Congestion Control Based on QOS improvement in Consensus in the Wireless Sensor Network

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***Abstract* -In the current world Wireless Sensor networks are used in many areas, shared by many applications, and very cost effective to collect various types of data. Since it is shared by many applications, congestion control is the main problem occurred in this type of sensor networks. Many algorithms are available to avoid this problem; among that weighted directed graph based congestion control algorithm is also the one. Due to the congestion, the network settled into a stable state, because of high traffic, giving little throughput. The increased time delay and packet loss caused by this congestion may deteriorate the quality of service (QoS). A congestion control algorithm based on QOS improvement in Consensus analysis (CC-QoS-CA), using graph theory is proposed in this paper, considering the sink as a leader. Every node is selected based on the QoS values, apart from normal consensus. If there is an improvement in the QoS value of a node then it will be considered for routing process. If there is no improvement in quality of service of a node, then only consensus will be applied. Ns simulation results showed that the proposed system, maintains a high throughput, a minimal delay time, and reduce the packet drop ratio.**

Keywords: Congestion control, CC-CA, QoS improvement, CC-QoS-CA

I. INTRODUCTION

For the past few years, there has been an extraordinary research interest in the area of autonomous networked system with emphasis on WSNs [1]. Wireless Sensor Networks are used in many applications like habitat monitoring [2], structural health monitoring [3, 4], image sensing [5], and physical game [6] greatly rely on congestion control techniques. Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure-less wireless networks to monitor physical or environmental conditions to considerately pass their data through the network to a main location or sink where the data can be observed and analyzed [7]. A Wireless sensor network consists of hundreds or thousands of sensor nodes. These sensors have the potential to communicate either among each other or directly to an external base-station (BS) [8] [9]. A larger number of sensors allows for sensing over larger geographical regions with greater accuracy [9]. Sensor nodes synchronize among themselves to produce high-quality information about the physical environment. Every sensor node bases its knowledge of its computing, and decisions on its mission, the information it currently has, communication, and energy resources. These scattered sensor nodes has the capability to collect and route data each to other sensors or back to an external base stations [10].The Sensor nodes which will deploy in the distant area, like the satellite in the outer space, and the high mountain area, renewing is not practical. Thus, the most important aim for WSNs is on the low energy use within the independent, supportive nodes which may be controlled by means of a small memory and a low computing ability [11].

A wireless sensor network consists of lots of autonomous sensors which are dispersed, to monitor physical or environmental conditions. Due to exchanges of the information and the physical parameters, in combination of the variable wireless sensor network conditions, may consequence in erratic behavior in the form of traffic load variations and fluctuations in the link capacity. These are the possibility of increasing congestion in WSNs. When a network is congested, it reached to a stable state, increased time delay and packet drop ratio, affects the quality of service (QoS). Even though the traffic demand is more, but little throughput is available. Particularly, packet loss may trigger the time-out retransmission scheme of TCP. Retransmitted packet may deteriorate the congestion and stimulate more retransmission request. As a result, congestion in WSN increase the per packet energy consumption and reduce delivery ratio.

The limited and unpredictable nature of WSNs necessitates decentralized, robust, self-adaptive, and scalable mechanisms which are vital to the mission of dependable WSNs. Novel approaches should be simple to implement at individual node level with minimal exchange of information [12]. The consensus analysis of the complex network theory, such as fish swarming and bird flocking, is used in this paper. With the help of the graph theory, a congestion control algorithm based on QOS improvement in Consensus analysis (CC-QoS-CA) is proposed in this paper, considering the sink as a leader. Ns simulation results shows that our CC-QoS-CA could restrain the congestion over wireless sensor network and maintain a high throughput and a low delay time. It can also improve the QoS for the whole network.

The paper is organized as follows. Section 2 presents the existing congestion model based on the graph theory for WSNs. In section 3, the theoretical results for congestion control based on QoS modified in the Consensus Analysis. Section 4 contains a performance evaluation of the proposed scheme. Conclusions are provided in Section 5.

II. EXISTING CONGESTION MODEL DESCRIPTION IN CC-CA

The congestion control algorithm based on consensus analysis with graph theory is used in this paper. In CC-CA, sink is considered as a leader node and the rest of the nodes are follower nodes. The mass information is collected and processed by the Leader node. The two most popular congestion control schemes are Queue based and rate based. A backlog is inherently necessitated in Queue-based scheme [13], the rate based scheme is chosen in this paper, since it can provide early feedback for congestion [14].The base paper consider that G=(V, E, A) is a weighted directed graph with n + 1 nodes, where V denotes the set of vertices v_i= (i ∈ L={0,1,2,…,n}), E denotes the set of edges e_{ij}=(i , j), i, j ∈ L of the graph G, and A = [a_{ij}] ∈R^{nxn} for 1,2,…..,n is a weighted adjacency matrix.

This paper considers that the vertex indexed by 0 is assigned as the "leader", which is the sink in WSN. The other vertices of the graph G indexed by 1,2,…,n are referred to as "follower agents," which are autonomous between v_i and v_j, then considered that there is a path between the two nodes; otherwise e_{ij} ∈ E. Define the weight matrix A for the graph G as follows:

$$a_{ij} = \begin{cases} 0.5 & e_{ij} \in E, \\ 0 & e_{ij} \notin E, \end{cases} \quad (1)$$

Where x_i ∈ R(I ∈ L) is denoted as the data bulk sent to node I, then the differential of x, denotes the data sent rate. If there is no data communication between node I and others, $x_i = 0$.

To study a leader-following problem, the connection weight between nodes I and the leader, denoted by b_i, is shown as follows. The sink, as the last hop in the monitor area of WSN, is assigned with the largest weight:

$$b_i = \begin{cases} 0.75 & v_i \text{ connected to the leader } v_0, \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

When the offered load exceeds the available capacity in the link, the packet will accumulate in the router buffer, which will induce the congestion. The congestion can be avoided, if the data bulk exchange of all nodes for one task converges to the same equilibrium point in the network. Then the congestion control problem can be attributed to the consensus problem of the complex network. Furthermore, in simulation, all the nodes are considered the same as each other, and they spilt the bandwidth fairly.

The leader (node 0) is the sink of WSN, through which all the information collected by the sensors is transmitted. So the sink is globally reachable in WSN topology. Theorem 5 proves that the CC-CA guarantees the convergence of the system error; in other words, the data sent rates for all nodes converge equally to the sink's.[11]. Though the congestion problem is inevitable, the CC-CA provides better performance comparing to the traditional congestion algorithm.

III .PROPOSED SYSTEM

The QoS improved CC-CA, is proposed in this paper where, the QoS values are considered for routing process. As a result, every node is selected based on the QoS values, apart from normal consensus methodology. The proposed system proves that every node is selected based on the QoS values, apart from normal consensus methodology, causes increased packet received ratio with minimal delay, packet loss. If there is an improvement in the QoS value of a node then it will be considered for routing process. If there is no improvement in quality of service of a node, then only consensus will be applied. Node 0 is considered as a sink which can globally reachable in WSN topology. The CC-QoS-CA improves the quality of service by avoiding congestion.

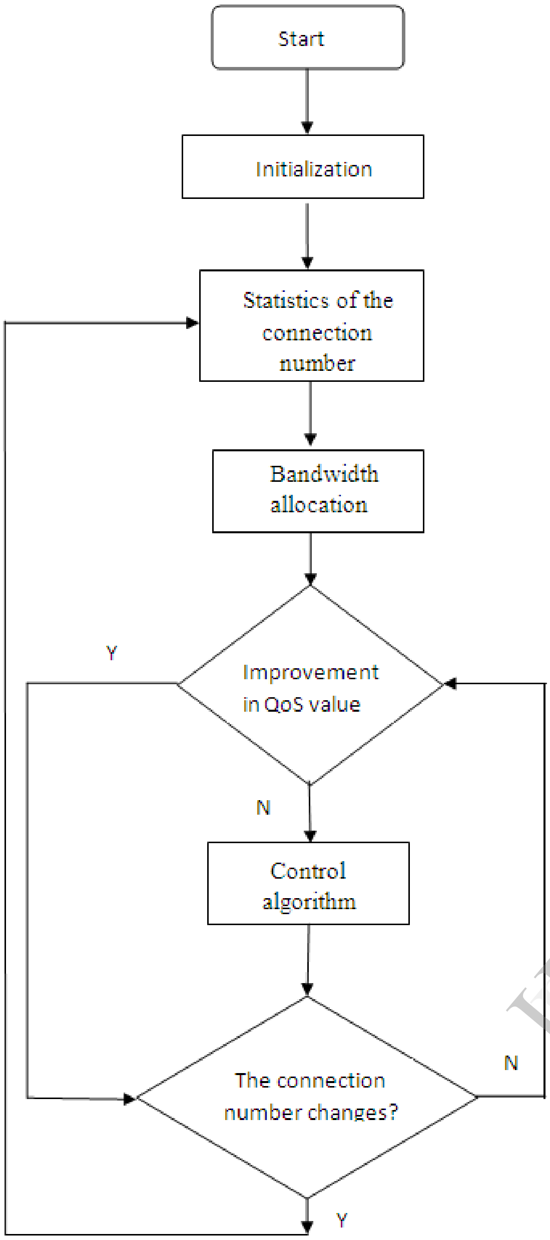

Figure 1 The flow chart of the QoS improved CC-CA.

IV. SIMULATIONS

This section states the performance of CC-QoS-CA compared with the CC-CA and normal method
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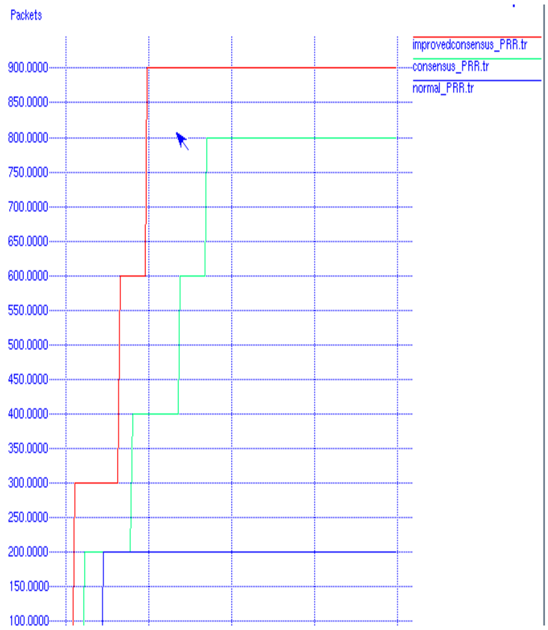
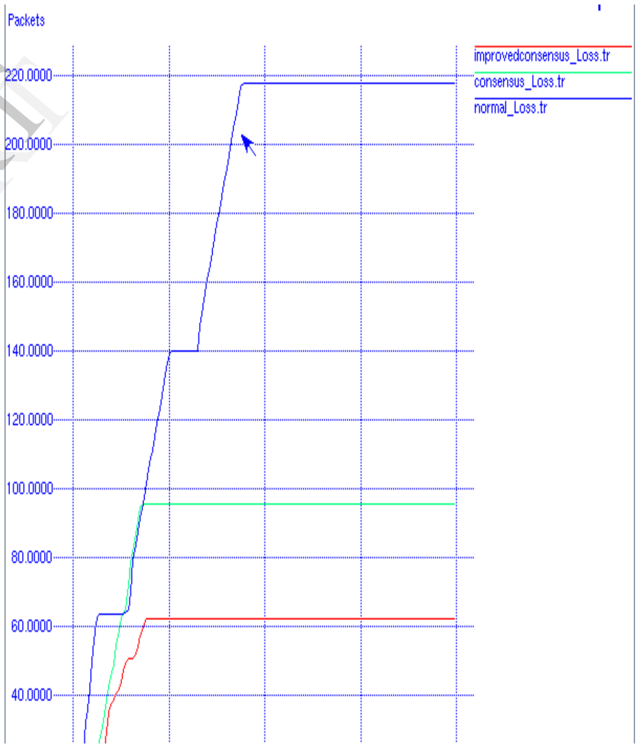
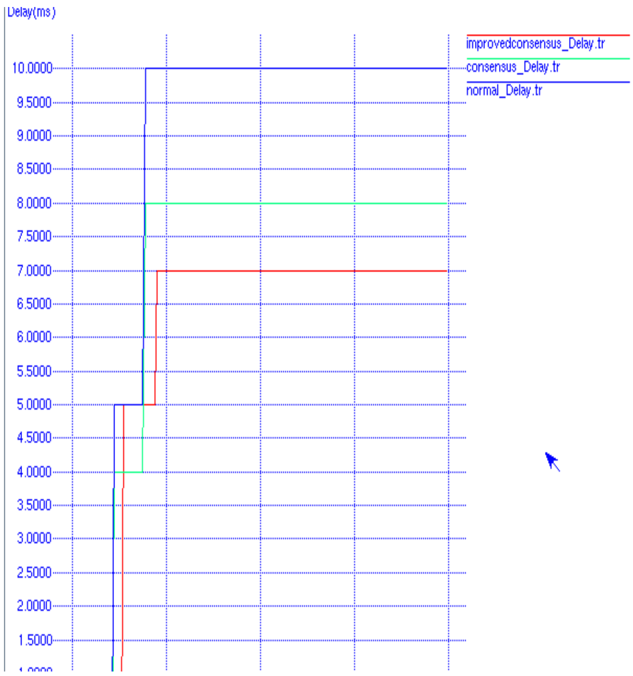
Packet Received Ratio



Packet Loss Ratio



Delay



When compared CC-QoS-CA with normal and CC-CA, simulation results showed that our CC-QoS-CA is consume the network resources well, with improved packet received ratio and reduce packet loss ratio with minimal delay time.

V. Conclusions

The congestion problem is inevitable due to many to one nature in WSN, which causes increased delays, packet drop and retransmissions. The proposed system improves the Quality of Service. Simulation results indicates that improved performance in packet received ratio, minimal delay time and reduce packet loss ratio as compared to normal and CC-CA methods. This can be achieved by QoS value in the routing process, which gives better performance.

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