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An Optimal Routing Method for Emergency IoT using Backpressure Scheduling

Arathy Davis[1], Erina Tomy[2], Angel Rose C.D[3] and Deepa Devassy[4]
Department of Computer Science and Engineering, Sahrdaya College of Engineering and Technology
Kerala, India

Abstract: - A network can have diverse packets generated dependent on the kind of events. A large portion of these may be regular packets. But it also produce emergency packets whenever some emergency event occurs, which need to reach destination faster. We propose a backpressure-based queue model where an emergency packet will be given preference and send forward using backpressure method. The end-to-end delay is calculated for different kind of packets. The resultant graph demonstrate that the emergency packets are conveyed faster than ordinary packets and the delay is essentially reduced.

I. INTRODUCTION

Internet of Things is a fast growing network of physical objects that are connected and communicating through inter- net. The security systems uses IoT in lot of areas. The sensor nodes in the system may detect some emergency situations and emergency packets will be generated. These emergency packets need to be delivered as fast as possible as some action will be associated with them. For example, when a fire is detected, the message containing temperature packet need to reach the security warning system. It is important than the regular data packets.

Backpressure-based routing and scheduling is an efficient way for resource allocation in wireless multihop networks. The key highlights of this method are simplicity, throughput optimality, robust to time-varying network conditions. Also it can be implemented without knowing traffic arrival rates or channel state probabilities.

The backpressure routing and scheduling was developed by Tassiulas and Ephremides.The first backpressure algorithm was proposed in [1] and it explains as below.Consider a multi- hop packet network where time is slotted. They can have random packet arrivals and different link selection options. Queue backlog is the number of packets in a queue that are waiting for service. It is represented as Qpcq t where c is the data in node n. At every time slot, data is transmitted from each node to other. Each node will collect information about its own queue backlogs along with its neighbour nodes queue backlog. The differential backlog d of each outgoing link (a,b) is found using the formula

$$d = Q_a^c(t) - Q_b^c(t) \qquad (1)$$

The link with maximum differential backlog is chosen to sent packets.

II. EXISTING SYSTEMS

Backpressure-based scheduling scheme can be used to ef- fectively control the network congestion. And by this way guarantee the throughput of networks [2] [3]. Also, it is used to gain dynamic adjustment by choosing the packets with the largest backlog difference in multi-hop networks. Backpressure routing and scheduling scheme is also a robust method for time-varied network environments [4]. Tassiulas and Ephremides are the original builders of the backpressure scheduling scheme [3].

Backpressure scheduling schemes have become an attraction in the field of sensor networks in last few years as the growth of sensor networks are increasing. The backpressure schedul- ing scheme is used in many fields like wireless multimedia sensor networks. It solves the problem of dynamic priority and congestion [5]. Looping problems and avoiding unnecessary long paths are the prime concentration of the majority of existing backpressure scheduling schemes. These problems are caused by calculating the weight only according to queue backlog difference. In the process of making routing decisions, routing loop penalty factor is introduced [6].

In the papers [7,8], the average E2E packet delay is reduced by addressing those problems causing large packet latency like routing loops and the last-packet problem. The queuing com- plexity at nodes is effectively reduced in [9,10] by focusing on using efficient queue structures. In traditional backpressure- based protocols per-flow queues is used as alternative.The papers [11,12] mainly consider the impact of other layers on backpressure routing and scheduling and focus on achieving efficient cross-layer design.

The paper [13] proposes a virtual queue-based method. In this, the network can generate sufficient backlog difference gradients when the network load is low as it establishes the backlog of queues in advance.All the above mentioned schemes do not give the priority to the emergency packets when urgent events occur.

III. METHODOLOGY

A network consists of two or more nodes interact with each other to exchange information effectively. The efficiency of a network is evaluated on the basis of delay and throughput. A higher the throughput and lower the delay is said to be a better network

Each sensor node can generate packets and these packets travel through different nodes to reach the destination node. Emergency packets will be generated when an emergency situation is identified. The regular packets and the emergency packets are distinguished in terms of the emergency flag. The packet format is as the fig 1. If the emergency flag of the packet format contains the value ”1”, then it is an emergency packet. If the emergency flag of the packet format contains the value ”0”, then it is an regular packet.

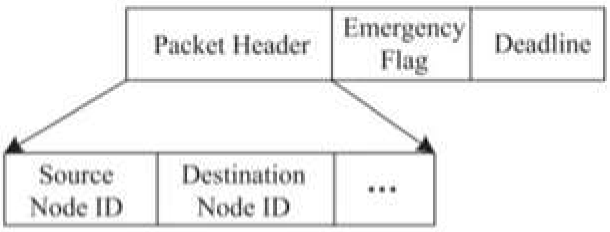

Fig 1:- Packet Format

Every packet includes the packet header, emergency flag and packet deadline. The packet header length will be different based on the type of the communication protocols. But the source node ID and the destination node ID is a must in every packets. The emergency flag and the packet deadline describe the packet emergency information. If the value of emergency flag is 1, then the packet is considered as emer- gency packet.And if the value of emergency flag is 0,it will be considered as regular packet. To define semi-emergency packets we use packet deadline value. If the emergency flag is true and the packet deadline value is greater than threshold value, it is defined as semi-emergency packets.

Whenever a emergency situation happens,emergency pack- ets will be generated. These packets have to be delivered to the user fast as possible.Here we are concentrating to reduce the delay of the emergency packets.

Here, each node will be assigned with 2 queues. One for carrying the emergency packets and the other for transferring the regular packets. Whenever it is found that the emergency queue of any node is non empty,the transmission of regular packets get stop and start to pass the emergency packets. This transmission continues until the emergency queue of every node is empty.Then starts to forward the regular packets. Emergency packet forwarding and regular packet forwarding will be based on the back pressure algorithm.

Consider a network containing a number of nodes. Let the node m be a node in the network. Node m calculates the queue backlog with its neighbor node n.Node m calculates the backlog of each queue with each neighbor node n every time slot according to Eq. (3). Link (m,n)is used to transmit packets with the largest queue backlog difference.

$$d^{f}_{mn}(t) = Q^{f}_{m}(t) - Q^{f}_{n}(t) \quad (2)$$

We select the node with the maximum queue backlog difference d f to forward the packet into queue to deliver the packet as soon as possible.

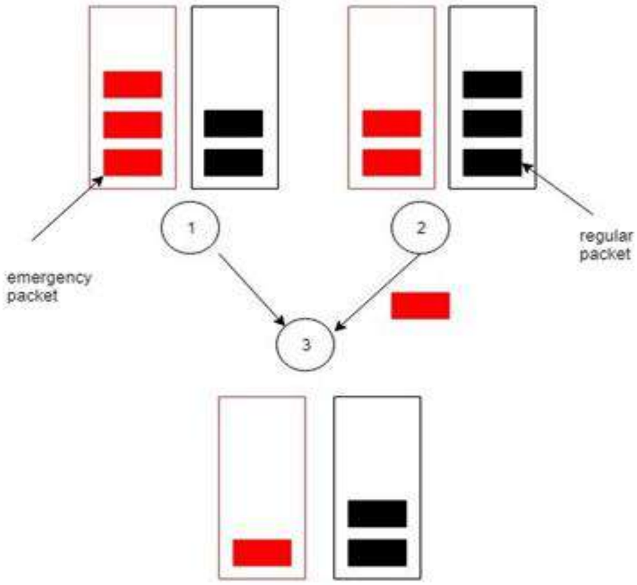

Fig 2:- Emergency Packet Forwarding

IV. RESULTS

The performance of this method is analysed using a network simulation result.The simulation is performed on NS-2 simu- lation platform.We considered a wireless network having 30 nodes with a random topology for the simulation.Each sensor nod have a transmission range of 200 m. All the links are bidirectional but only one packet can be sent in each direction in one time slot.

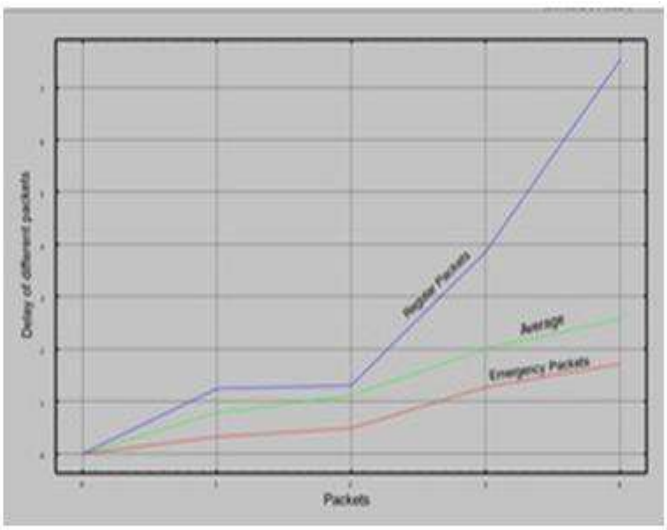

Fig 3:- End-To-End Delay of Different Packets

The end-to-end delay of different packets is shown in Figure 3.The average end-to-end delay is the average time a packet take from packet generation to delivery at destination. In our case the emergency packets need to reach the destination as fast as possible. So here the end-to-end delay need to be lesser as it is an important metric to evaluate the real-time performance of the scheduling scheme.

We can observe from Figure 3 that the average end-to-end delay is very lower than that of the regular packets.

Hence, it can be concluded that by using the above method the emergency packets can reach destination faster than the regular packet.

V. CONCLUSION

In this paper, a new method using backpressure based queue model was discussed. It helps to increase the efficiency of emergency packets by reducing the end-to-end delay and increasing the throughput. This is evaluated using simulation in ns2. The resultant graph shows significant reduction in delay of emergency packets. So the performance of emergency packet is guaranteed and the throughput of the network is increased.

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