International Conference on Wireless and Mobile Networks

- ICWMCN 2011 -

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Conference Proceedings

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# Conference Program

**ICWMCN 2011**  
October 24-25, 2011, Paris, France

9, rue Vésale, 75005 Paris, France

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<td>Registration</td>
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**Optimised Beaming for TDMA Based Heterogeneous Body Sensor Network MAC**  
Ashutosh Chhildiyal, Balwant Godara, Amara Amara

**Congestion Area Pricing Method Using Generated Packet Prediction Model on Wireless Sensor Networks**  
Ga-Won Lee and Eul-Nam Huh

| 11:00-11:30       | 11:00-11:30       |
| Coffee break      | Coffee break      |

| 11:30-12:30       | 11:30-12:30       |
| Session 2         | Session 6         |

**Invited speakers:**

Rachit Agarwal  
**Self-Organization of Wireless AD HOC Networks as Small Worlds Using Long Range Directional Beams**

Mohamed-haykel Zayani  
**Tensor-Based Link Prediction in Intermittently Connected Wireless Networks**

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<th>12:30-14:00</th>
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**All lunches and dinners are in charge of each participant**
CONGESTION AREA PRICING METHOD USING GENERATED PACKET PREDICTION MODEL ON WIRELESS SENSOR NETWORKS

Ga-Won Lee and Eui-Nam Huh
Kyung Hee University Dept. of Computer Engineering, Yongin-si, Republic of Korea

Abstract—This paper introduces generated packet prediction model and congestion area pricing scheme in wireless sensor networks. Reliable event detection at the sink is based on collective information provided by sensor nodes. But due to the unreliable wireless communication nature, it is hard to guarantee the end-to-end reliability and timeliness. Hence, we propose a congestion area pricing method that ensures the reliable delivery of packets to a base station, and that minimizes packet dropping within sensor network.

I. INTRODUCTION

In order to guarantee Quality of Service (QoS) in WSNs, numerous researches have done based on Wireless Sensor Network. These methods are mainly designed to 1) reduce generated data from sensor[1,2] 2) congestion detection and control according to queue status in sensor node[3,4] 3) congestion detection method using packet service time[5] 4) control data transfer rate of receiver node by sending congestion status information to neighbor node[6]. To achieve lossless reliable data transfer, these congestion control methods commonly occur unnecessary traffic. Moreover, node control sampling period and drop the overflowed packet when node detect congestion. Many applications in WSNs require collecting all data to be transmitted without loss, these packet-dropping are at high risk.

In this paper, we propose a congestion pricing boundary point and price level modeling to maximize "Network welfare". To detect congestion, we predict periodic and event-driven packet generation by modeling WSN condition. In addition, we present congestion area pricing model for reduce packet loss.

II. PROPOSED SCHEME: PACKET PREDICTION MODEL

A. Bureau of Public Roads(BPR) function

Travel time function is to calculate travel time changes when traffic increase for solve traffic problems and improvement urban transportation. Previous researches can be divided into experienced formula and theoretical formula. Experienced formula can be divided to linear function, exponential function, logarithm function and BPR function. Campbell, Wordrop model is theoretical function.

Most famous BPR function is shows that travel time changes when traffic increase. BPR performance is closely related to speed and capacity.[7,8]

B. Network Model

The model proposed in this study assumes a closed WSN of mono-centric network including a single sink without transfer from one sensor network to another network. Packet generation is predicted including both periodic data and event data. Data volume transferred over the whole network is predicted by estimating the packet volume including path-through traffic as well as end-to-end packet delivery. It is assumed that data transfer between nodes is allowed in the configured WSN.

The networks configured in this model are categorized into the three types; basic network without congestion area pricing, theoretical congestion pricing network and congestion area pricing network. The three network types are identical in network configuration, number of nodes, number of areas, etc. and are distinguished by congestion pricing method.

The communication radius of each sensor node is equal and each node performs two-way communication. Periodic data and event data is created in each area.

![Fig. 1. Network Model](image)

C. Packet Generation

To estimate the volume of packets generated, the concept of production used in economics is applied to this study. Since relative change, that is, flexibility is important for estimating impact of all parameters, representing packet generation in natural logarithm facilitates flexible analysis. Therefore, packets generated in the network are modeled using the Cobb-Douglas
rate in the theoretical congestion pricing network was 30.2kbps with average data transfer rate 14.3kbps in the congestion area, showing 7.86% increase in average data transfer rate with 5% increase in the congestion area. Average data transfer rate was 28.5kbps in the congestion area pricing network with average data transfer rate 14.5kbps in the congestion area, showing 2.86% increase in average data transfer rate with 20.83% increase in the congestion area. Variations in area-specific transfer rates are shown in Fig. 2 and 3. When the theoretical congestion pricing is applied, increase in data transfer rate is larger in an area further away from the sink. On the other hand, when the congestion area pricing is applied, increase in data transfer rate is larger in an area closer to the congestion area.

IV. CONCLUSION

As the power resource of sensor nodes is highly influenced by data transmission, data loss must be minimized. We presented congestion pricing models in WSNs for avoid congestion to support reliability for QoS requirements. To achieve modeling congestion pricing area in WSNs, several modeling elements were discussed, implemented, and tested.

There have been many congestion detection and control method and implemented. These protocols are mainly focused on methodological way. Few studies have been devoted to the modeling of congestion modeling for WSNs. Proposed congestion area pricing modeling method has many advantages and network can be quantitatively analyzed. These modeling methods are important in the long view for network control and analyze.

The contributions of this paper are three-fold. First, we predicted amount of generated packet in networks. Second, we model the network for reduce congestion. In addition, we extended a lowest-cost routing method with applying each pricing model. Each congestion pricing models were analyzed. Hence, the proposed scheme is efficient for reliable data transfer in WSNs and offers a new method to avoid congestion, thereby improving data rate.

In future work, we will gather more prerequisite elements to achieve accurate network modeling and our research will focus on the impact of congestion pricing. Future work will be as follows: 1) multi-centric network congestion modeling 2) network utility changes analysis through node utility 3) congestion area decision with network utility(network welfare) 4) theoretical congestion pricing and congestion are pricing network utility comparison 5) data transfer pattern changes analysis.

ACKNOWLEDGEMENT

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REFERENCES