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PERFORMANCE OF MULTI-ANTENNA TERRESTRIAL RECEIVERS IN LEO SATELLITE BASED OFDM TRANSMISSION SYSTEMS

Abstract

Orthogonal Frequency Division Multiplexing (OFDM) is a communications technology that provides very efficient use of radio frequency spectrum, hence is widely used in modern terrestrial wireless applications all over the world. Prime examples of its use are in digital terrestrial television (DTT) broadcast systems, such as those based on the European broadcast standard DVB-T, or the Japanese broadcast standard ISDB-T. In all these broadcast systems though, the use of multi-antenna receivers for improving system performance is never taken into consideration. This is not on account of some technical hurdle, but simply based on the fact that expecting consumers to deploy multiple antennas for their television sets is not feasible. In comparison though, the potential benefit that can be achieved from deploying multiple terrestrial receiver antennas in a LEO satellite-based transmission system is definitely worth exploring, and is the goal of this paper. This paper first describes the structure of a basic demodulator needed to receive transmission from a LEO satellite-based OFDM transmitter using a single terrestrial antenna. Then several methods for combining received signals from second, third, all the way up to Nth receiving antenna inside the demodulator are investigated. Each method has its own pros and cons though, and associated level of implementation complexity. At one end of the complexity spectrum lies the simple aggregation of all incoming signals from all the receiving antennas into one signal before feeding it to the demodulator. At the other end, separate demodulators could be deployed to demodulate each antenna's received signal separately, and then dynamically choosing between these based on certain predefined performance criteria. Additionally, it should be pointed out that any single demodulation method turns out not to be best suited to each of several differing reception scenarios. For instance, a maritime receiver might benefit from received signal aggregation in calm weather, but such a method would only deteriorate performance in turbulent weather where choosing just the demodulated antenna output with the best reception would yield far better results. This paper formulates and then simulates several demodulation methods for multi-antenna receivers under various conditions, and provides guidelines on how to choose the best demodulation method for each case. Finally, the performance of multi-antenna vs single-antenna receiver systems is compared and advantages as well as cost performance issues are pointed out.