is more evident in fading channels, particularly non-UMP QPSK has roughly \( \sim 2 \) dB penalty in Rayleigh fading and even about \( \sim 10 \) dB penalty in Rice \( K = 10 \) dB over UMP alphabets for sufficiently large SNR. It is interesting that non-UMP QFSK \( \kappa = 1/2 \) is also well robust to the channel parametrization. Therefore, we may expect that non-linear modulations avoiding all catastrophic parameters are generally more robust to the channel parametrization than the linear one. We supplement the error simulations by related end-to-end throughput simulations including BC stage using for simplicity the same alphabet. We evaluate the throughputs as a relative number of bits of correctly detected 256-bit long packets, see Fig. 16.

**B. Error Performance of Full-response CPM**

Here, SER in the MAC stage of non-linear full-response CPM \( \kappa = 1/2 \) with optimized modulation pulses are shown. We have seen that the presence of discrete memory does not influence the UMP property, although it can not be ignored at the receiver side. We use a joint \( [\hat{c}_A, \hat{c}_B] \) decoding algorithm based on the vector Viterbi algorithm [24] describing the structure of receiving signals by a super-trellis with super-states. Each super state is a vector of states which joint together the actual state at the node A with the state at the node B. Then, the joint estimate of \( [\hat{c}_A, \hat{c}_B] \) is obtained by the sequence Viterbi algorithm over the super-trellis. Thereafter, the exclusively