An Efficient Data Scheduling Mechanism for Smart Homes

Rajesh S M, Sukruth Gowda M A, Shiva Prasada K H, Sandhya G

Abstract: The growth in technology with respect to Internet of Things is rapid in the current scenario. Every device, every aspect is becoming smart. Smart home is one such application where in which delay in the efficient delivery of critical packets is the challenge. The existing techniques are time consuming and will not be able to satisfy the changing requirement. In this paper an efficient scheduling technique is proposed for smart home communities by identifying the critical messages and assigning priority along with the deadline to such packets which helps in reducing the delaying and serving the critical packets at the required time.

Index Terms: Smart Home, Priority, IoT, Critical Packets

I. INTRODUCTION

TECHNOLOGY is rapidly widening its applications where, everything we see, we listen is smart, smart cities, smart phone, smart cities, smart agriculture. The concept which is driving all this is Internet of Things, It is deployed with combination of sensor devices, communication protocols, networking techniques. The important topic with respect to IoT is the safest way of communication, where scheduling algorithm, energy of the nodes, increase the performance providing the security needs to be focused more. One such application is smart home. Sometimes it is required to send the critical information which is very much important and has to reach the destination at the earliest to take necessary actions. But the traditional technologies are not capable of handling these scenarios. Multiple scheduling schemes are available to improve the delivery of packets avoiding the delay and ensuring proper end to end communication. Algorithms like First Come First Serve, Earliest Deadline First provides the solution for the same. Applications also include priority based schemes, a priority is set to the packets so that depending on the priority value the packet will be served. The problem will be when in an environment, multiple node acts as source and sink the priority may collide if the two different nodes gives the same priority at the sink node while accepting the packetand the destination may node may deny service for the packet which is very much critical. In this paper an efficient packet scheduling approach is proposed, which helps in making reach the critical packet information first to the sink node.

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II. LITERATURE SURVEY

A generalized IoT based architecture was proposed by M V Moreno [1]. They apply the concept of big data analytics. The concept is explained considering the smart campus scenario and processing of multiple transit-card transactions. The approach provides a reliable solution for profitable services, energy management and also for smart buildings.

Backpressure scheduling scheme was presented by T Qiu [2] which helps in congestion control in the network. But during the emergency situation the critical packets that has to be delivered at the earliest. The method finds all possible routes to deliver the packets from source to destination, the path may not guarantee in delivery of those critical packets. Along with the backpressure, an event aware backpressure scheduling is implemented to avoid the existing problem. This method identifies the shortest path and avoid the traffic at network.

A reliable system depending on the behavior of the objects was proposed by M Nitti [3], which is implemented in Social Internet of Things, where the objects have the capability in connecting with other objects in an automatic manner. The trustworthiness is calculated by the experience and opinion in common of friend objects. The general information about each object is distributed and stored using the distributed hash table. The malicious nodes were able to be isolated using this mechanism.

T Qiu [4], in their research work propose a LOES scheme as the emergency response in large scale network is the challenge. The scheme merges the priority based packet scheduling along with the local optimization. The location information of the local nodes are exchanged between the nodes, which helps in distance calculation and also to reduce hop counts. The comparison results shows that the LOES scheme outperforms compared to the other existing techniques. [10]

Peng Guo [5] et.al, in their work mainly focuses on the critical event monitory in wireless sensor networks. When ever there will be an critical event happens, an alarm message is broadcast to entire network. The proposed sleep scheduling approach helps in decreasing the delay of alarm message broadcasting, the energy consumption is also reduced. [8] [9]

Changhee [6] et.al developed an agent based scheduler which merge the age and the inter-arrival time of the incoming packet information to decide the critical and recent information. This also helps in the information freshness at the sink node.

Varsha Jain [7] et.al proposed a dynamic multilevel priority packet scheduling method.

The proposed approach maintains three different priority queues for each node, one priority queue which has real time data packets, other queues contains non real packets, packets which depends on threshold of dispensation time of packets. The approach outperforms in terms of throughput and end to end delay transmission. [11]

III. SYSTEM DESIGN

In the proposed work an efficient emergency data scheduling algorithm is used for smart home communities. In which mul- tiple nodes willing to send data to the same destination node at the same time, we use efficient data scheduling mechanism based on the priority and the counter value set to the data in terms of time to reach the destination. Therefore, the delay in transferring the emergency data is reduced. Since many nodes likes to send the data at the same time it may results in network congestion to reduce it, we are using the prior scheduling on the spanning tree which helps in establishing all the possible paths from source to destination. To ensure that the given data is emergency data, data is initially classified in to emergency or non-emergency data based on the priority and time period given (counter).The work majorly has three phases:

a. Network Construction.
b. Data Classification.
c. Scheduling.

In the Network Construction phase, we have targeted around 50 nodes representing the different sensors deployed in the smart home against different operations to be monitored. Operations such as maintaining room temperature, smart light system and so on, the sensors used for such operations are moisture sensor, IR sensor, gas sensor, fire sensor, etc. The network connection among the nodes is established using the using spanning tree structure to enhance the transmission efficiency. The root of the spanning tree is considered as the Sink Node.

The data generated from each sensor might not be an emergency data, but every sensor generates the data at the random amount of time or simultaneously and every data has to be significantly monitored. Data from the fire or gas sensor may have some harmful effects on the smart home and immediate actions are required hence these data has to be highly prioritized when compared to the other sensors data. In the data classification phase, we classify the data collected from the sensors as emergency data and non-emergency data.

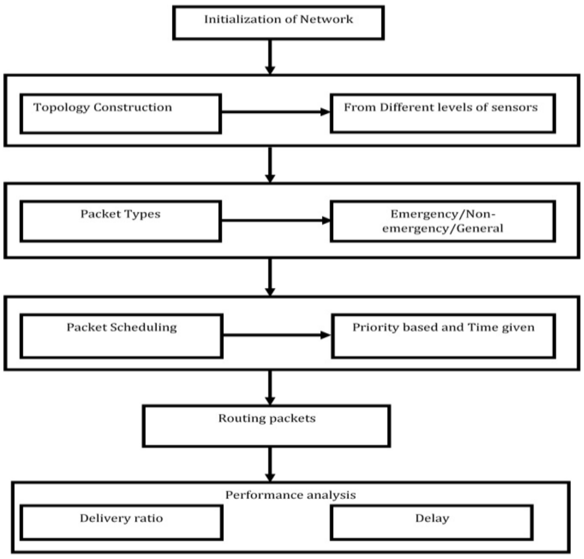

Fig. 1: Proposed Architecture

Emergency data are added with the extra information on it. I.e., priority indicating the importance to be given for the data and Time period signifies the data to be reached with in the given amount of time.

In the third phase scheduling for emergency and non-emergency data will be carried based on the prior scheduling results. That is during prior scheduling the paths are estab- lished based the available information from its neighboring nodes which indicates the per established and shortest path from the node generating the data and to the base station.

IV. EXPERIMENTAL SETUP AND RESULTS

With the help of Network Simulator 2 tool, the simulation is performed on the proposed data scheduling algorithm, the performance analysis of the algorithm is evaluated by considering the parameters like - end-to-end delay, packet deployment rate, overhead and throughput by comparing with FCFS Algorithm. In this work, fire monitoring service in the smart home (sensor data) which require high prioritization when compared with the data generated from other sensors is considered. In the simulation environment 40-50 nodes including sink node is deployed on an area of 250m, the nodes are connected to each other using tree network, based on Spanning Tree Protocol (STP). The root node represents the sink node, the child nodes or ordinary nodes generate packets of different emergency data in randomized manner. Every packet generated from the ordinary nodes has its own priority and deadline (counter). In the network established every node hold the information about its neighbours node. The packet size is measured in bytes and maximum allowed packet size is 1100B and the rate of data transfer 200kb/s.

Steps involved in experimental setup:

1. Nodes Deployment using Spanning Tree Structure.
2. Finding the neighbor nodes, Prior Scheduling and Sink node Creation.

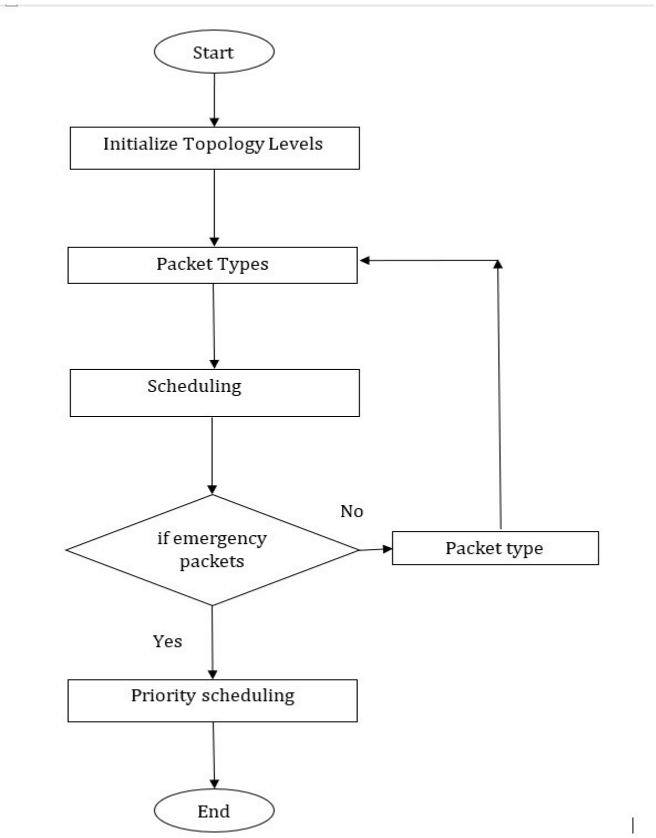

Fig. 2: Data Classification and Scheduling

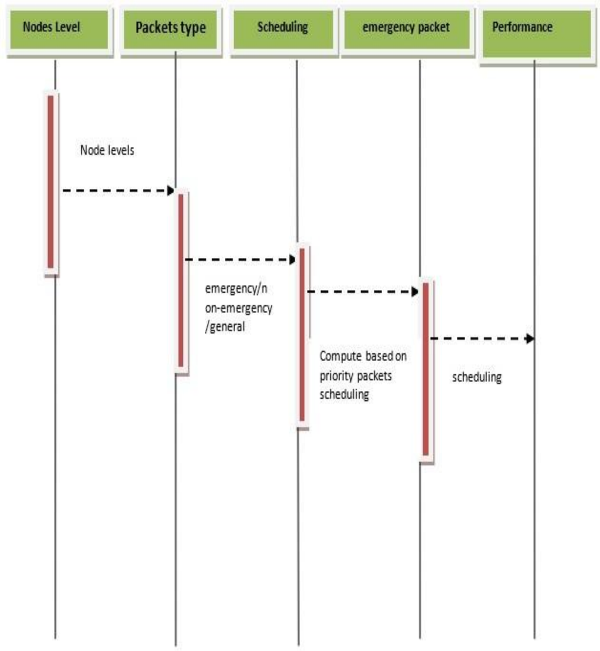

Fig. 3: Sequence Diagram

Figure 4 shows the initial process where the nodes are deployed and network is constructed using spanning tree structure by creating the sink node. Packets are sent to all its neighboring nodes to know which nodes are connected to each other to perform prior scheduling for this we can find the basic path to the base station and also the fastest path to the base station.

We have considered the execution of the algorithms at different scenarios:

1. Occurrence of Emergency Event.

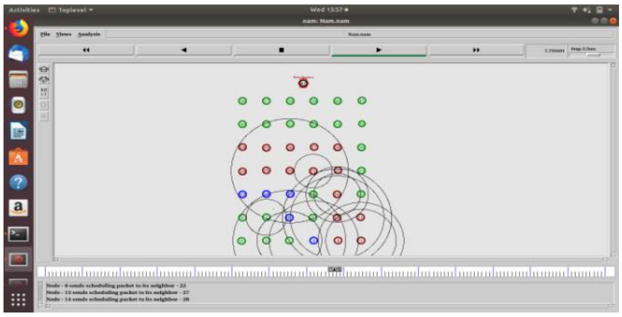

Fig. 4: Network Deployment

2. Occurrence of Emergency Event when there are events with non-emergency.
3. Occurrence of Multiple Emergency events and Non Emergency Events.
4. Non- Emergency Event at normal scenerio.

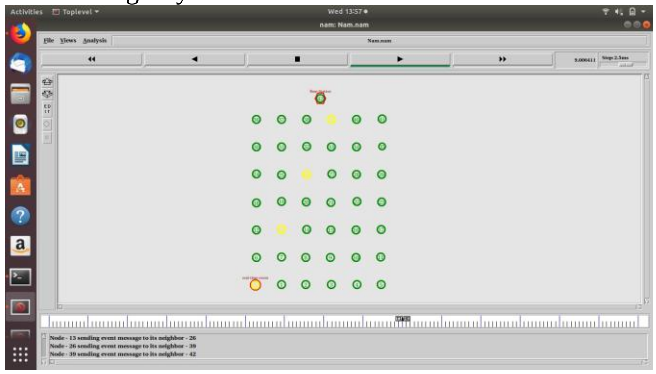

Fig. 5: Sending Emergency Packets

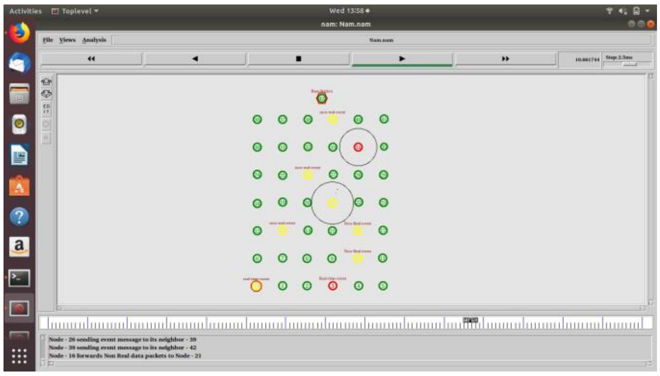

Fig. 6: Sending Emergency Packets when Non Emergency Event Occurred

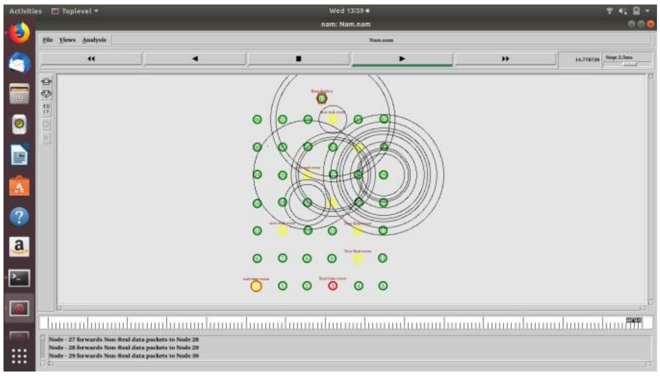

Fig. 7: Sending of Non Emergency Packets

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Figure 5 describes the scenario of sending the emergency packets when there are no obstacles from the non-emergency events, also we can achieve high performance with less delay. But during the occurrence of the multiple emergency events and the non-emergency event also we are required to send emergency packets by holding the events of non-emergency showed in the figure 6 and figure 7 shows that non-emergency packets are sent once the emergency packets are reached to the base station.

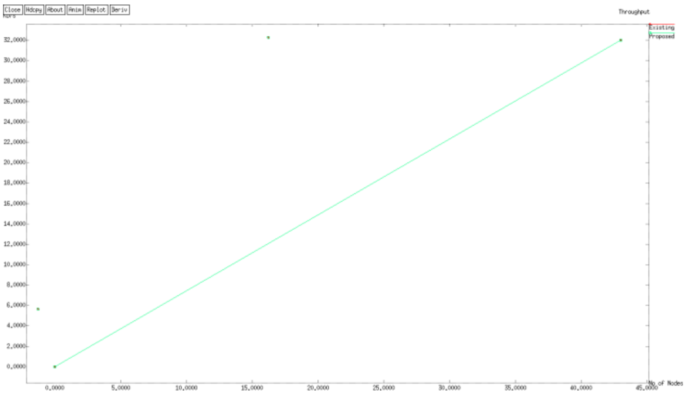

Fig. 8: Throughput

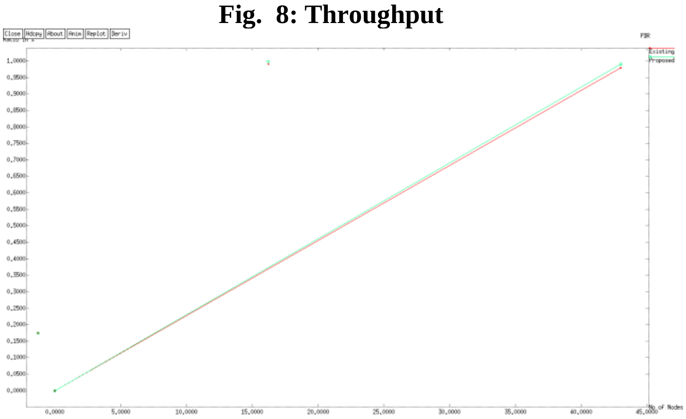

Fig. 9: Packet Deployment Rate

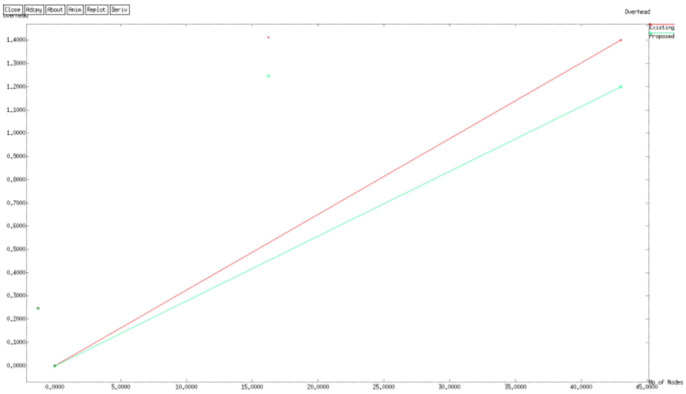

Fig. 10: Overhead

The experimental result as discussed, the metrics considered are Packet deployment rate, overhead, delay and throughput. For comparison , FCFS scheduling is considered which is

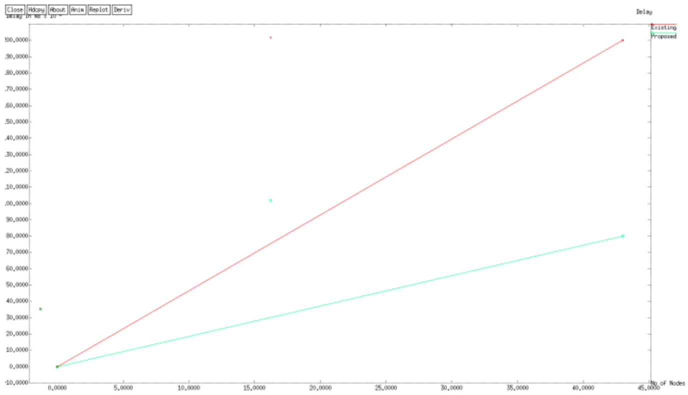

Fig. 11: Delay

widely used. In all the aspects the proposed work outperforms FCFS. Figure 8 and Figure 9 shows the througput and packet deployment rate, where there is slight improvements in the performance of the proposed scheduling scheme. Figure 10 and Figure 11 shows the graph with respect to overhead and end to end delay. The proposed scheme provides good results which reduces the overhead of the network and also decreases the delay in delevring of the critical packets.

V. CONCLUSIONS

Multiple applications of scheduling the packet for smart home such as medical emergencies, other rescue operations where the packet carrying the information has to be served first. The existing methods FCFS, EDF will not completely provide good results. So an efficient priority based critical packet scheduling delivery method is proposed. The method assigns more priority along with that critical id including deadline to the packets so that the sink node serves it. The proposed approach shows better results in throughput, delay, packet deployment rate and overhead.

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