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Improving Quality of Service in Wireless Sensor Networks Using Prioritized Clustering Approach

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Abstract: A Wireless Sensor Network (WSN) consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance and is now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring. Proposed work is Improving Quality of Service in Wireless Sensor Networks Using Prioritized Clustering Approach. Proposed system provides an efficient way to overcome congestion in wireless cluster sensor network. Proposed system provides priority both on data and location to improve quality of service.

Keywords: WSN, Congestion Aware Routing, Priority, Sinks, Sensor.

I. INTRODUCTION

Wireless sensor networks (WSNs) consist of a large number of limited capabilities (power and processing) Micro Electro Mechanical Systems (MEMS) capable of measuring and reporting physical variables related to their environmentThe development of wireless sensor networks was motivated by military applications such as battlefield surveillance and are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control In surveillance applications, sensors are deployed in a certain field to detect and report events like presence, movement, or intrusion in the monitored area. Data collected by sensors are transmitted to a special node equipped with higher energy and processing capabilities called “processing node” (PN) or “sink”. The PN collects, filters, and compiles data sent by sensor in order to extract useful information. There are various issues in WSN like Node Deployment, Data Reporting Model, Network Dynamics, Data aggregation, Quality of service, Congestion[1][2].

Node deployment in WSNs is application dependent and affects the performance of the routing protocol. The deployment can be either deterministic or randomized. In deterministic deployment, the sensors are manually placed and data is routed through pre-determined paths. However, in random node deployment, the sensor nodes are scattered randomly creating an infrastructure in an ad hoc manner. If the resultant distribution of nodes is not uniform, optimal clustering becomes necessary to allow connectivity and enable energy efficient network operation [1].

Data sensing and reporting in WSNs is dependent on the application and the time criticality of the data reporting. Data reporting can be categorized as either time-driven (continuous), event-driven, query-driven, and hybrid. The time-driven delivery model is suitable for applications that require periodic data monitoring. As such, sensor nodes will periodically switch on their sensors and transmitters, sense the environment and transmit the data of interest at constant periodic time intervals. In event-driven and query-driven models, sensor nodes react immediately to sudden and drastic changes in the value of a sensed attribute due to the occurrence of a certain event or a query is generated by the BS. As such, these are well suited for time critical applications. A combination of the previous models is also possible. The routing protocol is highly influenced by the data reporting model with regard to energy consumption and route stability [2].

Most of the network architectures assume that sensor nodes are stationary. However, mobility of both Base stations or sensor nodes is sometimes necessary in many applications. Routing messages from or to moving nodes is more challenging since route stability becomes an important issue, in addition to energy, bandwidth etc. Moreover, the sensed phenomenon can be either dynamic or static depending on the application, e.g., it is dynamic in a target detection/tracking application, while it is static in forest monitoring for early prevention. Monitoring static events allows the network to work in a reactive mode, simply generating traffic when reporting. Dynamic events in most applications require periodic reporting and consequently generate significant traffic to be routed to the BS [2].

Since sensor nodes may generate significant redundant data, similar packets from multiple nodes can be aggregated so that the number of transmissions is reduced. Data aggregation is the combination of data from different sources according to a certain aggregation function, e.g., duplicate suppression, minima, maxima and average. This technique has been used to achieve energy efficiency and data transfer optimization in a number of routing protocols [3].

In some applications, data should be delivered within a certain period of time from the moment it is sensed; otherwise the data will be useless. Therefore bounded latency for data delivery is another condition for timeconstrained applications. However, in many applications, conservation of energy, which is directly related to network lifetime, is considered relatively more important than the quality of data sent. As the energy gets depleted, the network may be required to reduce the quality of the results in order to reduce the energy dissipation in the nodes and hence lengthen the total network lifetime. Hence, energy-aware routing protocols are required to capture this requirement [1][2].

Basically, each sensor node comprises sensing, processing, transmission, mobilize, position finding system, and power units. These nodes collect and transmit the information. Under light load the data traffic in the network is light. When an event has been detected, the load becomes heavy and the data traffic also increases. This might lead to congestion. The most predicament issues that happen in WSN is Congestion. There are many sources for congestion. They are buffer overflow, concurrent transmission, packet collision and many to one nature. Congestion causes packet loss, which in turn reduces throughput and energy efficiency. Therefore congestion in WSN's needs to be controlled for high energy-efficiency, to prolong system lifetime, improve fairness, and improve quality of service (QoS) in terms of throughput (or link utilization) and packet loss ratio along with the packet delay.[2]. Section 1 gives introduction of WSN. In section 2 we provide literature survey. In section 3 existing system is introduced. Section 4 contains our proposed approach.

II. EXISTING SYSTEM

Existing system is based on random re-routing algorithm (RRR) for selecting routes to forward packets along high congested areas. This algorithm is distributed and adaptive which can detect the occurrence of unusual events and provides better quality of service for packets that carry information of these unusual events. Packets from unusual events are routed along preferred paths, while routine data are randomly shunted to slower and possibly longer secondary paths.

A.

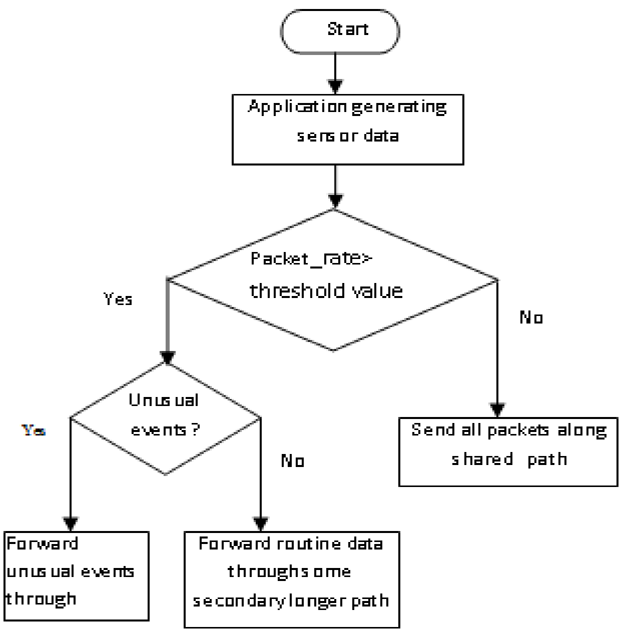

Figure 1: Flowchart of Existing System

Whenever a sensor node has some data to forward (either received by sensor node from its neighbor node or generated by sensor node itself), it would check packet rate of network.

a. If packet rate is greater than some threshold value, it means there is congestion in the network.
   a) Sensor node then checks whether data to be forwarded is unusual event or routine data.
   b) If packet is of unusual event then sensor node will forward it through some shortest reliable path.
   c) Routines packets are forwarded through some secondary longer path.
b. If packet rate is less than threshold value, it means there is no congestion, so all packets are forwarded through shared path.

B. Drawbacks of Existing System:

a. Basic drawback of existing system is that whenever a node receives packet from its neighbor node it has to check traffic level. We know that sensor nodes are energy constraints and checking traffic level for every packet, received by every forwarding node from its neighbor node, consumes lots of energy.
b. Existing system provides no way to route data to some high priority locations or system do not provide location based priority (in cluster network).
c. Degrading services of low priority data due to
a. high priority data.

III. PROPOSED WORK

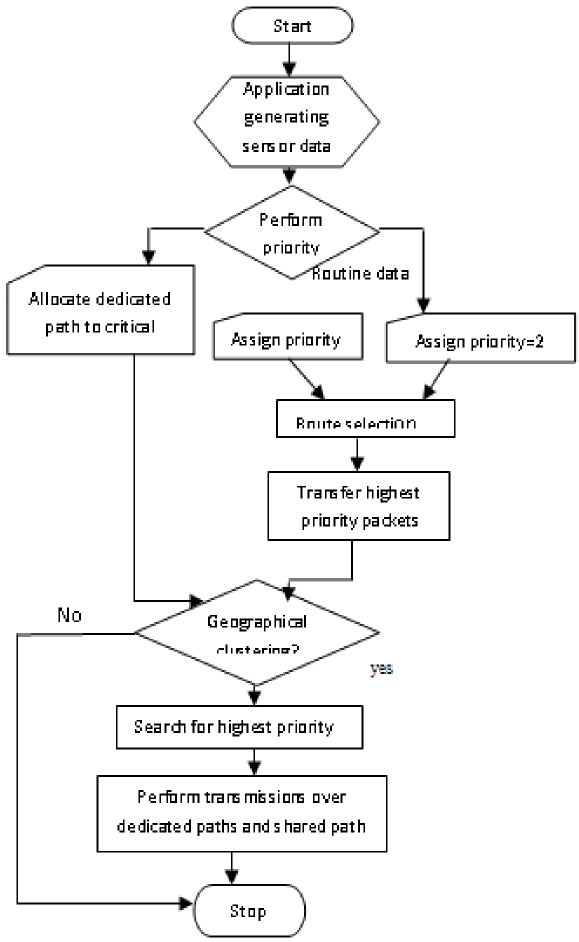

Figure 2: Flowchart of proposed approach.

Proposed system is "Improving Quality of Service in Wireless Sensor Networks using Prioritized Clustering Approach".

We characterize congestion as the degradation of service to HP data due to competing LP traffic. In this case, congestion detection is reduced to identifying competition for medium access between HP and LP traffic. Congestion becomes worse when a particular area is generating data at a high rate. This may occur in deployments in which sensors in one area of interest are requested to gather and transmit data at a higher rate than others. In this case, routing dynamics can lead to congestion on specific paths. These paths are usually close to each other, which lead to an entire zone in the network facing congestion. We refer to this zone, essentially an extended hotspot, as the congestion zone (Conzone).

Our approach is shown in figure 2. Our contributions in this work are listed as follows:

A. *Our Approach is divided into two Phases:*

a. *Phase 1*: In first phase we will classify data to assign different priority levels. The priority assignment can be according to one of following :

   a) How frequently a data is sent over the network that is whether data is routine data (sent more frequently) or information message (sent less frequently).

   b) According to data receiver sensor such as sensors doing some critical task will get data first.

b. We will assign a tunnel based path for the highest priority data; it means these data values are critical to send will definitely get the destination within specified time.

c. The second level priority nodes will be send in wait if there is some data transfer for higher priority node. They can afford some delay.

d. The third level priority nodes include the acknowledgement etc. They can afford packet loss also.

B. *Phase 2:*

Now in second phase to represent the large sensor network we will divide it in the form of clustered approach. These clusters will be defined in terms of their geographical location.

For performing the tunneling for highest priority regions, we will create a location based priority assignment or the routing.

A dedicated path will be assigned for highest priority clusters whereas data can be transmitted to other clusters from shared path.

IV. SIMULATIONS AND RESULTS

Figure 3 shows comparison of end to end delay for proposed algorithm and simple wireless cluster sensor network. Green line represents end to end delay for proposed algorithm and red line represents end to end delay for simple wireless cluster sensor network. Our proposed algorithm has low end to end delay as compared to simple wireless cluster sensor network, so our proposed algorithm is more efficient than simple wireless cluster sensor network

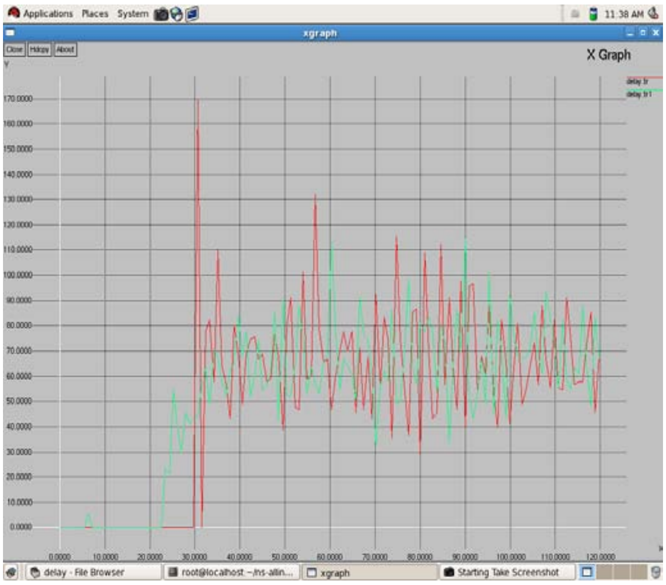

Figure 3: Comparison of End to End Delay for Proposed System and Simple wireless Cluster sensor network

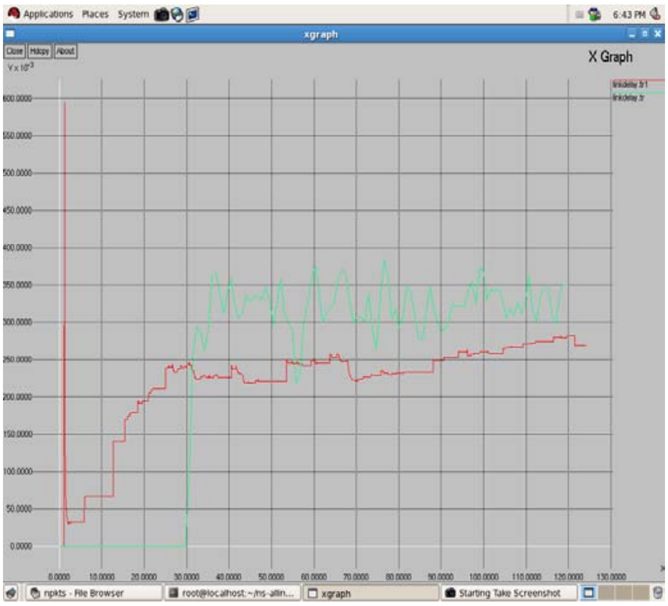

Figure 4: Comparison of link delay for proposed system with simple wireless cluster sensor network

Figure 4 above represents comparison of link delay for proposed algorithm with simple wireless cluster sensor network. Red curve represents proposed algorithm and green curve represents simple wireless cluster sensor network. Initially our approach has higher delay but once packets start transmitting over network, link delay reduces. From this figure it is clear that our approach has low link delay as compared to link delay for simple wireless cluster sensor network, so proposed algorithm is more efficient than simple wireless cluster sensor network.

Figure 5 represents comparison of throughput for proposed algorithm and simple wireless cluster sensor. Green curve represents proposed algorithm and red curve simple wireless cluster sensor network. From this graph it is clear that throughput of proposed algorithm is more as compared to throughput of simple wireless cluster sensor network, so proposed algorithm is more efficient.

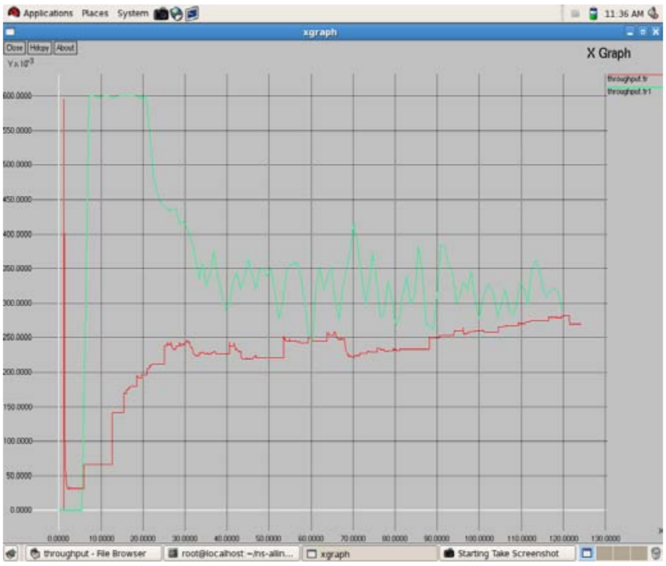

Figure 5: Comparison of throughput for proposed system and simple wireless cluster sensor network

Figure 6 shows comparison of loss rate for proposed protocol and simple wireless cluster sensor network. Red Curve represents proposed approach and green curve represents simple wireless cluster sensor network. From figure it is clear that proposed protocol has low loss rate than simple wireless cluster sensor network, so proposed protocol is more efficient than simple wireless cluster sensor network.

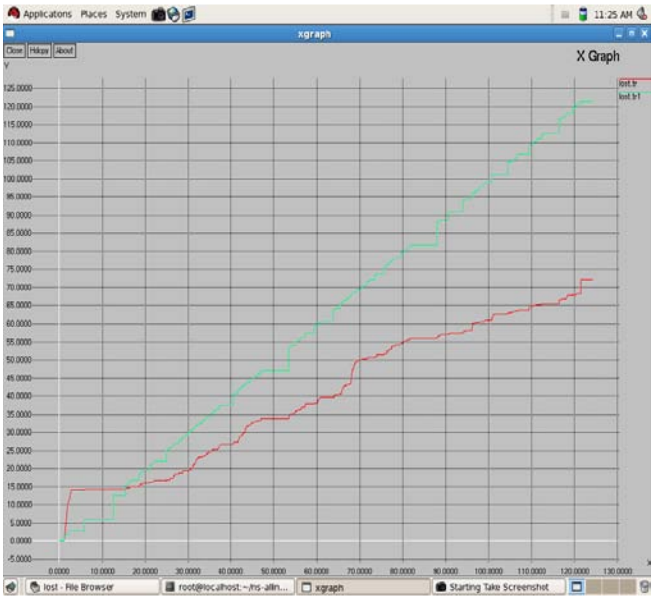

Figure 6: Comparison of loss rate for proposed system and simple wireless cluster sensor network

V. CONCLUSIONS

Proposed system is Proposed system is “Improving Quality of Service in Wireless Sensor Networks using Prioritized Clustering Approach”. The proposed system provides better approach for controlling network overload using congestion aware protocol. Proposed system saves energy of intermediate forwarding node by providing priority decision on the sending node. Proposed system also increases delivery ratio of both low priority node as well as high priority node. Proposed system overcomes the problem of energy consumption of existing system.

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