Seamless Handover Mechanism for the QoS Improvement in Mobile Wireless Sensor Networks

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***Abstract*—Different operations have been recommended for portable sensor systems, few of these operations require exchanging of an enormous measure of information in a little timeframe. This is a critical task, since mobility can prompt a fall in the nature of a built-up connection. Due to periodic link failure, may thus require a portable hub to constantly initiate or else again need to build up another connection with the help of active neighbor hub. Keeping in view of the end goal to continue with the information exchange, the advance connection formation may bring about additional information transmission delay and make the greater part of the operations delay sensitive. With a specific end goal to overcome from latency, in this venture we executed Seamless Handover Mechanism to empowers a portable hub to exchange the correspondence to a superior connection before the aspect of the current node decline. After utilizing the Seamless Handover Mechanism our results demonstrate that, the latency is inversely proportional to the duty cycle and density. Our aim is to improve the Quality of Service by considering the handover technique from a node to an active neighbor node which also shows the improved throughput and end to end delay.**

Keywords—MAC protocols; wireless sensor networks; mobility; latency; Seamless Handover Mechanism.

I. Introduction

Wireless sensor networks is defined as remote framework comprising of spacial flow of self-speaking to devices by utilizing the sensors in order to audit the physical or environmental conditions. In Wireless sensor networks the aggregation of sensor nodes gathers the information from the surroundings to bring out the particular application goals and also helps to process the information. Usually the sensor nodes gather the information through radio transmitter, to sink either straightforwardly or through a gateway.

A Mobile Wireless Sensor Network (MWSN) is also called as Wireless Sensor Network in which the sensors nodes are not static i.e., all the sensor nodes are mobile. MWSN are less, in which it enhances the lifetime of remote sensor systems, overall network lifetime, and data capacity. Due to the movement of nodes in the system, it leads to cause an issue called latency. A large portion of the major qualities of MWSN are same as that of typical static Wireless Sensor Network. Wireless sensor nodes are armed with four units, namely sensing unit for sensing the surroundings to keep track on some criterion like temperature, humidity, pressure and others, processing unit is for handling the data sensed by sensing unit based on predefined instructions, communication unit is for communicating data processed by processed unit with other nodes in the network and power unit is for facilitating power supply to nodes which is usually battery or capacitors.

Some of the challenges facing in Wireless sensor networks were Energy, Operating System, Quality of Service, Limited memory and storage space. In Wireless sensor networks most of the Energy is absorbed in information assortment, information refines, and information transmission. Sometimes it becomes a challenge to refresh or change the batteries because of analytical conditions. The Operating System should be less complicated than the general operating systems. It should have a simple programming criterion, rather of being anxious with the low-level hardware issues like scheduling, pre-empting and networking, the application planners can focus on their application logic. Different Operating Systems developed for Sensor nodes include TinyOS etc. The main level of service contribution by the sensor system to its users is Quality of Service (QoS). Wireless Sensor Network are being used in different real-time operations and in some crucial operations also, so it is essential for the system to provide a better or good QoS. It is difficult to achieve the QoS because the system structure may change periodically. Sensor systems need to be equipped with the appropriate amount of bandwidth so that it is able to accomplish a essential need for QoS. Most of the time routing in sensor systems need to sacrifice energy performance to meet delivery requirements. In Wireless sensor networks the QoS is designed to support the scalability, including or deleting the nodes should not influence the QoS in the Wireless sensor networks. Information collection is the main goal of sensor nodes. The sensors repeatedly sense the data from the surrounding environment, process it and transmit it to the base station or sink. There is no need to transfer the information to the sink, in order to avoid the energy when the sensors collect the redundant information. So additional management has needed to take care, while information transmission and collection. A sensor is microscopic equipment includes a small amount of memory and storage space for the code. In order to establish an effective security mechanism, it is required to restraint the code size of the security algorithm.

The rest of the paper is organized as follows: Section II discusses the related work. Problem statement is defined in Section III. Section IV discusses about existing system. Section V discusses about the proposed system details. Section VI discusses about the implementation details and results are discussed in Section VII. Finally, this paper is concluded by suggesting some possible future work.

II. RELATED WORK

In wireless sensor nodes, the most significant sources of energy consumption is due to idle listening and many ideas have been proposed based on duty cycling in order to reduce this cost. Receiver initiated MAC [2] presents a new asynchronous duty cycle MAC protocol, in which the receiver only initiates the process, it mainly helps to data transmission even under the wide range of traffic loads.

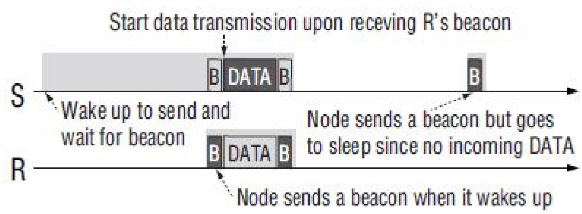

Fig. 1: Overview of RI-MAC.

Figure 1 represents the overview of the process of RI-MAC [2], in which the intended receiver node initiates the data frame transmission. In this every node frequently wakes up based on its own timetable in order to check if there are any incoming data frames predetermined for this node. When the radio is on, the node immediately communicates a hello packets or beacon if the system is idle, declaring that it is awake and ready to receive a data frame. The node with pending data is to be send, node S in the figure 1, stays active silently while waiting for the beacon from the intended receiver R. Once it receives the beacon from R, node S sender starts data frames transmission immediately, which will be acknowledged by R with another beacon. This acknowledgment represents the two things, firstly it acknowledges the correct receipt of the sent data frame and secondly it requests a new data frame transmission to the same receiver. If in the system there is no any incoming packets or data frames after communicating a beacon also, the node goes to sleep phase. In RI-MAC, the activity like the sender, that want to transmit data frames to the same receiver is mainly controlled by the receiver. This helps to makes RI- MAC more efficient in detecting collisions.

Contention based on duty cycle MAC conventions, MAC is differentiated into Synchronous and Asynchronous MAC protocols. In synchronous it includes S-MAC, T-MAC, R-MAC and DW-MAC, in Asynchronous it includes B-MAC, X- MAC, Receiver Initiated-MAC. Contradict with X-MAC, Receiver Initiated-MAC achieves higher throughput, higher packet delivery ratio and greater power efficiency under a considerable variety of traffic loads. Comparisons of Receiver Initiated-MAC with X-MAC X-MAC:

- Throughput is less.
- Latency is more.
- Duty Cycle is more.

Receiver Initiated-MAC:

- It helps to improve the throughput.
- Reduce the transmission latency.
- Improved duty cycle.

Receiver Initiated-MAC accomplishes Zero packet loss contrasted with the over 15% packet loss in X-MAC.

III. OBJECTIVE

A large portion of the applications need to transmit a huge amount of information in a brief timeframe. This is trying, since mobility can prompt a fall in the nature of a set up connection. Immediate connection establishment may thusly require a portable hub to over and over set up new connections with the corresponding neighbor hubs to continue with the information exchange or data transfer. The new connection foundation leads to vast majority of the applications delay sensitive.

In order to overcome from the above problem in this venture we execute proposed Seamless Handover Mechanism. The main objective of this paper is, when a current link breaks in the middle of information transfer, due to this some remaining data packets cannot completely transfer before the link disconnection. As a result, it will find the new neighboring node without abort the communication with the current node. This is done by using broadcasting of a data packet in which handover request is fixed. Keeping in mind the end goal to overcome this, Seamless Handover Mechanism is utilized as a part of request to reduce latency.

IV. EXISITING SYSTEM

Even though RI-MAC [2] accomplishes effective channel utilization and high packet delivery ratio, it has a few bad marks. In a round of transmission, the Backoff Window (BW) size in beacons never diminishes. Instead, it either stays unaltered or continuously increasing whenever the collision is detected. The increase can be quick if there should be occurrence of small transmission intervals. This will prompt to a large BW as time passes by. Subsequently, a sender needs to stay idle for a long period of time before it can transmit data packets, due to this it presents RI-MAC additional extra latency. Main issues with this approach are a large packet delivery latency and requires extra packet administration overhead at the destination.

To reduce the monotonous increase of BW size [4] and to diminish the probability of the dwell time, in this baggage transmission pattern of data packets are used. Instead of transmitting single packets, the node transmits pre-characterized number of packets in burst. The burst transmission might be unfair, but it is good in terms of latency. Due to this approach, the packet delivery latency is somehow improved compared to the other existing techniques.

V. PROPOSED SYSTEM

The proposed mechanism in this paper called Seamless Handover Mechanism. It is a procedure of information session exchanged starting with one site or base station then onto the next without separating the session hence it is called as seamless.

Let us consider the sensor nodes A, B, C, and D it can place either inside or on the body, based on the operations requirements. So, whenever the node A transfers the information to the node B, automatically the connection is established between them. When node B significantly moves away from node A, so that the distance of both the nodes will vary. At a time, the link between the two nodes will guarantee break at a particular time. This illustrates how the link breaks when the distance of two nodes vary. At this time, the node A can't do anything rather to wait until the current link disconnects. When node A is not receiving any signal from node B, it automatically looks up the other neighbor node on the way to the sink, so here node C is the other neighbor node to proceed with the data transfer.

Seamless Handover is mainly defined as, carried out process of information transfer from one sensor node to another sensor node without collapsing the main link, this technique has been used whenever there is necessary to bring out when a current link breaks in the middle of information transfer. In order to confirm a handover, the time taken for information transfer should be considerably long and the occurrence of link breaks should be honestly high.

In order to reduce BW capacity and to lessen the probability of their side or dwell time, here burst transmission of packets is used. Consequently, rather than going after the intermediate to deliver only a single packet, a hub transmits a pre- characterized number of parcels in burst. By using handover technique our mechanism enables a versatile hub to exchange the correspondence to a superior connection before the nature of the present one disintegrates. As a result, it will find the new neighboring node without abort the communication with the current node. This is done by using broadcasting of an data packet in which handover request is fixed. Keeping in mind the end goal to overcome from this Seamless Handover Mechanism is utilized as a part of request to reduce latency.

VI. IMPLEMENTATION DETAILS

Below steps represents the Seamless Handover Mechanism Algorithm:

Step 1: When organizing the Wireless Sensor Network, firstly the Base station determines which sensor is needed to be Active neighbor node based on the distance.
Step 2: When the Connection is lost due to the distance variation between sender and receiver, at that time one of the active neighbor node is selected for transmitting the information to the receiver or resume the process.
Step 3: For selected neighbor node, the special beacon is received from the base station.
Step 4: Then after receiving the beacon from the base station, it will send the channel information request to the base station and after receiving the reply from the base station, the updated and selected active neighbor node information is sent to all other mobile nodes.
Step 5: After all the above process is done, the new connection establishes and the packet transmission resumes the process. Below figure 2 represents how Seamless Handover Mechanism. works.

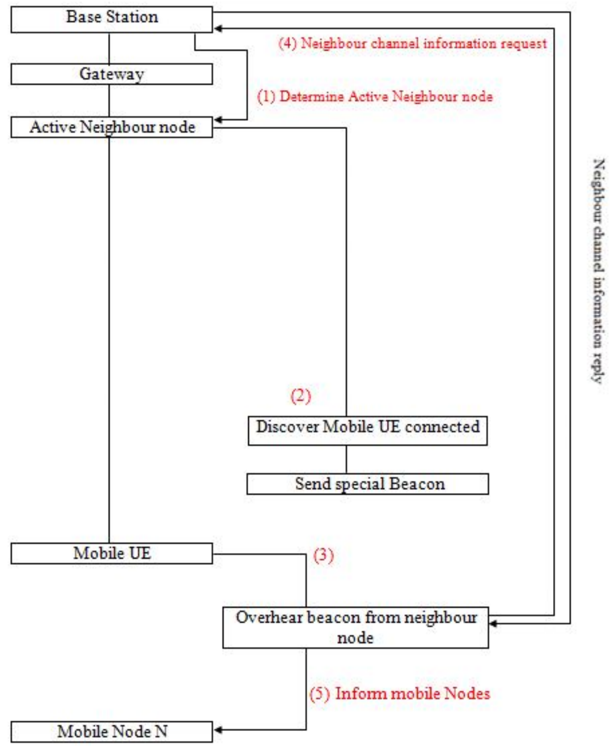

Fig. 2: Seamless Handover Mechanism

NS2 is used as a front-end tool to simulate the proposed network. In this paper, we are considering the parameters in order to show our results through Bit Error Rate, End-to-End delay, Throughput, Packet Delivery Ratio, will be discussed clearly in results section. Table I shows the initial parameters considered for implementing our work in NS2 environment.

TABLE I. SIMULATION PARAMETERS

Parameter	**Value**
Channel type	Wireless channel
MAC type	MAC/802_11
Number of Sensor	50
X dimension	11000
Y dimension	11000
Initial energy in joules	10
Simulation time	60

Table I specifies the parameters considered for simulating the proposed work. Shows type of channel is wireless, MAC layer protocol is MAC/802_11, Number of nodes used in this scenario is fifty. Topography of X and Y dimensions is mentioned as11000, initial energy is ten joules and overall simulation time is 60 seconds.

VII. RESULTS

Here the graphs plotted by considering the traditional RI-MAC, Optimized RI-MAC and proposed RI-MAC with Seamless Handover Mechanism. It is explained briefly by considering parameters like Bit Error Rate, End-to-End delay, Throughput, Packet Delivery Ratio.

Bit Error Rate is defined as the error occurred while transferring a data in the network. Below figure shows the comparison graph of Bit Error Rate. Here mainly considering the packets dropped with respect to time, based on that, Bit Error rate graph is plotted. X-axis in the graph is Time and Y-axis is Packets dropped. Red colored line in the graph shows the Bit Error Rate for the traditional system, whereas the green colored line in the graph shows the Bit Error Rate for the optimized system, whereas the blue colored line in the graph represents the Bit Error Rate for the proposed system. In traditional and optimized mechanism, there is no handover technique being used, hence whenever the connection is lost the packets drop will be more, due to this reason more error occurs in both traditional and optimized mechanism. However, in proposed Seamless Handover Mechanism whenever the connection is lost, a new connection is established, packets drop will be less when compared to the above both approaches. So that error is less which is shown in the figure 3.

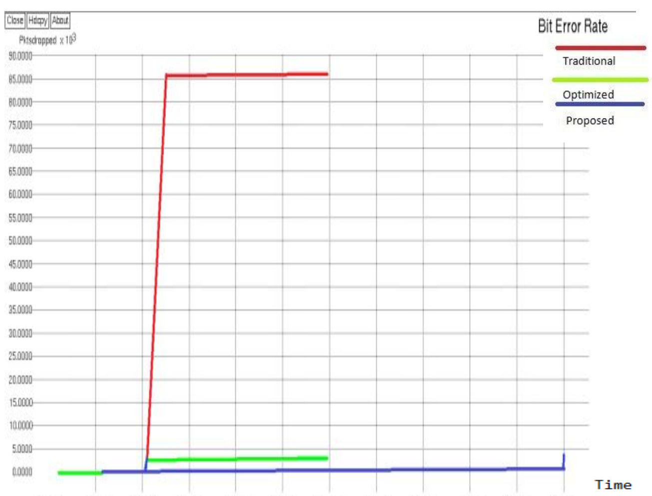

Fig. 3: Bit Error Rate graph

End-to-End delay is defined as the time required for a packet to travel across the system or the time required for the packet to reach from source to the destination. In any case, the delay should be kept low as possible in order to achieve the network efficiency. Figure 4 shows the comparison graph of End-to-End delay between the traditional, optimized and proposed methods. Here mainly considering the delay with respect to time, based on that End-to-End delay graph is plotted. X-axis in the graph is Time and Y-axis is Delay. Red colored line in the graph shows the delay for the traditional system, whereas the green colored line in the graph shows the delay for the optimized system, whereas the blue colored line in the graph represents the delay for the proposed system. In traditional and optimized mechanism, there is no handover technique being used, in which whenever the link breaks it leads to packets drop more and also takes time to re-establish the link again, due to this reason more delay occurs in both traditional and optimized mechanism. However, in proposed mechanism the Seamless Handover Mechanism has been utilized so that delay is less because of handing over a node to the surrounding active neighbor node whenever the connection is lost.

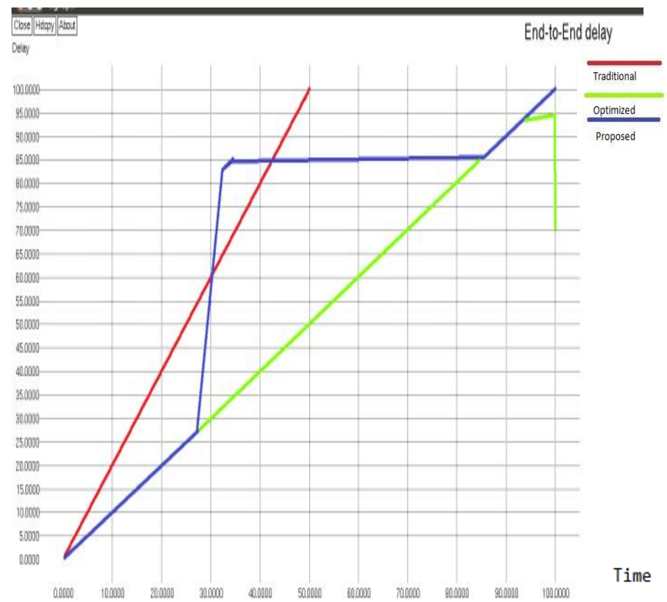

Fig. 4: End-to-End delay graph

Throughput is the number of packets that are successfully received in a unit time. In other words, it is a data sent per unit time. High performance of system involves high throughput. Figure 5 shows comparison graph of throughput. The formula for finding throughput is product of Packet size with the received packets successfully with respect to Time. X-axis in the graph is Time in seconds and Y-axis is Received time in Mbps. Red colored line in the graph shows the throughput for the traditional system, whereas the green colored line in the graph shows the throughput for the optimized system, whereas the blue colored line in the graph represents the throughput for the proposed system. In traditional and optimized mechanism, there is no handover technique that has been used, in which whenever the link breaks there is delay in delivering the packets to the destination, due to this reason throughput is less in both traditional and optimized mechanism. However, in proposed mechanism the Seamless Handover Mechanism has been utilized so that throughput is high which is shown in the throughput graph.

Packet Delivery Ratio is defined as ratio of data packets received by the destination to those of the data packets generated by the source. Figure 6 shows comparison graph of packet delivery ratio. It can be calculated by using formula:

$$PDR = \frac{\textit{Total number of packets received}}{\textit{Total number of packets sent}}$$

X-axis in the graph is Time in seconds and Y-axis is Packet delivery ratio. Red colored line in the graph shows the packet delivery ratio for the traditional system, and the green colored line indicates throughput for the optimized system, whereas the blue colored line in the graph represents the packet delivery ratio for the proposed system. In traditional and optimized mechanism, the packet drop is more due to periodic link disconnection hence it achieves less ratio. However, in using proposed mechanism by handover method we achieved high packet delivery ratio compared to the traditional and optimized mechanism.

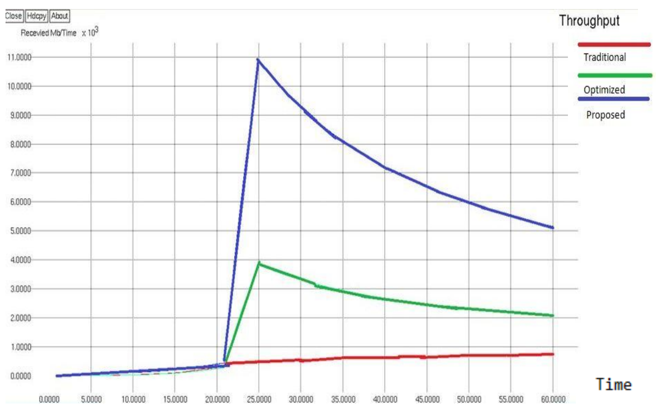

Fig. 5: Throughput graph

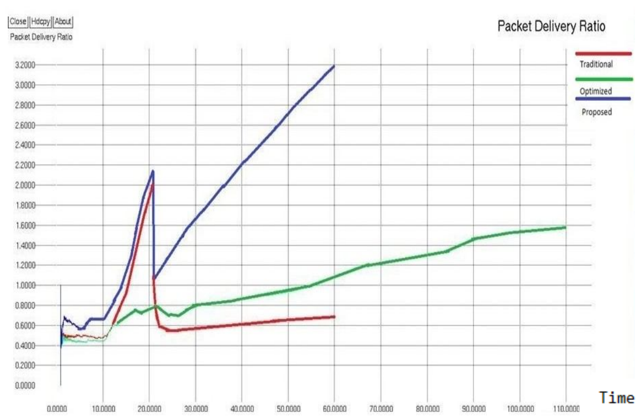

Fig. 6: Packet Delivery Ratio graph.

VIII. Conclusion

The proposed method is implemented in NS-2 simulation. We outline the Seamless Handover Mechanism keeping in mind the end goal to lessen the latency, where handover is a key component in keeping up connection to base station even at high speed. At the point when a mobile station changes its geological position, it might likewise need to change its connection point in the system with a specific end goal to retain the quality of the connection. By latency value we found it varies from 3.135 to 2.891respectively. In duty cycle the active time is improved from 0.490 to 0.503 based on this we can say that latency and duty cycle are definitely improved in proposed system. In the proposed framework, we have utilized especially Horizontal Handover Mechanism occurs within a similar technology. So, in future it is suggested that Vertical Handover mechanism allows the users to keep up the connections when they switch from one system to another provided without interrupting the service continuity. This future scope also enables and support different network topologies to maintain the throughput stable.

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