CLAIMS

We claim:

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

a plurality of wireless base transceiver stations (BTSs) and/or a centralized processor (CP);

a plurality of user equipment devices (UEs); and a plurality of beacon stations;

the one or more BTSs and/or the centralized processor (CP) to estimate uplink (UL) channel state information (CSI) from UL signaling;

wherein one or more of the plurality of BTSs and beacon stations are configured to send a plurality of training signals between the BTSs and the beacon stations;

wherein one of more of the plurality of BTSs, the CP, and/or one or more beacon stations process the plurality of training signals to estimate a plurality of RF calibration coefficients;

wherein one or more of the plurality of BTSs, the CP, and/or one or more beacon stations use the plurality of RF calibration coefficients to precondition a matrix of UL CSI and obtain a matrix of downlink (DL) CSI;

one or more precoders of one or more of the plurality of BTSs, the CP, and/or one or more beacon stations to use the DL CSI for precoding radio signals which are simultaneously transmitted from the plurality of BTSs, the precoding to cause deliberate radio frequency interference to create concurrent, non-interfering enclosed shapes in space of coherent wireless signals around one or more antennas of one or more of the UEs; and

wherein the CP is to adapt the size of the enclosed shapes in space by selecting different subsets of the plurality of BTSs.

2. The system as in claim 1 wherein the plurality of BTSs are interconnected to the centralized processor (CP) via a base stations network (BSN), wherein the one or more precoders of one or more of the plurality of BTSs use the DL CSI for precoding the radio signals.

3. The system as in claim 2 wherein the CP is aware of the DL CSI between the plurality of BTSs and the UEs, a CP precoder of the CP to utilize the DL CSI to precode data sent over the DL channels.

4. The system as in claim 3 wherein the DL CSI is estimated at the UEs and fed back to one or more of the plurality of BTSs.

5. The system as in claim 1 wherein the DL CSI is derived at one or more of the plurality of BTSs from the UL-CSI using radio frequency (RF) calibration and exploiting reciprocity of the UL and DL channels.

6. The system as in claim 1 wherein the plurality of RF calibration coefficients are employed to compute the DL MU-MAS precoding weights from the UL channel.

7. The system as in claim 6 wherein precoding weights are computed to pre-cancel inter-client interference to every UE.

8. The system as in claim 6 wherein precoding weights are computed from linear precoding methods including zero forcing, block diagonalization, and/or matrix inversion.

9. The system as in claim 6 wherein precoding weights are computed from non-linear precoding methods including dirty-paper coding, Tomlinson-Harashima, lattice trellis, and/or vector perturbation.

10. The system as in claim 2 wherein Round-Robin or proportional fair scheduling are used to guarantee similar symbol error rate (SER) performance to all UEs.

11. The system as in claim 2 wherein the one or more precoders of one or more of the plurality of BTSs and/or the CP precoder dynamically switches between linear and non-linear precoding techniques to minimize the computational complexity of the precoder, depending on a number of the plurality of BTSs and/or UEs.

12. The system as in claim 1 wherein the matrix of DL CSI is obtained by preconditioning the matrix of UL CSI with a matrix containing the plurality of RF calibration coefficients.

13. The system as in claim 1 wherein the plurality of RF calibration coefficients are obtained from one or more downlink DL channels and uplink (UL) channels between the plurality of BTSs and the plurality of beacon stations.

14. The system as in claim 13 wherein the one or more DL and UL channels are estimated via training signals sent from/to the plurality of BTSs to/from the plurality of beacon stations.

15. The system as in claim 1 wherein the plurality of beacon stations comprise any of the plurality of BTSs.

16. The system as in claim 1 wherein the plurality of beacon stations comprise any of the UEs.

17. The system as in claim 2 wherein the plurality of RF calibration coefficients are sent from at least one of the plurality of beacon stations to the CP via a wireless or wireline feedback channel.

18. The system as in claim 17 wherein quantization or codebook-based limited feedback techniques are employed to feedback the plurality of RF calibration coefficients from the plurality of beacon stations to the CP.

19. The system as in claim 2 wherein the MU-MAS is a long-term evolution (LTE) network, the UEs are LTE UEs, the plurality of BTSs are LTE enhanced NodeB (eNodeB) entities or mobility management entities (MME), the CP is an LTE gateway (GW), and the BSN is an S1 or X1 interface.

20. The system as in claim 19 wherein a UL LTE demodulation reference signal (DMRS) or an LTE sounding reference signal (SRS) is employed to estimate the UL CSI from the plurality of UEs to the eNodeB BTSs.

21. The system as in claim 19 wherein a DL LTE cell-specific reference signal (CRS), or an LTE CSI reference signal (CSI-RS), and/or an LTE demodulation reference signal (DM-RS) are employed to estimate the DL and UL CSI between the eNodeB BTSs and the plurality of beacon stations used for RF calibration.

22. The system as in claim 19 wherein an LTE physical uplink shared channel (PUSCH) is used to feedback the RF calibration coefficients from the plurality of beacon stations to the CP.