Practical Adaptive QAM Communication Systems with Diversity

Andrea Conti[1], Hanna Bogucka[2]

[1]*University of Ferrara, Italy,* [2]*Poznan University of Technology, Poland*

The motivation:

– Digital modulation adaptivity is needed in modern wireless communication systems to satisfy users' demands for Quality of Service (QoS),

– Slow Adaptive Modulation (SAM) is more practical than fast adaptive modulation (FAM) techniques

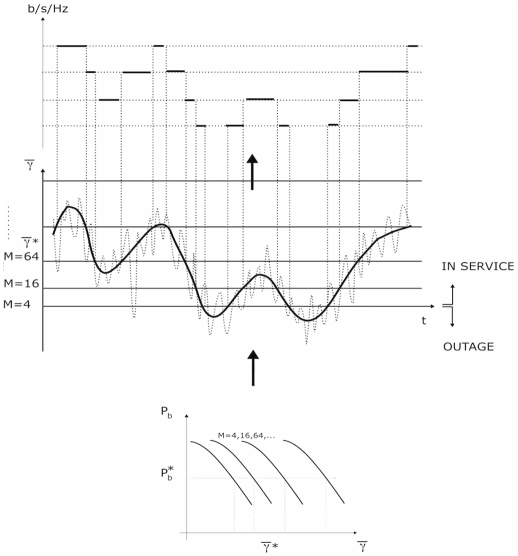
– There is the need to design adaptive transmission schemes employing diversity techniques to improve the performance

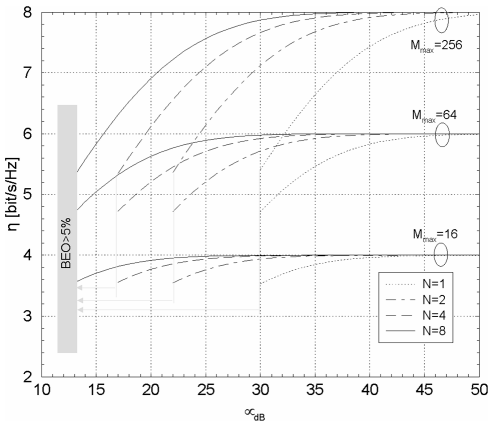
– Novel link-adaptation methods must be developed to account for imperfect Channel State Information (CSI)

The goals:

– To find a utility-based approach to SAM for QAM with diversity, which accounts for the above mentioned CSI imperfections.

– To develop practical algorithms for SAM with power limitations





$$U_{ml} = x f_1(\delta_{ml}) + (1-x) f_2(\eta_{ml})$$

Power-economizing component

Throughput-maximizing component

The results:

– QAM Symbol-error rate probability expression (with diversity), which has to be satisfied to guarantee the QoS.

$$P_s(\overline{\gamma}) = \sum_{i=1}^{M} p_i \sum_{j \in \mathcal{B}_i} I_N(\boldsymbol{\zeta}^{(i,j)}, \phi_{i,j}, \psi_{i,j}),$$

$$I_N(\boldsymbol{\zeta}, \phi, \psi) \triangleq \frac{1}{2\pi} \int_0^{\phi} \prod_{n=1}^{N} \frac{\sin^2(\theta+\psi)}{\sin^2(\theta+\psi)+\zeta_n} d\theta$$

– Utility-based approach to SAM, which accounts for the CSI imperfections.

– Our Utility-based approach is relevant to the game-theoretic approach, in which a particular strategy (the transmitted power and the modulation constellation option) is chosen by the decision-making control unit of the transceiver as a response to the set of possible (however uncertain) channel conditions.

– The considered utility function enable a proper weighting of advantages obtained in terms of energy saving or spectral efficiency.