Reliable Communication over highly Connected Noisy Networks

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We consider the task of multiparty computation performed over networks in the presence of random noise. Given an n-party protocol that takes R rounds assuming noiseless communication, the goal is to find a coding scheme that takes R' rounds and computes the same function with high probability even when the communication is noisy, while maintaining a constant asymptotic rate.

Rajagopalan and Schulman (STOC '94) were the first to consider this question, and provided a coding scheme with rate O(1/\log (d)), where d is the maximal degree of connectivity in the network. While that scheme provides a constant rate coding for many practical situations, in the worst case, e.g., when the network is a complete graph, the rate is O(1/\log n), which tends to 0 as n tends to infinity.

We revisit this question and provide an efficient coding scheme with a constant rate for the interesting case of fully connected networks. We furthermore extend the result and show that if a (d-regular) network has mixing time m, then there exists an efficient coding scheme with rate O(1/m^3\log m). This implies a constant rate coding scheme for any n-party protocol over a d-regular network with a constant mixing time, and in particular for random graphs with n vertices and degrees n^{\Omega(1)}.