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An Energy Efficient Long Hop Load Balancing Priority Scheduling (LHLBPS)

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Abstract: Internet of Things is a new technology which can be applied almost in every field of life. More concretely, IoT associated with wireless telecommunications. Due to which immense bulk of object can converse with each other with or without people interaction. IoT present an idea for the mastery of network to feel and recognize data from the environment. This paper suggests a LHLBPS a power efficient message scheduling algorithm that are executed at the Broker of Wireless Sensor Network. The proposed algorithm LHLBPS contain two fold lines crisis parcels put in Priority Queue and served first and others bundles put in Normal Queue allocated greater priority for data originating from long distances to be executed first in this way avoiding re-transmission. The proposed paper uses multi-hop WSN that use intermediate nodes for transferring the data. LHLBPS algorithm proposed a load balancing and double queue (i) Normal Queue (ii) Priority Queue assign to Broker. In load balancing technique sensor node select the minimum weighted queue. The novel scheduling algorithm schedule intense priority for data packets that are coming from more hops and far distance placed at normal queue of Broker and served first but if emergency data packet received or coming at Broker node these packets placed in priority queue of Broker. These packet will be forwarded first to Base Station without any delay with respect to other data packets that are placed in normal queue of Broker. This approach used to overcome the congestion of network and also improved performance and lifetime of network. In addition, minimize the data packets interval loss and maximize the throughput of network.

Keywords: Internet of Thing (IoT); Long Hop (LH); Load Balancing Scheduling Scheme; LHLBPS scheduling algorithms;

I. Introduction

Wireless sensor networks (WSNs) are the sensors known to be autonomous in nature monitoring and capturing data in a sensing field [1]. Furthermore, they increase the throughput of network. WSN technology paved way for the IoT system. In an IoT system devices connected to the internet not only monitor data but also based on data decision making takes place as well. IoT growth is at exponential rate be it wearing gadgets, home appliances, smart cars and health care sector. The communication between devices, computing application, systems and services has been entered into new paradigm, creating new opportunities for public and private sector, educational institutions and industries.

There are three main data exchange affiliations in an IoT systems:

• Human to human association: The information exchange from one individual to the next. This happens via video call, phone call, voice call and social correspondences. It is normally known as joint effort association [2-3].

• System to human association: The information exchange from systems, for example, figuring gadgets, sensor hubs or others to the clients for examination purposes. For instance, climate anticipating utilizes brilliant gadgets to accumulate the information from the earth and transmit back to Base Station (BS) in the dominance place for other examination.

• System to system association: The information exchange between gadgets without people connections. For example, a vehicle conversing with another vehicle about its

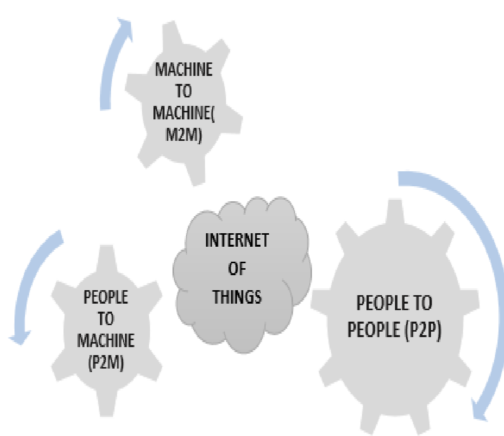

Figure 1: IoT Systems

speed, path change or breaking goals, and so forth [4-5].

So, an IoT network would be a merge of above mentioned categories and can be seen in Fig.1.

I. Long Hop Scheduling Technique

This scheduling technique explains how data gathering at base stations is organized in case where data is traveling from far off nodes. The method follows a simple mechanism of counting the hops of a particular data packet. The data packet with more hop counts gets guided first towards the base stations.

II. Load Balancing Scheduling Scheme

In an IoT system the load balancing scheduling plan is required to manage blockage of network and network throughput.

Nevertheless, in huge scale Emergency Internet of Things (EIoT), emergency packages may exist in perspective on the severe events or circumstances. The regular load balancing scheduling plan will examine all the possible routes between the source and objective center points that reason a superfluous long path for packages. Therefore, from the beginning to end concede increases and the constant execution of emergency bundles can't be guaranteed. To address this insufficiency, this paper proposes LHLBPS, an event careful load balancing scheduling plan for EIoT. A load balancing line show with emergency packages is first imagined reliant on the examination of the passage method of different groups. In the meantime, LHLBPS unites the most concise route with backpressure plot amid the time spent next-hop center point picking. The emergency packs are sent in the most constrained manner and avoid the framework blockage. The wide examination results watch that LHLBPS can decrease the ordinary from beginning to end deferment and addition in the typical sending rate. For the emergency packages, the continuous execution is guaranteed. This research recommends a LHLBPS a power efficient message scheduling algorithm for IoT that are executed at the Broker of Wireless Sensor Network. The proposed algorithm LHLBPS contain two fold lines crisis parcels put in Priority Queue (PQ) and served it first immediately and others bundles put in Normal Queue (NQ) allocate greater priority for data originating from long distances to be executed first in this way avoiding re-transmission.

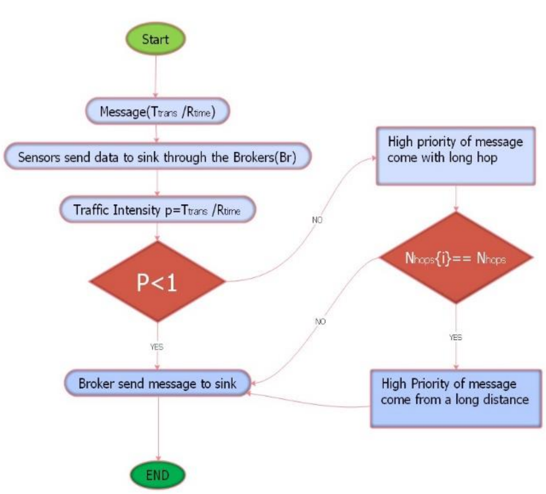

Figure 2: LH Procedure flowchart

II. RELATED WORK

The issue of coordinating groups over greater hops or lesser hops has been brought by various makers up starting late and their choices are changed depending upon the system taken and criteria considered. In [7] displayed a two-level method for topology control in wireless sensor frameworks. One of the procedures for transmission imperativeness minimization contains reducing the transmission extent of each center. According to the makers, power use of the network will be reduced using this plan, as a course with many short hops is usually more imperativeness proficient than one with several long hops.

Consequently, it is expected to give some adaptable and dependable frameworks to profit green distributed computing Load Balancing [6] is a system which isolates the workload over different figuring assets, for example, PCs, hard drives and network. In this reasonable distribution of assets of customer demand endeavored to accomplish in the best approach to guarantee legitimate use of asset utilization. It likewise attempts to fix the issue that all the processor in the frameworks and each hub in the network must share measure up to measure of workload which is appointed to them. It can make achievable through legitimate equipment or software which can be a multilayer or an area name framework process. The key variables which make efficient load balancing are reinforcement plan on the off chance that the framework flops a bit, guaranteeing framework strength, throughput, reaction time, least idleness, least network delay, execution time, low overhead, low postponement and versatility.

In [3-5] decided various reasons why long-hop coordinating is logically precious. Haengi's examinations showed that directing past what many would consider conceivable is an especially forceful strategy a significant part of the time. The models of imperativeness usage used in the above examinations don't definitely reflect the execution of sensible WSN center points, since they acknowledge a predictable essentialness cost (sometimes zero) per bit in the midst of transmission and social affair.

Another proposed research, an undeniably viable model of the thinking about the power subtleties of financially available center points. Use this to take a gander at the supreme essentialness ate up using the long-hop and short-hop frameworks and to perceive the circumstances when the short-hop system gives better execution [8-10]. In [8] examined VM Load balancer algorithm to locate the reasonable virtual machine in a short timeframe. Creator proposed to tally the maximum length of the virtual machine to distribute another solicitation. In the event that the length of the current virtual machine isn't adequate, at that point another virtual machine would be included.

In [9] proposed an algorithm for adding ability to the dynamic parity component for the cloud. The algorithm got recommended load balancing point by taking lesser time every loaded errand. Load balancing in the cloud differs from built up intuition on load-balancing structure and execution by using servers to play out the load balancing. This obliges new chances and economies-of scale, similarly as showing its own exceptional arrangement of challenges [3].

Load balancing is used to guarantee that none of your current resources are inactive while others are being utilized. To balance load flow, you can move the load from the source hubs which have surplus workload to the generally gently loaded objective hubs. When you apply load balancing in the midst of runtime, it is called dynamic load balancing. This can be recognized both in an immediate or iterative manner as shown by the execution center assurance: In the iterative methods, the last objective center point is settled through a couple of cycle steps. In the quick systems, the last objective center point is picked in one phase. The disseminated dynamic priority based algorithm is utilized for balancing the load on instances viably and to improve the framework consistency, least reaction time and increment the throughput. Dispensing the assets on virtual machines dependent on priority accomplishes the better reaction time and preparing time. Load balancing guarantees all instances in a hub in the networks to do the break even with measure of work at any instant of time. Priority based asset arrangement to improve the use of assets and diminishing reaction time of cloud services [1].

Many existing writing works have been explored as portrayed underneath. In [2] proposed a design. In which accomplish the administration level goal, all accessible equipment assets are pooled in a typical shared space in distributed computing framework, from which the facilitated applications can get to the assets according to their needs.

In [3] proposed a utility capacity as a general two level engineering for dynamic and self-sufficient asset designation. The capacity comprised of a neighborhood specialist that was in charge of computing the utilities, for present or fore threw workload. The outcomes were then transferred to worldwide judge, which processes close ideal setup of resources. In [4] depicted an engineering for dynamic scaling of web application. Similarly, the undertakings can be spoken to as the Bumble bees and the Virtual Machines can be spoken to as sustenance sources. Moreover, the VMs are arranged as indicated by three circumstances, balanced overload, high overload and low overload. At the point when the VMs are overloaded, the undertakings are evacuated and go about as a bumble bee.

In this way, these undertakings are submitted to the VMs that has low overload. These assignments are reliant on what number of high priority undertakings are performed on those VMs. It must be noticed that the choice of the VM is performed as it were for the VM which has the low overload and the least number of the executed priority assignments. After fitting task of assignments on VM, all data is refreshed so that the rest of the assignments can acquire their requirements under load VM. This algorithm has presented certain advantages spoken to in the proper asset use expanding the throughput while keeping the different Quality of service (QOS) parameters which are based on the assignment priority. On the other hand, the downsides are introduced for the low priority assignments which experience the ill effects of inert state or long time holding up in the line. These assignments might be disregarded causing the unbalancing of the workload balancing.

This paper is organized as: Section II, Portray Long Hop Scheduling Technique. In Section III, Load Balancing Scheduling Scheme. Area IV, surveys related work from the writings. Section V, proposed energy efficient scheduling strategy (LHLBPS). Performance assessment and discourse have been done in Section VI. At long last, finish up our paper in Section VII.

The scheduling computations are a basic perspective for WSN and IoT frameworks. A couple of computations are proposed for imperative usage advancement and Quality of service (QOS) in WSN.

III. METHODS AND EQUIPMENT'S

In proposed work, sensor nodes have been used in an outside region and classifications into sensors nodes that are utilized to get fundamental data from the field and transfer it to Broker (Br). And the Br gather the data from sensor nodes and transfer it to goal base station (BS). Duty of BS is accumulating information of all sensors hub through Br.

Message Scheduling Algorithm

Figure 3. Shows that Single-hop and multi-hop technology. In radio network there are two types of communications (I) Single-hop (II) multi-hop. In proposed work using multi-hop routing because multi-hop network covers larger area than single-hop. A node is a switch for another node to reach its destination. In radio network major source of

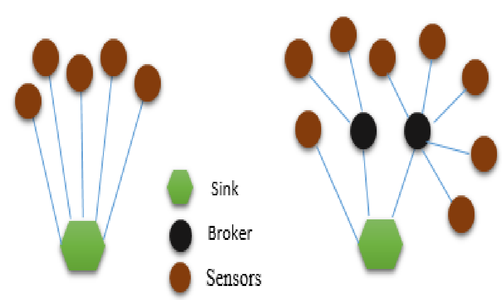

Figure 3: Single-Hop and Multi-Hop Communication

power utilization is transceiver and high power required for far distance. In some situation multi-hop is more powerful as compare to single-hop routing. Multi-hop routing applications: WSN, WMN, Adhoc networks.

The sensor node depends on intermediary nodes for transferring the data packets. These data packets collected from nodes that are placed on the edge and using multi-hop from sender to receiver (destination). Therefore, these nodes used large amount of energy and bandwidth for sending and accepting of data from other sensors.

In clustering, sensor nodes are placed at multiple locations also used some other nodes to send information to Broker (Br) using Load Balancing (LB) technique sensor node select the minimum weighted queue. Broker contain two queues the "Normal Queue" and "Priority Queue". It shows that if data come from long distance and using multiple number of hops to reach the desired location. According to these points, it is very essential to execute these type of messages or data packets first. The basic concept or logic behind the proposed LHLBPS that allow high Priority Queue (PQ) for emergency data packets, and other data packets placed in Normal Queue (NQ). But if emergency messages are not received in Priority Queue (PQ) or PQ is empty than Normal Queue (NQ) is executed and served first.

Figure 4, shows a message generated by an IoT sensor. The sensor then sends this data message to brokers. The broker analyzes the traffic intensity using formula p=T/R. If the traffic intensity is less or currently there is no other packet received by the broker at that time, then the broker will send the message to base station immediately. In case when traffic intensity is high, the broker will analyze the nature of message. If the message is emergency message it will be placed in emergency queue and will be sent to base station immediately otherwise it will be placed in normal queue.

In normal queue, the designed algorithm will make a comparison of hop counts for each message received. If the newly received message has more hop counts than the ones already residing in the queue, the high priority will be set for the message having more hop counts. In case when the two or more messages arrive with same hop counts, the algorithm will compare the distance of these messages. High priority will be set for the message covering more distance than other. Afterwards, the messages will be sent to the base stations according to the set priority. In proposed scheduling

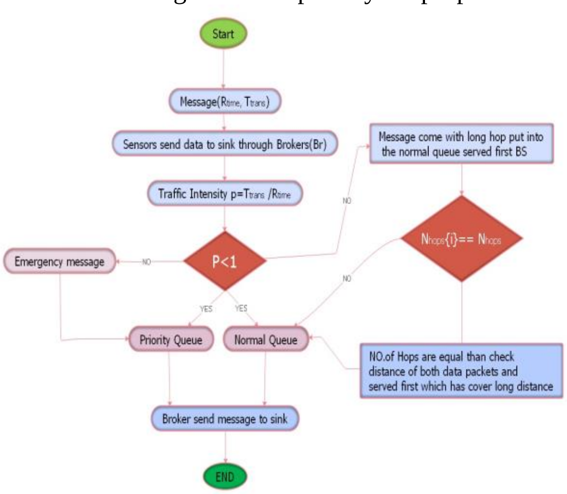

Figure 4: LHLBPS Framework

algorithm analyzing the clustering of WSN in which data packets of different sensor nodes sending to Base Station (BS) through Brokers (Br). Figure 3 Explain that 4 data packets placed in cluster at different locations and move toward the Base Station (BS). We suppose that every sensor nodes sending data packets in different time and reach at the same time at Br before sending it to BS they are situated in queue at the Broker. Because Br contain following queue:

- Normal Queue (NQ)
- Priority Queue (PQ)

Each data packet coming from using different distance and number of hops. In LHLBPS scheduling algorithm data packets that are coming from sensor nodes or normal nodes to Br are placed in NQ but if data packets coming from far distance and using greater number of nodes than transmit it first to BS. If in any case, there are some data packets that are using same number of hops like yellow and orange SNs in Figure 6 the proposed algorithm LHLBPS take the 2nd parameter of longer distance in compensation. Thus, orange packet transmits first at Br due to its sensor placement orange data packets transfer first to the broker than other packets.

<u>Algorithm 1: Pseudocode for Long Hop Load Balancing Priority Scheduling (LHLBPS) algorithm at Brokers level</u>

Input: G, $f^{sel}_{m,n}$, N^{sel}_{m} , $d^{emg}_{m,n}$
procedure LHBPS(G, $f^{sel}_{m,n}$, N^{sel}_{m} , $d^{emg}_{m,n}$)
    At every time slice t
    if time slice t=0 then
        Broadcast the neighbor node list
Calculate the shortest path with every other node
    for all m € v do
    Find node n with the shortest path of the top
    end for
    end if
    for all n € v_m do
    if $d^{emg}_{m;n}$ (t) is the minimum weighted queue difference then
        $N^{sel}_{m} \rightarrow n$
    end if
    end for
    for all Br € network do
      nodes msg (R_{time}; T_{trans}) to the BS
      $P = T_{trans}/R_{time}$
      if P < 1 then
        nodes msg → BS (no traffic)
      Else if ($d^{emg}_{m,\,n}$ == true)
        Send msg to base station without any delay
      Else
        arrange nodes msg depend on prolonged hops and Long distances in descending order
      if $N_{hops(i)} = N_{hops(j)}$ then
        if $d_{SN2} > d_{SN1}$ then

```
Select node msg has higher N_hops and longer distance d_SN2 as the first packet passes → BS forward node msg → BS
end if
else
Transmit node msg has greater N_hops
                first → BS
end if
end if
end for
end procedure
```

Table 1.
Symbols Definition

Symbols	Definitions of symbols
m, n	The sensor nodes number.
f	The Queue number.
V	The set of nodes in the network.
E	The set of links in the network.
G=(V,E)	The sensor network model.
Vm	The set of neighbor nodes of node m.
Dm,n	The geographical distance of node m and node n.
Nhopes	Number of hopes from each node to the BS.
d	The distance from each source to the BS.

Queuing model used in LHLBPS:
M/M/1 model used in proposed LHLBPS algorithm. It is used to calculate arrival and service rate for all data packets that are received from other devices. In the system M/M/1 queuing shows the length of the Queue. Poison process is used to determine the arrival and service exponential distribution. "μ" and "λ" are used to introduce the arrival and service rate of "m" messages after calculating the traffic at the Broker. Traffic intensity is denoted by "p" should be < 1. If traffic intensity "p" is greater than 1, the recommended algorithm receive packet from nodes and evaluate its either emergency message or not, and using number of hops and distance.

If "p" is bigger than 1, the suggested algorithm stays away from bundles getting to many gadgets and connections from retransmission.

ʎ = 1/Rtime
μ= 1/Ttrans
P = Rtime / Ttrans = ʎ/ μ

Energy Utilization Model

The basic idea behind this proposed work is to apply message scheduling algorithm that overcome the power utilization and increase the life time or duration of network. Energy is utilized in sending, receiving and listening of messages in the network. Typical power model is shown and used in figure 6.

Sensor used shortest route to send their message to next hop. Shortest route is found through applying the Dijkstra algorithm. The complete energy used by the network can be shown as follows:
To transfer number of bits:
ETx = k (Eelec + _amp ∗ d (2)   (4)
To accept number of bits:
ERx = (k ∗ Eelec)   (5)
Total energy used by each sensor:
ETotal = L (ETx) +M(ERx)   (6)

Where ETx energy consumption from sensor to next object. ERx depleted energy to accept part of bits. Elec is shown as the depleted energy to run the transmitter circuitry. AMP is the consumed power during transferring to increase the signal. L and M are number of sending and receiving messages from non-broker sensor nodes, "d" is used for distance between transmitters.

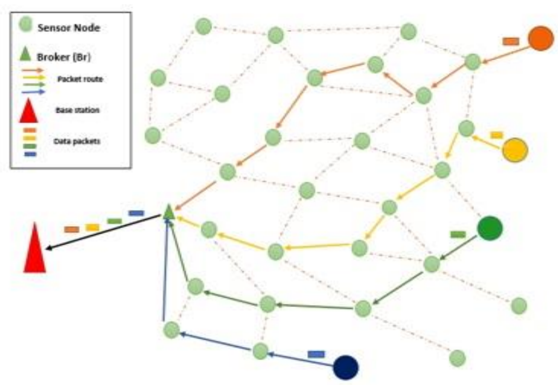

Figure 5: The schedule of 4 jobs beneath LH algorithm

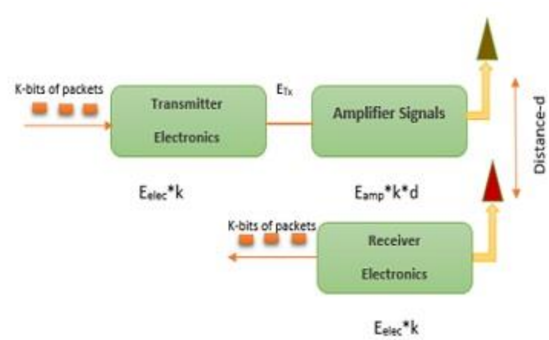

Figure 6: The wireless communication model

IV. EVALUATION/RESULTS

In proposed work, performance of LHLBPS algorithm is evaluating through Matlab simulation. The IoT, is the network of interrelated devices and ability to send or transmit data without using human to human or human to system interference. Therefore, the simulation implemented with hundred (100) sensor nodes, these are spread in area (500 x 500) m2 randomly. Proposed work likewise think about that the nodes are exploit outside to sense the condition of environment that send the detecting data to Brokers (Br) nodes. Br duty is to gather the data or information from sensor nodes and sent it to Base Station.

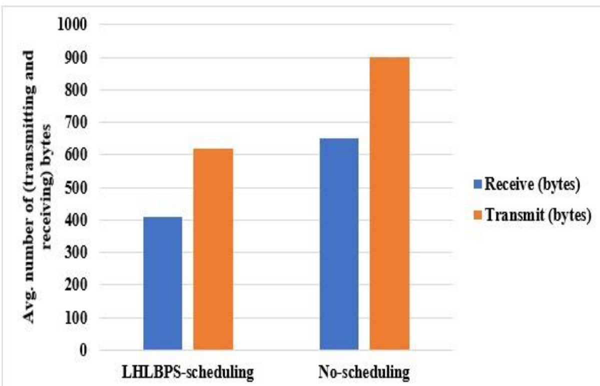

Figure 7: Avg. Queue of (sending and accepting) data packets

In each round, every sensor node transmits information 250 bytes to the Br and Brokers transmit it to BS. The Base Station is adjusted at the mid of cubic field.

Assessment is done when the no scheduling and proposed LHLBPS scheduling algorithm is used. It is very essential to further minimize the processing time, using of capacity and power utilization of system. Figure 7. Exhibit that recommended algorithm LHLBPS has less number of emit and accepted messages in the system network. Because LHLBPS used proper scheduling algorithm. It exhibits that the use of recommended algorithm LHLBPS has reduce the complete emitting and accepting power and eventually increase the lifespan of network.

No. of hops is the bulk of information transfers on multi-hop correspondence to achieve the planned goal. A single-hop create or exit when message is send or transmit to the next node of network.

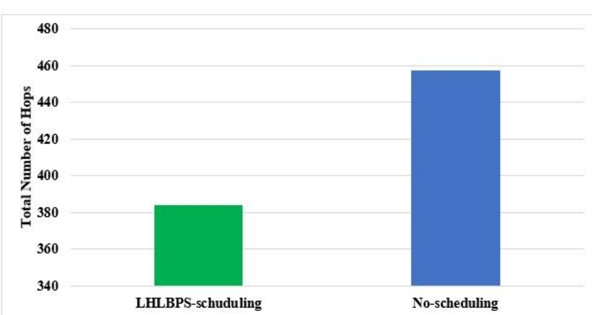

Figure 8: Total Queue of Hops

Next hop has the flag for the node of previous hops, depending upon the kind of routing algorithm used. It will decrease the amount of data packets from source to destination. Figure 8 clearly explains that recommended LHLBPS algorithm has minimal number of hops as compared to no scheduling algorithm.

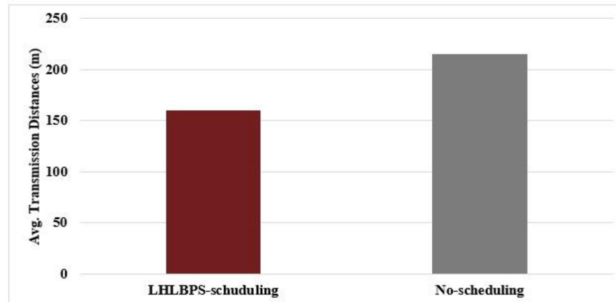

Figure9: Avg. Shifting Varies (m)

Wireless or wired transmission distance is mainly determined by the sensitivity of the receiver and the power of the transmitter within single or multi-hop communication. It can be improved by directly increasing the transmitting power or receiving sensitivity. It can only be acceptable when large distance from sender to receiver will absorb or used more energy. Actually, minimizing the average transferring distance for the data packet will have good effect on the delay time and use of energy.

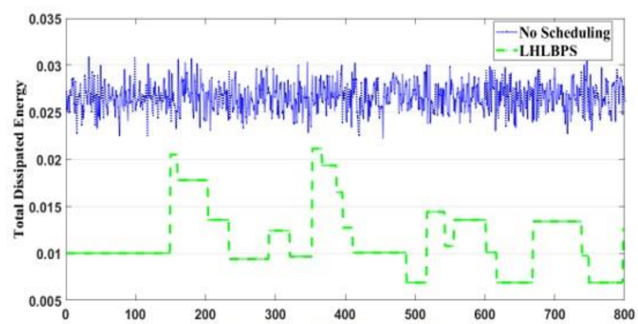

Figure 10: Avg. Dissipated energy of Br's

Figure 9 ATD from every single sensor node to the Base Station (BS) presents that average transmission distance is minimized when the proposed LHLBPS algorithm is used. Figure 10 explains that energy consumption of recommended algorithm LHLBPS is less than no scheduling algorithm. Because in LHLBPS broker (Br) changed when its residual energy is less than threshold energy required for Broker in one round and in no scheduling algorithm broker (Br) is changed in every round.

V. CONCLUSION

This paper suggests a LHLBPS a power efficient message scheduling algorithm for IoT systems that are executed at the Broker (Br) of Wireless Sensor Network (WSN). The proposed algorithm LHLBPS contains two fold lines crisis parcels put in Priority Queue (PQ) and served first and others bundles put in Normal Queue (NQ) allocated greater priority for data originating from long distances to be executed first in this way avoiding re-transmission. Energy saving ends up as one of most basic focus of Wireless Sensor Nodes (WSNs) and Internet of Thing (IoT) networks to increase their power cycle for these network systems. This methodology can be used to defeat the blockage of network and additionally improved execution and life duration of network. Furthermore, limit the data packet interval loss and boost the throughput of network.

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