Run-time Adaptation of a Reconfigurable Mobile UMTS Receiver

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I. Introduction

UMTS receivers are mobile devices, which should have a low energy consumption and operates in a frequently changing environment. The idea of this paper is to adapt the amount of signal processing for the reception within an UMTS mobile to this changing environment. In this way the amount of signal processing can be decreased for a good channel to decrease the energy consumption and for a bad channel the signal processing can be increased to guarantee a minimum Quality of Service for the signal. Due to space limitation, this paper only describes the approach. For full details see [1].

II. Approach and Results

The heart of a UMTS receiver is a RAKE receiver that decodes the symbols from the channel. The RAKE receiver is followed by a Viterbi or Turbo decoder, which performs forward error correction on the received information from the RAKE receiver (see Figure 1).

In our approach the error correcting capacity of these Viterbi and Turbo decoders are investigated in detail. The idea is that when the error correcting capacity of these decoders is known, the amount of signal processing in the RAKE receiver can be controlled until the used decoder is just able to correct the received data. In other words, do as little as possible in the RAKE receiver.

To obtain an idea about the quality of the signal after the RAKE receiver, we derived a Bit Error Rate (BER) estimation algorithm. Using this algorithm, we can tell whether the used forward error correction decoder is able to correct the received signal or not. The used BER estimation algorithm has several attractive properties compared to conventional channel estimation methods e.g. based on pilot symbols.

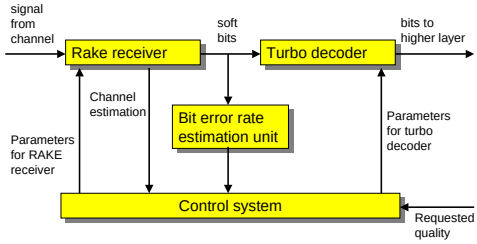

Fig. 1. The Control System for a UMTS Receiver

Attractive properties are: simplicity, accuracy, low overhead, prediction possible for other parameter settings, independent of the environment and generality.

Finally, we build a control system that is based on the components mentioned above and chooses the right settings for the parameters of the RAKE receiver.

Simulations show that the developed control system can adapt the UMTS receiver to the current environment without harmful oscillations. The committed QoS is almost always fulfilled. The reduction in terms of energy consumption compared to a static RAKE receiver is significant, e.g. for some scenarios the energy consumption of the receiver can be halved. However, the gain depends strongly on the dynamic of the environment.

III. Conclusion

The overall conclusion is that it is certainly useful *and possible* to adapt a RAKE receiver at run-time to the current condition of the wireless channel to minimize the energy consumption while providing an adequate quality of service to the end-user. The obtained gain – in terms of lower energy consumption – is strongly dependent on the dynamics of the conditions of the wireless link.

References

[1] L. T. Smit. *Energy-Efficient Wireless Communication.* PhD thesis, University of Twente, Dec. 2003. ISBN: 90-365-1986-1.