A Queueing Theoretic Model For Opportunistic Network Coding
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Network coding has been introduced to increase the performance of networks using the technique of mixing packets [1]. Bit level XOR mixing of data packets going in opposite directions through an access point (or a router) can reduce the number of data transmissions and spectrum access [2]. The saved transmission time/spectrum can be used to send more data and thereby increase the throughput. This scheme requires that the senders store the last transmitted packet so that the received network coded packets can be decoded at the destination. If only one node is sending packets to the access point at a given time instant, then transmitting those packets uncoded can communicate only one packet during a single spectrum access. Therefore it is inefficient in terms of transmission cost, whereas transmitting a coded packet can communicate two packets during the same duration of spectrum access. Therefore it may be advantageous for the access point to wait for sometime for a packet to be received from the other node to have a coding opportunity. But if this waiting time is prolonged, the system performance will degrade, and packet transmissions will get delayed significantly.

We introduce a new analytical model for a system with two nodes communicating through a single access point to keep track of the age of the packets waiting in the access point for network coding opportunities. Our derivation follows and extends the ideas initiated in [3] and [4]. An important advantage of our model is that it can be used to determine analytical expressions for two important parameters which determine the performance of an access point which employs network coding, i.e., the maximum waiting time of a data packet in the access point and the average number of spectral access attempts by the access point. We then demonstrate how the proposed model can be used to determine the network coding strategy that corresponds to the waiting times which minimizes the average

REFERENCES

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