



1. Title of the Thesis: SC-FDMA Performance with Receiver Diversity Techniques over Land Mobile Satellite (LMS) Channel

2. Name of the supervisors:

Dr. Maria Del Carmen Aguayo-Torres, Dr. Juan Sanchez-Sanchez

3. Abstract: The major expansion seen in wireless technology over last two decades is a direct result of the increasing demand of high data rate transmissions. Third Generation Partnership (3GPP) developed Long Term Evolution (LTE) mobile communication to meet high data rate requirement. The satellite terrestrial will be LTE-A. Besides cellular communications, Land Mobile Satellite (LMS) systems will be significant part of the fourth generation of wireless systems. LMS will provide services which are not feasible via Land Mobile Terrestrial (LMT) systems over a wide area of network with low cost. Although complete different technologies can coexist in a single device, having the same (or similar) technology for the physical and medium access control layers over the forecasted heterogeneous network present a set of advantages. Fourth generation of wireless systems are expected to be formed by the convergence of what now are considered independent systems.

The demand of high data rate results in significant Inter Symbol Interference (ISI) for single carrier systems over bandwidth and power limited channels. Overcoming the time and frequency selective nature of the propagation channel requires the use of robust coding and powerful signal processing techniques. Recent examples include different transmitter/receiver diversity techniques for high data rate transmissions as well as the use of multiple antennas at

transmitter/receiver known as Multiple Input Multiple-Output (MIMO). Multiple antenna communications technologies propose significant advantages over single antenna systems. These advantages include extended range, improved reliability in fading environments and higher data throughputs. In certain environments (such as the uplink of a mobile link) usually only one antenna is available at the transmission, thus only Single Input Single Output (SISO) or Single Input Multiple Output (SIMO) transmissions are feasible.

Orthogonal Frequency-Division Multiplexing Access (OFDMA) has been a more widely used modulation/access technique due to its robustness against frequency selective fading channels, scalability and MIMO compatibility. However, it suffers from a high Peak-to-Average Power Ratio (PAPR) which may be particularly troublesome in uplink cellular and downlink satellite transmissions as costly high-power amplifiers are needed in transmitting terminals.

Single Carrier Frequency-Division Multiple Access (SC-FDMA) has become an alternative to OFDMA techniques since, due to its low PAPR; it was chosen as the uplink multiple access schemes in 3rd Generation Partnership Project (3GPP) Long Term Evolution (LTE). The reduction of PAPR in the uplink transmission results in a relaxation on the constraints regarding power efficiency, which is needed in user terminals and satellite units. SC-FDMA can be described as a version of OFDMA in which pre-coding and inverse pre-coding stages are added at the transmitter and receiver ends respectively, thus symbols are transmitted in time but after processing in the frequency.

Even with the use of OFDMA or SC-FDMA, ISI has to be compensated by equalization, which is usually performed in frequency domain. There are two types of linear equalizers: the Zero Forcing (ZF) and Minimum Mean Square Error (MMSE) equalizer. The zero forcing equalizer cancels all ISI, but can lead to considerable noise enhancement. MMSE equalizer technique minimizes the expected mean squared error between the transmitted symbol and the symbol detected at the equalizer output, thereby providing a better balance between ISI mitigation and noise enhancement. Because of this more favorable balance, MMSE equalizer tends to have better BER performance than equalizer using the ZF algorithm.

This dissertation is aimed to provide an analysis of the performance for a SC-FDMA system with receiver diversity over cellular and satellite links in terms of Bit Error Rate (BER).