Impact of Spatial Diversity Techniques in Combating Interference and Multipath Fading in Wireless Communication Systems

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ABSTRACT

The wireless communication Channel suffers from many impairments such as the thermal noise often modeled as Additive White Gaussian Noise (AWGN), the path loss in power as the radio signal propagates, the shadowing due to the presence of fixed obstacles in the radio path, and the fading which combines the effects of multiple propagation paths and the rapid movement of mobile units reflectors. Multiple propagation paths cause signal attenuation due to destructive addition of multipaths in the propagation media and interference from other users. Severe attenuation makes it impossible for the receiver to determine the transmitted signal unless some less-attenuated replica of the transmitted signal is provided to the receiver. These problems may result in significant link degradation and affect overall capacity of wireless communication systems. It is therefore crucial to effectively combat or reduce these effects at the receiver.

To overcome these problems, spatial diversity techniques are employed. Spatial diversity involves employing multiple transmit and receive antennas. This increases the amount of diversity and may enable the wireless systems to have high voice quality, high bit rate data services, and better network coverage and be more power and bandwidth efficient. These techniques have been found to be better than single transmit, single receive antenna systems. Multiple transmit and receive antenna systems have been shown to improve the general performance of a wireless communication systems. Open-loop and closed-loop spatial diversity techniques have been investigated and used in the simulation. Maximal Ratio Combining (MRC) receive diversity technique was used as the bench mark to gauge the performance of transmit diversity techniques and multi-antenna wireless communication systems. Maximum likelihood equalization and Alamouti space time block coding techniques were also applied and found to

significantly improve the performance of wireless communication systems by combating interference and multipath fading.