

CLAIMS

1. A method implemented within a multiuser (MU) multiple antenna system (MU-MAS) comprising:
 - measuring link quality between a target user and a plurality of MU-MAS 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 MU-MAS antenna within a defined user cluster; and
 - precoding data transmissions between the MU-MAS antennas within the user cluster and the users reachable by those MU-MAS 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 MU-MAS antennas or the users transmit training signals and the users or the MU-MAS 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 MU-MAS antennas having non-zero link-quality metrics to the target user.
5. The method as in claim 1 further comprising:
 - Implementing MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation at the BTSs in an interfering MU-MAS 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 MU-MAS cluster.

6. The method as in claim 5 wherein the antennas in the interfering MU-MAS 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 the users and MU-MAS 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 $\tilde{\mathbf{H}}_k$ is computed and the precoding weight $\mathbf{w}_k$ for the target user k is defined as the right singular 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 MU-MAS precoding weight for user k is given by

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

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 a MU-MAS comprising:
a plurality of wireless users;
a plurality of base transceiver stations (BTSs) having a plurality of MU-MAS antennas for establishing multiple concurrent 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 MU-MAS antenna within a defined user cluster and precoding data transmissions between the MU-MAS antennas within the user cluster and the users reachable by those MU-MAS 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 MU-MAS 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 MU-MAS precoding with inter-MU-MAS-cluster interference (IMCI) cancellation in an interfering MU-MAS 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 MU-MAS cluster.

23. The system as in claim 22 wherein the antennas in the interfering MU-MAS 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 the users and MU-MAS 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 $\tilde{\mathbf{H}}_k$ is computed and the precoding weight $\mathbf{w}_k$ for the target user k is defined as the right singular vector corresponding to the null subspace of $\tilde{\mathbf{H}}_k$.

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 MU-MAS 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 $\tilde{\mathbf{H}}_k$.

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 $\tilde{\mathbf{H}}_k$ is computed and the precoding weight $\mathbf{w}_k$ for the target user k is defined as the right singular 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

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

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

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 $\tilde{\mathbf{H}}_k$ is computed and the precoding weight $\mathbf{w}_k$ for the target user k is defined as the right singular vector corresponding to the null subspace of $\tilde{\mathbf{H}}_k$.

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

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

where $\mathbf{U}_o$ 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 54 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.

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 IDC1 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 OFDM 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 OFDM 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 (BTSSs) 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 BTSSs 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 S_2 has increased relative to S_1 and/or S_1 has decreased relative to S_2 such that the relative values of S_2 and S_1 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 S_2 has increased relative to S_1 and/or S_1 has decreased relative to S_2 such that the relative values of S_2 and S_1 have resulted in a second threshold being reached, then implementing conventional DIDO precoding on the BTSSs 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 S_2 has increased relative to S_1 and/or S_1 has decreased relative to S_2 such that the relative values of S_2 and S_1 have resulted in a third threshold being reached, then implementing conventional DIDO precoding on at least one of the base transceiver stations (BTSSs) 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 IDC1 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 S_2 has increased relative to S_1 and/or S_1 has decreased relative to S_2 such that the relative values of S_2 and S_1 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 S_1 and S_2 ; 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 S_1 and S_2 .

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 IDC1 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 (BSTs) connected through a BST network having a first average latency and wherein the second DIDO network comprises a plurality of BSTs connected through a BST 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 BSTs 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 OFDM tones to determine a first subset of precoding weights;

deriving a second subset of precoding weights for a second subset of OFDM 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 OFDM tones to determine a first subset of precoding weights;

deriving a second subset of precoding weights for a second subset of OFDM 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.