Abstract

In view of the present scenario of wireless communication and networking technology, link adaptation (LA) has assumed a significant role in increasing spectral efficiency of the communication systems. It exploits the variation of the wireless channel by dynamically selecting an efficient combination of transmission parameters, such as, modulation scheme, power level etc. based on the feedback information received from the receiver end regarding the channel condition. In this thesis, we have examined some candidate strategies for LA-based wireless system and examined their performances.

First, we proposed a novel BER-aware adaptive modulation scheme for integrated voice and data transmission over wireless channel, wherein higher-level modulation is applied along with permissible shrinking of symbol intervals for the voice bits in a given frame. The feasibility of the proposed scheme has been examined for time-invariant AWGN channel and fading channels in a point-to-point link. The results of our analysis indicate that, using the proposed scheme, one can achieve an appreciable enhancement in data throughput, without making any sacrifice in capacity and QoS for voice transmission. Subsequently, we examined a spectrally-efficient wireless communication technique using an appropriate blend of diversity and adaptive modulation. In particular, we examined the performance of the Alamouti transmit diversity (ATD) scheme aided by adaptive modulation, wherein the transmitter employs two antennas and the receiver can use one or two antennas, *i.e.*, system supports 2×1 and 2×2 transmit/receive antenna configurations. Using the results of this investigation, a 2×1 hybrid adaptive system (two antennas for base station and one antenna for mobile units (MUs)) has been examined for small-size MUs, wherein ATD and maximal-ratio combining (MRC) are considered for uplink and downlink transmissions, respectively. With the increasing demand for higher speed in a fading environment, the energy consumption becomes a challenging issue for MUs. In view of this, energy consumptions in diversity-based wireless systems using adaptive modulation have also been examined. Our analysis indicates

that, in the proposed ATD/MRC-based 2×1 hybrid adaptive transmission system, with an asymmetric capacity allocation for uplink (with higher capacity) and downlink (with lower capacity) traffic, one could significantly reduce the energy consumption and hence increase the battery life for the MUs. Finally, a novel phase-shifting scheme, named TIPA (transition-initiated phase acceleration) has been proposed for digital phase modulation technique to implement adaptive modulation schemes with very-large scale integration (VLSI). We examined the proposed scheme for BPSK modulation, and studied its feasibility for VLSI design using simulation tools. This scheme, being generic in nature for any digital phase-modulation scheme, has been extended for implementing QPSK and 16-QAM, which are realizable in VLSI. Finally, combining them all, an adaptive-modulation unit has been designed for VLSI implementation with triple options of BPSK, QPSK and 16-QAM.

Keywords: Link adaptation, adaptive modulation, shrinking of symbol interval, simultaneous voice and data transmission, diversity, Alamouti transmit diversity, maximal-ratio combining, energy consumption, transition-initiated phase acceleration