ABSTRACT

Mobile WiMAX is a broadband wireless access service that enables the convergence of mobile and fixed broadband networks through a common wide area broadband radio access technology and flexible network architecture. Orthogonal Frequency Division Multiple Access (OFDMA) is used in Mobile WiMAX Air Interface. It has improved multipath performance in non-line of sight environments. Synchronization is a major factor in designing multicarrier modulation system receiver, since, it affects the receiver performance. It depends on the precision of Carrier Frequency Offset (CFO) and Timing Offset (TO) estimation.

In uplink OFDMA for mobile WiMAX, the received signal is the sum of transmitted signals from different mobile users. Each mobile user experiences an independent timing and frequency offset which makes synchronization more complicated at the base station. Several techniques have been proposed to estimate CFO and TO in OFDMA which have not given better performance. In OFDMA, the subcarriers are divided into different groups. Each group of subcarriers is assigned to a user based on different subcarrier assignment schemes. Generalized Carrier Assignment Scheme is more robust in fast fading environment and well suited for mobile user. So, CFO estimation based on Generalized Carrier Assignment Scheme (GCAS) is better suited in uplink OFDMA for mobile WiMAX.

Modified Data Aided Phase Incremental Technique (MDA-PIT) has been proposed for CFO estimation. In the proposed technique, CFO estimation is performed after Fast Fourier Transform to use the received frequency domain pilot subcarrier information. It has been designed to provide a better Mean Square Error than other conventional techniques. Modified Integrated Estimation and Compensation technique has been proposed to compensate Residual Frequency Offset (RFO). The proposed technique has better BER performance due to the efficient suppression of Inter Carrier Interference (ICI) and Multi User Interference (MUI). In addition, the difference between CFOs of two OFDMA symbols lies within the range of RFO which is not considered in other conventional techniques. Hence, the effect of ICI and MUI on the received symbol is pre-compensated using the CFO of previous symbol.
Timing synchronization and channel estimation using perfect sequence in uplink Time Domain Synchronous Orthogonal Frequency Division Multiple Access (TDS-OFDMA) is proposed. The effect of timing offset and channel estimation in mobile WiMAX is analyzed. The proposed technique works better than the techniques based on preamble patterns under Urban, Indoor Office-B and HIPER LAN-A channel due to accurate auto correlation of perfect sequence. The complexity of uplink TDS-OFDMA is reduced by perfect sequence used as guard sequence instead of cyclic prefix. The channel estimation is achieved with same guard sequence. The proposed technique has good detection probability at low Signal to Noise Ratio.

A novel Multiuser Detection (MUD) algorithm is proposed in uplink OFDMA for mobile WiMAX. The proposed MUD algorithm is better than conventional Initial Ranging Algorithm (IRA). The timing offset estimation performance of MUD algorithm is better than conventional IRA since its ability to reduce Multiple Access Interference is higher, resulting in better detection and parameter estimation. The proposed MUD algorithm detects the active ranging subscriber with minimum timing offset estimation error since an error in timing offset has got more adverse effect than a misdetection.

The proposed techniques for Carrier Frequency Offset and Timing Offset estimation have been simulated using MATLAB. Simulation results show that the proposed techniques for Carrier Frequency Offset and Timing Offset estimation have better performance in terms of Mean Square Error, Bit Error Rate, detection probability and probability of timing estimation.