Enhancing QoS using scheduling scheme in WMSN

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Abstract - *Wireless Multimedia Sensor Networks (WMSN) are capable of sensing multimedia data contents such as audio, video, still images which requires high bandwidth than wireless sensor networks. Existing techniques of WSN do not compete with the requirements of WMSN applications. Quality of Service (QoS) requirement in WMSN is the major issue. Advanced Dynamic packet scheduling scheme is proposed to schedule various types of real time and non real time packets in the wireless multimedia sensor networks with resource constraints in the sensor nodes is the major issue. To reduce sensor energy consumption an effective level based routing mechanism is employed for better energy efficiency and to achieve the QoS requirements of WMSN applications, the proposed scheduling scheme algorithm reduces high processing overhead and save the bandwidth by eliminating the expired packets at the node itself to enhance the quality of service by means of increasing node lifetime in the network and by reducing the delay.*

Keywords: **Wireless Multimedia Sensor Networks (WMSN), Quality of Service, delay, Prioritization.**

1. INTRODUCTION

WMSN can be used in various areas such as environment monitoring, video surveillance, health care, object tracking etc. Most of the applications require visual information to be delivered with predefined QoS requirements. Many recent works have been proposed for providing QoS support at different layers of the communication stack, including QoS routing algorithms [1].

A routing protocol shows how routers connect with each other, disseminating information that activates them to select routes between any two nodes on a wireless network [2]. Routing algorithms determine the specific choice of route. Every router has a prior knowledge of the networks attached to it directly. A routing protocol shares the information first to immediate neighbors, and then to other nodes in the network. This way, routers gain knowledge of the topology of the network. Among many network design issues, such as routing protocols and data aggregation, that reduce sensors energy consumption and delay, scheduling packets at sensor nodes is highly important since it ensures delivery of different packets based on the priority and with a minimum latency. The major challenges of QoS aware routing protocols are as follows [3]:

• Resource constraints: Sensor nodes are the low cost small devices with low power that are equipped with limited data processing capability, transmission rate, battery energy, and memory. The resources in the nodes of the WMSN result in less QoS awareness and causes challenging problems.

• Energy consumption: The WMSN applications consume more amount of data is the major problem when compared to WSN. Energy consumption is an important concern in WMSN. Usually, a sensor contains the routing table and path information which reduces efficiency and can waste energy [4].

• Dynamic network: Most of the network architectures assuming nodes in the network are stationary. How-ever, in some applications mobility of both base station and sensor nodes are necessary. The sensors in the network may suffer from node and link failure. This results in dynamic routing where the routes are formed dynamically.

• Packet error and variable link capacity: Wireless links exhibit widely varying characteristics over time and space due to blockage and noise in the environment. Thus, capacity and delay attainable at each link are location-dependent and continuously varies, which makes QoS as challenging task.

In this paper, Advanced Dynamic packet scheduling scheme is proposed to deploy the nodes are virtually in a hierarchical manner such that each node has three levels of priority queues except nodes at the last level. According to the packets, priority node will route the image packets to destination.

Section 2 explains the related works carried out in routing protocols that can be used in WMSN image transmission. Section 3 explains the preliminaries and the assumptions to implement the proposed work. The section 4 explains the algorithms for the proposed scheme. The section 5 discusses about the proposed work and section 6 describes performance metrics and results. Finally, we conclude the paper in Section 7.

2. RELATED WORK

The path between the source node and sink node can be set by using the hop count in the multi hop WSN. The location of the nodes in the network is fixed for every node and has same transmission power, radio interference and environmental factors which leads to asymmetric links in the network [6]. Recent studies shows WSN routing protocols focuses more on energy efficiency which increases network life time.

Transmitting image data needs both energy and QoS aware routing in order to ensure efficient usage of the sensors and effective access to the gathered measurements [13]. Energy level of each sensor nodes, available size of buffer are considered to find next best hop to increase the packet reach ability, increase lifetime of the network and to reduce the delay[3]. The routing protocol which provides some QoS is Sequential Assignment Routing (SAR) which follows multi hop routing for path selection SAR takes energy resources into account to provide QoS packets are prioritized [7]. Energy aware QoS routing protocol which uses queuing model to handle real time and non real time data traffic and by assigning different bandwidth ratio to each node for sending data to the sink node. Nevertheless, it fails to consider end to end delay. Parameters of QoS in WMSN are [8]:

- Throughput: is the number of data flows effectively transmitted at given period of time, in some situations bandwidth is also specified. When the throughput is high then the performance is also high. Those nodes in the WMSN image based applications requires high throughput.

- Delay: is the time taken for the packets to reach the destination from the source node, which includes queuing delay, propagation delay, transmission delay, processing delay, etc

- Jitter: is defined as variations in delay, despite many other definitions. It is often caused by improper queuing, network congestion experienced by consecutive packets.

Packet loss rate: is the percentage of data packets that are failed to reach the destination during the transmission process. It can be used to represent the probability of failed packets. The packet loss is caused by network congestion, bit error, or poor connectivity. This parameter is related with the reliability of the network.
Different Queuing models are involved are as follows [7].

2.1 First In First Out (FIFO) QUEUING

The packets are served based on their arrival time in the queue. Packets from remote locations reaches the intermediate nodes needs more time to reach the destination.

2.2 Priority queuing

Each packet is prioritized where the highly prioritized packets are served first. It has low complexity and offers partial QoS support.

2.3 Weighted fair queuing

The packets are assigned to different classes and to different queues. Packets are processed in each queue using round robin fashion. It offers bounded delay and guaranteed throughput.

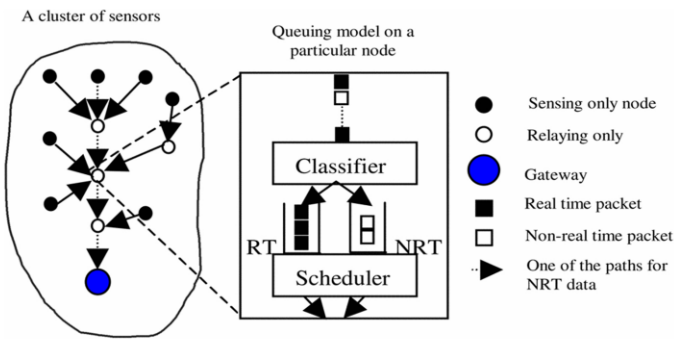

Fig 1. Queuing model in the wireless sensor networks [6]

3. PRELIMINARIES

In this section, we present some terminologies that are used in the designing of proposed packet scheduling scheme.

3.1 Assumptions

The assumptions that are made to implement the advanced packet priority scheduling scheme.

- Real time image e.g., forest fire image sensed at forest by sensors comprises real time traffic and image sensed by weather forecasting to collect temperature information comprises non real time image.
- Every sensor nodes are synchronized with timeslots
- All nodes have queues with three levels Pr1, Pr2, Pr3.
- Pr1 queue is for real-time data, Pr2 queue is meant for non-real time remote location data and Pr3 queue contains non-real time local data.

4. ALGORITHM

This algorithm shows how to schedule the packets (tasks) by assigning three priority queuing levels for each node.

//Assign time slots to all nodes located at different levels T_k at k level sensing time as T_s

Remaining time $T_1(k) = T_k - T_s$

The total real time task at n node at level k – nk(Pr1)

proctime (Pr1)k = Pr1

if proctime (Pr1)k < $T_1(k)$

Pr1 tasks of n nodes at 1(k) follows FIFO

Remaining time $T_2(k)$ = T1(k) – proctime(Pr1)k

proctime (Pr2)k = Pr2

if proctime (Pr2)k < $T_2(k)$

Pr2 tasks are processed as FIFO

Pr3 tasks follow FIFO for remaining time

$T_3(k) = T_2(k)$ – proctimePr2(k)

else

only Pr2 tasks are processed for T2(k) time

end if

else

only Pr1 tasks are processed for T1(k) time

end if

if ((Pr1 queue == empty) &&(Pr2 tasks are processed with some time slots since T(k) < = proctimePr2(k)))

Pr3 tasks are pre-empted by Pr3 tasks

Context are transferred again for processing Pr3 tasks

end if

if (reaching time > remaining time)

delete the tasks at node itself

end if

5. PROPOSED WORK

Image is transmitted from the source node to the destination by assigning priority for both real time and non real time image packets. The proposed work is to schedule the image packets among different levels in the ready queue. According to the priority of the packet and availability of the queue, node will schedule the packet for transmission.

5.1 Packet Formation

Packets with different fields are considered for transmitting the image from source to destination by considering real time and non real time packet. The fields are given below

i. Source address
ii. Destination address
iii. Packet type
iv. Packet id
v. Color of the packet
vi. Sending time
vii. Life time
viii. Hop count
ix. Priority (0 or 1)

5.2 Topology formation

The nodes in the WMSN are virtually organized in a hierarchical structure. Nodes that are at the same hop distance from the destination are considered to be located at the same level. Nodes in zones that are one hop are considered to be at level 1 and nodes that are two hop distance is said to be at level 2. Whole structure divides in the zone. The zone also divides in small square data and is transmitted from the lower level nodes to destination through the nodes of intermediate levels.

5.3 Prioritization

The sensor nodes in the wireless networks consist of three queues. According to priorities, tasks are scheduled in queues (Pr1, Pr2, Pr3). Pr1 queue is for real-time data, Pr2 queue is meant for non-real time remote location data and Pr3 queue contains non-real time local data. The image packet from the lowest level nodes traverses through various intermediate nodes and finally reaches the destination.

The image packets of nodes at different levels are processed using the Time- Division Multiple Access (TDMA) scheme. Each level is assigned with fixed time slot. If that time is greater than the time calculated for Pr1 queue then all Pr1 packets will proceed as FIFO. Whatever time remains that's usable for Pr2 queue and Pr3 queue in between, and any higher priority calculated time is greater than total remaining time, then higher priority queue task will be send as FCFS and no lower priority task will be sent.

5.4 Routing mechanism

When the source node needs to communicate with another node, the path discovery process is initiated. The nodes do not contain any routing and path information but maintains separate counters broadcast id and sequence node number. The source node initiates broadcasting the route request for path discovery to send packets to its neighbours. When same route request broadcast from various neighbours the intermediate node receives the route request. If already received the same source address and broadcast id, the redundant request is dropped and do not rebroadcast the request.

6. PERFORMANCE METRICS AND RESULTS

This section mainly focuses on the proposed approach by sending real time and non real time image by assigning different priority by means of image packet prioritization, an image file is divided into different packets and high priority packets take upper hand in the network traffic.

6.1 Simulation specification

Network Simulator [NS2] is a discrete-event and packet level computer network simulator is used for simulation purposes. It provides substantial support to a bunch of protocols like TCP, UDP, FTP, HTTP and DSR. It Uses TCL as its scripting language and network protocol stack written in c++. It is assumed that nodes are homogenous and distributed in a flat type network.

Table -1: Simulation parameters

Node number	15
Channel model	Two-ray ground
Mac protocol	TDMA
Queue length	15
Traffic	FTP

6.2 Performance estimation

In this proposed scheduling scheme, every node checks the life time of the packets and the reaching time duration. If the reaching time is greater than the remaining lifetime of the node then it is considered to be dead packets and node drops those packets immediately. The proposed scheduling scheme performs efficiently when compared to the existing scheme. Performance is calculated in terms of end to end delay and waiting time of the packets and energy saving. Deletion of dead packets is shown in the figure 2. Reach time is calculated by using the below equation,

Reaching time = remaining hop count *10ms

The figure 3 shows the real time packet delay graph, which clearly indicates the delay time required for both real time packets and non-real time packets are similar and less when compared to the existing approach.

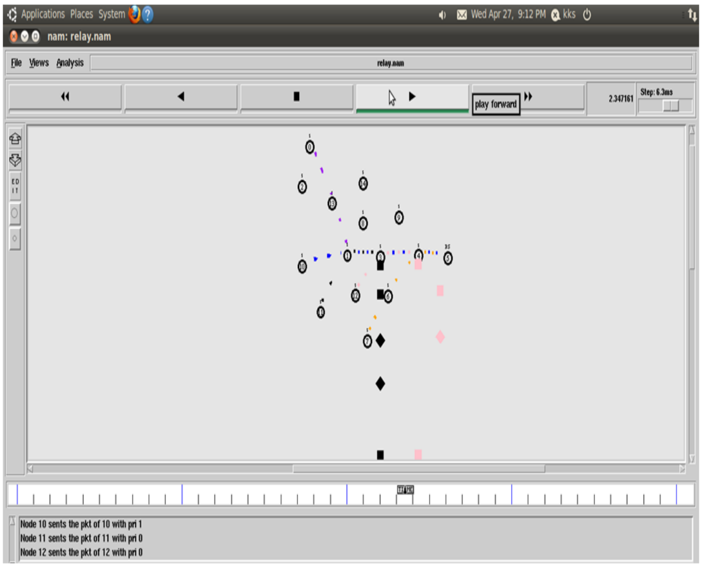

Fig.2 Dead packet removal

Table-2: Comparison of real time and non-real time packet delay

SCHEME	REAL TIME PACKET DELAY(time in ms)	NON REAL TIME PACKET DELAY(time in ms)
Dynamic multi-level packet scheduling scheme	28 ms	360 ms
Advanced DMP scheduling scheme	25 ms	260 ms

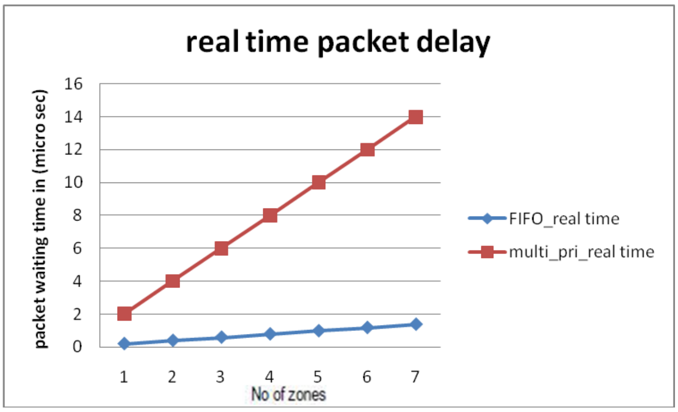

Chart -1: Delay comparison

In level based priority scheduling scheme non real time packets waiting time is less when compared to the priority based scheduling methods. In life time based priority packet scheduling scheme, non real time waiting time is reduced when compared to other methods. And advanced dynamic packet scheduling scheme, waiting time for non real time and real time packets is reduced when compared to all the other scheduling schemes.

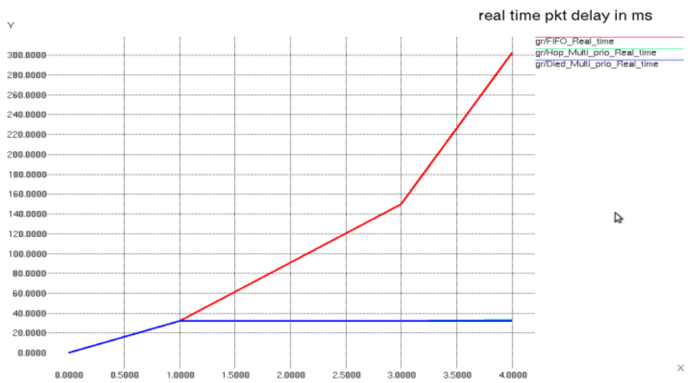

Fig.3 Delay comparison.

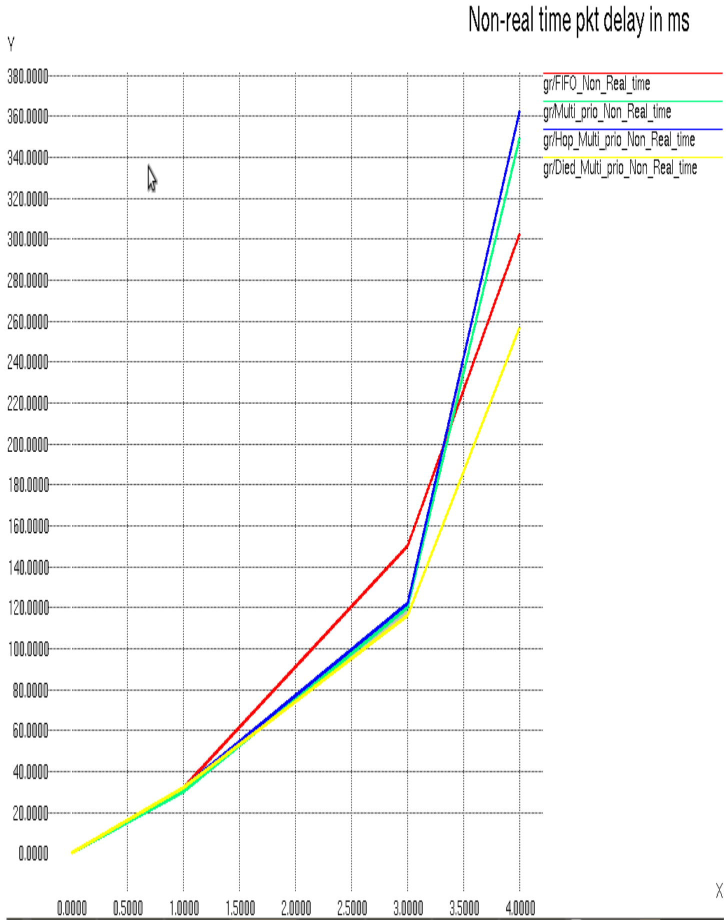

Fig.4 Graph for non real time packet delay

As enhancements to the proposed Advanced DMP scheme, priority is assigned based on deadline of the task instead of shortest job processing time. And to reduce the processing time and to save bandwidth the packets with expired deadlines are removed from the nodes itself. although, if the real time packets holds the resources for longer time other packets has to wait for long time which causes deadlock. This reduces the performance of end to end delay for that circular wait and preemptive conditions are involved to prevent deadlock.

7. CONCLUSION

Though, the applications of WMSNS are increasing, specific techniques are employed to meet the QoS requirements and to handle the scarce resources of the sensor nodes. In this paper, the proposed approach for transmitting real time and non -real time image are assigned priority base on certain circumstances for transmission. The proposed approach is evaluate by set of comparative evaluations in terms of average delay, image packet overhead, reach ability to investigate the QoS enhancement for WMSN image transmission application. In the performance estimation, link quality estimation, prioritization and path selection were employed for the requirements of image transmission in WMSN.

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