

CLAIMS

1. A method implemented within a multiuser (MU) multiple antenna system (MAS) comprising:
 - communicatively coupling one or more centralized units to multiple distributed transceiver stations or antennas via a network, the network comprising wireline or wireless links or a combination of both;
 - employing the network as a backhaul communication channel; and
 - employing transmit antenna selection, user selection, or transmit power balancing to enhance channel space diversity within the MU-MAS;
 - transmitting a plurality of data streams concurrently from the multiple antennas to a plurality of users.
2. The method as in claim 1 wherein a space selectivity indicator (SSI), time selectivity indicator (TSI), and/or frequency selectivity indicator (FSI) are used as measures of the channel diversity.
3. The method as in claim 2 further comprising defining different subsets of transmit antennas and selects the subset that optimizes the SSI for transmission over the wireless links.
4. The method as in claim 2 wherein a selection criterion is based on SSI, TSI and/or FSI thresholds derived from measurements.
5. The method as in claim 2 wherein a minimum singular value of an effective channel matrix of every client device is used as SSI.

6. The method as in claim 2 wherein a minimum singular value or the condition number of a composite channel matrix from all client devices is used as SSI.

7. The method as in claim 2 wherein an absolute value of the sum of the complex channel gain from some or all transceiver stations is used as TSI.

8. The method as in claim 2 wherein the SSI is used to measure and predict the areas of coherence.

9. The method as in claim 2 wherein an average SSI is used to select adaptively between fixed transmit antenna configuration and transmit antenna selection methods based on changing channel conditions.

10. The method as in claim 2 wherein temporal correlation of the SSI is exploited to select an optimal antenna subset while reducing the computational complexity of the method.

11. The method as in claim 3 wherein searching for the optimal antenna subset is suspended as soon as the first subset that satisfies the SSI threshold is found, thereby reducing computational complexity.

12. The method as in claim 3 wherein only a limited number of antenna subsets are selected based on certain performance criterion as a means to reduce the computational complexity of the method.

13. The method as in claim 1 wherein a base transceiver station (BTS) that overpowers the other BTSs reduces its transmit power to balance the power from all BTSs to the clients.

14. The method as in claim 1 wherein a base transceiver station (BTS) that overpowers the other BTSs keeps its power level unaltered, the other BTSs increase their transmit power to balance the power from all BTSs to the clients.

15. The method as in claim 1 wherein a maximum auto-correlation coefficient of the covariance matrix is used as an indication of transmit power imbalance.

16. The method as in claim 15 wherein thresholds of auto-correlation are defined to select between power balanced and imbalanced methods and those thresholds are obtained based on certain performance criterion.

17. The method as in claim 16 wherein the selection is based on hysteresis loop and multiple thresholds of auto-correlation are defined for that hysteresis.

18. The method as in claim 15 wherein the auto-correlation is mapped into a transmit gain value and that value is used to adjust the power of the BTSs.

19. A multiuser (MU) multiple antenna system (MAS) comprising:
one or more centralized units communicatively coupled to multiple distributed transceiver stations or antennas via a network;
the network comprising wireline or wireless links or a combination of both, employed as a backhaul communication channel; and
the MU-MAS employing transmit antenna selection, user selection and/or transmit power balancing are employed to enhance channel spatial diversity;
transmitting a plurality of data streams concurrently from the multiple antennas to a plurality of users.

20. The system as in claim 19 wherein a space selectivity indicator (SSI), time selectivity indicator (TSI), and/or frequency selectivity indicator (FSI) are used as measures of the channel diversity.

21. The system as in claim 20 further comprising defining different subsets of transmit antennas and selects the subset that optimizes the SSI for transmission over the wireless links.

22. The system as in claim 20 wherein a selection criterion is based on SSI, TSI and/or FSI thresholds derived from measurements.

23. The system as in claim 20 wherein a minimum singular value of an effective channel matrix of every client device is used as SSI.

24. The system as in claim 20 wherein a minimum singular value or the condition number of a composite channel matrix from all client devices is used as SSI.

25. The system as in claim 20 wherein an absolute value of the sum of the complex channel gain from some or all transceiver stations is used as TSI.

26. The system as in claim 20 wherein the SSI is used to measure and predict the areas of coherence.

27. The system as in claim 20 wherein an average SSI is used to select adaptively between fixed transmit antenna configuration and transmit antenna selection systems based on changing channel conditions.

28. The system as in claim 20 wherein temporal correlation of the SSI is exploited to select an optimal antenna subset while reducing the computational complexity of the system.

29. The system as in claim 21 wherein searching for the optimal antenna subset is suspended as soon as the first subset that satisfies the SSI threshold is found, thereby reducing computational complexity.

30. The system as in claim 21 wherein only a limited number of antenna subsets are selected based on certain performance criterion as a means to reduce the computational complexity of the system.

31. The system as in claim 19 wherein a base transceiver station (BTS) that overpowers the other BTSs reduces its transmit power to balance the power from all BTSs to the clients.

32. The system as in claim 19 wherein a base transceiver station (BTS) that overpowers the other BTSs keeps its power level unaltered, the other BTSs increase their transmit power to balance the power from all BTSs to the clients.

33. The system as in claim 19 wherein a maximum auto-correlation coefficient of the covariance matrix is used as an indication of transmit power imbalance.

34. The system as in claim 33 wherein thresholds of auto-correlation are defined to select between power balanced and imbalanced systems and those thresholds are obtained based on certain performance criterion.

35. The system as in claim 34 wherein the selection is based on hysteresis loop and multiple thresholds of auto-correlation are defined for that hysteresis.

36. The system as in claim 35 wherein the auto-correlation is mapped into a transmit gain value and that value is used to adjust the power of the BTSs.

CLAIMS

We claim:

1. A method comprising:
 - obtaining N streams of information from a first network,
 - transforming the N streams of information into M streams of bits, each stream of bits being a combination of some or all N streams of information,
 - sending the M streams of bits to M distributed transceiver stations over a second network,
 - the transceiver stations simultaneously sending the streams of bits over wireless links to at least one client device in a way that at least one client device receives at least one of the original N streams of information.
2. The method as in claim 1 further comprising:
 - employing transmit antenna selection, user selection or transmit power balancing to enhance channel spatial diversity.
3. The method as in claim 2 wherein a space selectivity indicator (SSI), time selectivity indicator (TSI), and/or frequency selectivity indicator (FSI) are used as measures of the channel diversity.
4. The method as in claim 3 further comprising defining different subsets of transmit antennas and selects the subset that optimizes the SSI for transmission over the wireless links.
5. The method as in claim 3 wherein the selection criterion is based on SSI, TSI and/or FSI thresholds derived from measurements.
6. The method as in claim 3 wherein a minimum singular value of the effective channel matrix of every client device is used as SSI.
7. The method as in claim 3 wherein a minimum singular value or the condition number of the composite channel matrix from all client devices is used as SSI.

8. The method as in claim 3 wherein an absolute value of the sum of the complex channel gain from some or all transceiver stations is used as TSI.
9. The method as in claim 3 wherein the SSI is used to measure and predict the areas of coherence.
10. The method as in claim 3 wherein an average SSI is used to select adaptively between fixed transmit antenna configuration and transmit antenna selection methods based on the changing channel conditions.
11. The method as in claim 3 wherein temporal correlation of the SSI is exploited to select the optimal antenna subset while reducing the computational complexity of the method.
12. The method as in claim 4 wherein searching for the optimal antenna subset is suspended as soon as the first subset that satisfies the SSI threshold is found, thereby reducing computational complexity.
13. The method as in claim 4 wherein only a limited number of antenna subsets are selected based on certain performance criterion as a means to reduce the computational complexity of the method.
14. The method as in claim 2 wherein a base transceiver station (BTS) that overpowers the other BTSs reduces its transmit power to balance the power from all BTSs to the clients.
15. The method as in claim 2 wherein a base transceiver station (BTS) that overpowers the other BTSs keeps its power level unaltered, the other BTSs increase their transmit power to balance the power from all BTSs to the clients.
16. The method as in claim 2 wherein a maximum auto-correlation coefficient of the covariance matrix is used as an indication of transmit power imbalance.

17. The method as in claim 16 wherein thresholds of auto-correlation are defined to select between power balanced and imbalanced methods and those thresholds are obtained based on certain performance criterion.

18. The method as in claim 17 wherein the selection is based on hysteresis loop and multiple thresholds of auto-correlation are defined for that hysteresis.

19. The method as in claim 16 wherein the auto-correlation is mapped into a transmit gain value and that value is used to adjust the power of the BTSs.

20. A system comprising circuitry and/or program code to perform the operations of:

obtaining N streams of information from a first network,
transforming the N streams of information into M streams of bits, each stream of bits being a combination of some or all N streams of information,

sending the M streams of bits to M distributed transceiver stations over a second network,

the transceiver stations simultaneously sending the streams of bits over wireless links to at least one client device in a way that at least one client device receives at least one of the original N streams of information.

21. The system as in claim 20 wherein transmit antenna selection, user selection and/or transmit power balancing are employed to enhance channel spatial diversity.

22. The system as in claim 21 wherein a space selectivity indicator (SSI), time selectivity indicator (TSI), and/or frequency selectivity indicator (FSI) are used as measures of the channel diversity.

23. The system as in claim 22 further comprising defining different subsets of transmit antennas and selects the subset that optimizes the SSI for transmission over the wireless links.

24. The system as in claim 22 wherein the selection criterion is based on SSI, TSI and/or FSI thresholds derived from measurements.

25. The system as in claim 22 wherein a minimum singular value of the effective channel matrix of every client device is used as SSI.

26. The system as in claim 22 wherein a minimum singular value or the condition number of the composite channel matrix from all client devices is used as SSI.

27. The system as in claim 22 wherein an absolute value of the sum of the complex channel gain from some or all transceiver stations is used as TSI.

28. The system as in claim 22 wherein the SSI is used to measure and predict the areas of coherence.

29. The system as in claim 22 wherein an average SSI is used to select adaptively between fixed transmit antenna configuration and transmit antenna selection systems based on the changing channel conditions.

30. The system as in claim 22 wherein temporal correlation of the SSI is exploited to select the optimal antenna subset while reducing the computational complexity of the system.

31. The system as in claim 23 wherein searching for the optimal antenna subset is suspended as soon as the first subset that satisfies the SSI threshold is found, thereby reducing computational complexity.

32. The system as in claim 23 wherein only a limited number of antenna subsets are selected based on certain performance criterion as a means to reduce the computational complexity of the system.

33. The system as in claim 21 wherein a base transceiver station (BTS) that overpowers the other BTSs reduces its transmit power to balance the power from all BTSs to the clients.

34. The system as in claim 21 wherein a base transceiver station (BTS) that overpowers the other BTSs keeps its power level unaltered, the other BTSs increase their transmit power to balance the power from all BTSs to the clients.

35. The system as in claim 21 wherein a maximum auto-correlation coefficient of the covariance matrix is used as an indication of transmit power imbalance.

36. The system as in claim 35 wherein thresholds of auto-correlation are defined to select between power balanced and imbalanced systems and those thresholds are obtained based on certain performance criterion.

37. The system as in claim 36 wherein the selection is based on hysteresis loop and multiple thresholds of auto-correlation are defined for that hysteresis.

38. The system as in claim 37 wherein the auto-correlation is mapped into a transmit gain value and that value is used to adjust the power of the BTSs.