemented method for communicating with a plurality of distributed-input-distributed-output (DIDO) clients comprising:

determining channel state information (CSI) defining a channel state between each of a first plurality of DIDO antennas and each of the DIDO clients;

using the CSI to determine distributed-input-distributed-output (DIDO) precoding weights for each of the channels between each of the first plurality of DIDO antennas and the antennas of each of the DIDO clients;

using the CSI and DIDO precoding weights to determine link quality metrics defining link quality between each of the first plurality of DIDO antennas and the antennas of each of the DIDO clients;

using the link-quality metrics, to determine modulation coding schemes (MCSs) for different DIDO clients; and

transmitting precoded data streams from each of the first plurality of DIDO antennas to each of the individual DIDO clients using the determined MCSs for those clients.

146. The method as in claim 145 wherein, in a system which employs orthogonal frequency-division multiplexing (OFDM), the link quality metric comprises an average signal to noise ratio over all OFDM tones.

147. The method as in claim 145 wherein the link quality metric is a frequency response of the effective channels between the first plurality of antennas and the antennas of the clients.

148. The method as in claim 145 wherein, in a system which employs orthogonal frequency-division multiplexing (OFDM), the method further comprising:

based on the link-quality metrics, determining the different OFDM tones to be used to communicate with each of the different DIDO clients.

149. The method as in claim 145 further comprising:

transmitting an indication of the MCSs to be used for communication to each of the respective DIDO clients.

150. The method as in claim 149 wherein, in a system which employs orthogonal frequency-division multiplexing (OFDM), the method further comprising:

transmitting an indication of the different tones to be used for communication to each of the respective DIDO clients.

151. The method as in claim 145 further comprising adjusting the MCSs based on detected temporal variations of channel gain.

152. The method as in claim 145 wherein the MCSs are recalculated every fraction of channel coherence time.

153. The method as in claim 145 further comprising implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to transmit from the first plurality of DIDO antennas and create zero RF energy at the location of the first DIDO client.

154. The method as in claim 153 further comprising transmitting from M distributed DIDO antennas to create up to (M-1) points of zero RF energy.

155. The method as in claim 153 wherein the wherein the DIDO antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

156. The method as in claim 155 using block diagonalization precoding.

157. The method as in claim 156 wherein the locations with zero RF energy correspond to the location of each of the DIDO clients and DIDO precoding is used to create points of zero RF energy to the clients.

158. The method as in claim 157 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.

159. A machine-implemented method for performing precoding interpolation in a DIDO system which employs orthogonal frequency-division multiplexing (OFDM) and DIDO precoding to communicate with a plurality of distributed-input-distributed-output (DIDO) clients comprising:

selecting a first subset of ODFM tones to determine a first subset of precoding weights;

deriving a second subset of precoding weights for a second subset of ODFM tones by interpolating between the first subset of precoding weights; and

using a combination of the first subset of precoding weights and the second subset of precoding weights to precode a data stream prior to transmitting the data stream to a DIDO client.

160. The method in claim 159 wherein singular value decomposition (SVD) is performed on the first subset of OFDM tones to determine the first subset of precoding weights;

161. The method as in claim 159 further comprising implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to transmit from a first plurality of DIDO antennas and create zero RF energy at the location of the DIDO client.

162. The method as in claim 159 further comprising transmitting from M distributed DIDO antennas to create up to (M-1) points of zero RF energy.

163. The method as in claim 161 wherein the wherein the DIDO antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

164. The method as in claim 163 using block diagonalization precoding.

165. The method as in claim 164 wherein the locations with zero RF energy correspond to the location of each of a plurality of DIDO clients and DIDO precoding is used to create points of zero RF energy at each of the plurality of DIDO clients.

166. The method as in claim 165 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.

167. A system performing precoding interpolation in a DIDO system which employs orthogonal frequency-division multiplexing (OFDM) and DIDO precoding to communicate with a plurality of distributed-input-distributed-output (DIDO) clients comprising, the system comprising a processor for processing program code to perform the operations of:

selecting a first subset of ODFM tonesto determine a first subset of precoding weights;

deriving a second subset of precoding weights for a second subset of ODFM tones by interpolating between the first subset of precoding weights; and

using a combination of the first subset of precoding weights and the second subset of precoding weights to precode a data stream prior to transmitting the data stream to a DIDO client.

168. The system in claim 167 wherein singular value decomposition (SVD) is performed on the first subset of OFDM tones to determine the first subset of precoding weights;

169. The system as in claim 167 further comprising program code which, when executed by the processor, performs the operations of: implementing DIDO precoding with inter-DIDO-cluster interference (IDCI) cancellation to transmit from a first plurality of DIDO antennas and create zero RF energy at the location of the DIDO client.

170. The system as in claim 167 further comprising transmitting from M distributed DIDO antennas to create up to (M-1) points of zero RF energy.

171. The system as in claim 169 wherein the wherein the DIDO antennas are aware of the channel state information between the transmitters and the receivers, and the transmitters utilize the channel state information to determine interfering signals to be simultaneously transmitted.

172. The system as in claim 171 wherein utilizing the channel state information comprises using block diagonalization precoding.

173. The system as in claim 172 wherein the locations with zero RF energy correspond to the location of each of a plurality of DIDO clients and

DIDO precoding is used to create points of zero RF energy at each of the plurality of DIDO clients.

174. The system as in claim 173 wherein points of zero RF energy are created to remove interference between adjacent DIDO clusters.