

Study of Energy Consumption for Data Gathering in NC-based Wireless Sensor Networks

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I. INTRODUCTION

In wireless sensor networks (WSNs), the energy efficiency in data gathering is one of the major issues for the longevity of the network lifetime. The WSNs are event-based and query-based processes rather than the traditional end-to-end communication. Data that sensed by sensors are collected periodically in some applications to track and monitor the specific systems, for example room temperature automation, or vehicle accident avoidance, home healthcare monitoring and so on. Then, the collected data are sent to a sink via the intermediate sensors. Therefore, the intermediate sensors have to transmit both their own data and other forwarded data. When the time period of sensing and transmitting the data is small, a large amount of data to be sent in a period is increased. As a result, the intermediate sensors are fully occupied for performing the task of relaying for other sensors' data in spite of their own data. This leads to the battery of the intermediate sensors will drain quickly and the whole network of WSNs does not work for long period of time. To mitigate this problem, there are two viable solutions: (a) by performing data aggregation approach or (b) by using network coding approach. In this paper, we focus on the second approach to improve the energy efficiency for data gathering in the network of WSNs.

II. BACKGROUND

Network coding (NC) is an efficient technique in which a sensor is allowed to generate output data by mixing its received data. NC technique can be used to improve a network's throughput, data transmission efficiency and resilience to attacks and eavesdropping. R.R. Rout, et al. [1] propose a simple XOR network coding technique with the data aggregation functions at the intermediate sensors. The technique needs a specific topology of network coder nodes and relay nodes in order to ensure that the encoded packet can be decoded. Since data aggregation allows the relay nodes to modify the data payload, data integrity will be lost in their technique. Another type of common known NC is random linear network coding (RLNC). In RLNC, when a packet is received by a node, the node stores the packet in its memory. When a packet injection occurs on an outgoing link of a node, the node forms the packet from a random linear combination of the packets in its memory. Suppose the node has L packets $\{u_1, u_2, \dots, u_L\}$ in its memory. Then the packet formed is

$$u_0(t) = \sum_{i=1}^L \alpha_i u_i \quad (1)$$

where α_i is chosen according to a uniform distribution over the elements of F_q . The packet's global encoding vector γ that is placed in its header and which satisfies

$$u_0(t) = \sum_{k=1}^K \gamma_k w_k \quad (2)$$

where w_k is the message packets from the source. For the decoding process, sink node performs Gaussian elimination on the set of global encoding vectors from the packets in its memory to find the original messages [2].

III. MOTIVATION

In this paper, we focus on the study of effect of the energy consumption of the WSN by considering two NC methods: XOR and RLNC that are applied at the intermediate sensors. The reason for choosing a linear framework is that the algorithms for coding and decoding are well understood. The size of the encoded packet is the same as the size of an incoming packet, but an encoded packet generally carries information about several original packets. Energy is significantly consumed when the nodes transmit rather than when they compute. The previous work on RLNC combines the separated data blocks of the original packet. We work on the combination of many incoming packets from different sensors. Such kind of consideration is also introduced in [3]. The number of packets being coded together will be different from time to time. It depends on the packet overhearing capability of the sensor nodes and their lifetime.

IV. CONCLUDING REMARKS

We consider a sample tree topology of WSNs for investigating the energy consumption for data gathering when the XOR and the RLNC are applied. In our evaluation, we will determine the energy consumption based on the number of transmissions required to decode all original packets at the sink. Throughout this study, it is expected that a novel NC technique is proposed to address the problem of energy consumption in WSNs.

REFERENCES

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