Energy Consumption Improvements by Priority based MAC Protocol for WSN

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ABSTRACT
Improving energy consumption is major challenge in wireless sensor network (WSN). In this paper, we suggest a solution of this problem by introducing priority based media access control (MAC) protocol to transmit data among sensor nodes in the network. This priority based MAC protocol solves the problem of applications where critical data is sent first over the network than the other non critical data. This priority based MAC protocol uses modified IEEE 802.15.4 beacon frame. We add priority bit in beacon frame, by setting this bit we decide which data is critical. We propose a solution by introducing a protocol which is Energy consumption improvement by priority (ECIP-MAC) protocol. Whenever all sensor nodes send their data to base station, the base station can easily recognize which data is to be critical according to their priority bit. If we receive more than one same priority bit by different sender nodes, at this situation we apply priority based algorithm to remove this type of problems.

This priority based MAC protocol gives better improvements in energy consumption, throughput and efficient end to end data transmission as compare to other MAC protocols.

General Terms
Low duty cycle, Beacon frame, Priority Algorithm, Critical data, Non critical data.

Keywords
Wireless sensor network (WSN), Medium access control (MAC), Energy efficiency, ECIP-MAC (Energy Consumption Improvements by Priority MAC) protocol, FCFS (First come first serve).

1. INTRODUCTION
Wireless sensor network is the collection of different sensor nodes which are able to interact with each other in a physical environment. There are several reasons of energy wastage in wireless sensor network (WSN) like idle listening, collision, overhearing, control packet overhead[1] etc, to resolve these kind of problems there are many solutions given by researchers but MAC protocol is one of the best solution to reduce energy consumption. Sensor nodes are distributed in network and they powered by batteries so increasing life time of battery is major issues in WSN based applications. Following are the important attribute to define a good MAC protocol are scalability and adaptability to change in topology, energy efficiency, throughput, fairness and bandwidth utilization.

To improve energy efficiency we use low duty cycle operations in MAC layer protocol[4]. The concept of low duty cycle is to putting nodes into sleep and wake-up state periodically. In some applications of wireless sensor network (WSN) like underwater application, environmental monitoring, smart space, fire monitoring, medical system, military application, robotic exploration etc., it is require to send some critical data first, so to solve this problem we propose a solution of modified IEEE 802.15.4 beacon frame[7]. Source node and all other nodes between source to sink should transfer critical data faster than non critical data by specifying these critical data as high priority data over other data by using priority based algorithm and transmit these data first then other data. These critical data are selected by priority bit of beacon frame. By this procedure sender node reside in sleep mode more and this will lessen energy consumption.

To implement this we have studied various energy efficient MAC protocols like S-MAC [3], X-MAC [4], T-MAC [5], B-MAC [2].

2. ECIP-MAC
ECIP-MAC protocol is use to reduce energy consumption by using modified beacon frame format of IEEE 802.15.4.

2.1 Format of Modified Beacon Frame
We divide frame format into two parts[10]. First is sender beacon frame and second is receiver beacon frame.

2.1.1 Sender Beacon Frame
It has specific priority bit field, by which sender nodes can intimates their packets priority to receiver nodes. If priority bit is 1 it is critical data. If priority bit is 0 it is consider as non critical data. By this a receiver can identified which is higher priority data. If receiver receives more than one beacon frames then it selects the nodes which has priority bit 1. Higher priority data or critical data is send faster than non critical data. NAV field is used to define amount of data that we wish to transmit over the network.

2.1.2 Receiver Beacon Frame
There are two works of this beacon frame which is done simultaneously. The first work is to acknowledge previously received data packets and the second is to give notification to sender, to receive more data. So when sender receives, receiver beacon frame, sender is ready to send more data to receiver.

3. DATA TRANSMISSION BASED ON PRIORITY BIT
Here this protocol is based on priority data transmission[10]. In Wireless sensor network some application is required to

send some critical data first. So for this type of application we use concept of priority based data transmission. This protocol use priority bit in beacon frame. If this bit is 1, it is critical data. If it is 0, it is non critical data so critical data is delivering as soon as possible to receiver.

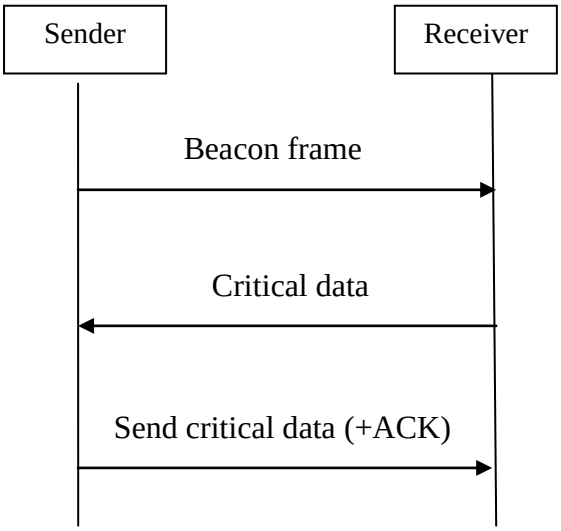

Fig 1: Data Transmission Among sender and receiver

4. PRIORITY BASED ALGORITHM

The algorithm is divided into these steps.

Step1:**Set-up phase-** All sensor nodes are ready to transmit their data to destination node. Before this they add beacon frame with data packets and the priority bit of this beacon frame is decided by following steps.

Step2: **At source node-** Several node transmit their data by setting their priority bit to 0 or 1. If data is more critical then priority bit set as 1 otherwise less critical data is coming and priority bit set as 0.

Step3: **At receiver node-** As per priority bit of beacon frame we perform following steps.

1. If we get higher priority data then we send this data over the channel.
2. If more than one data nodes are received with same priority that is 1, then we apply first in first out (FIFO) algorithm. We implement this algorithm by using counter on every incoming data packets. Lower the counter value higher the priority.

5. CONCLUSION

In this paper we improve energy consumption by using ECIP-MAC protocol. This protocol is based on the concept of priority based data transmission. In this paper we improve energy consumption by using ECIP-MAC protocol. In this paper we improve energy consumption by using ECIP-MAC protocol. This protocol is based on the concept of priority based data transmission. To perform priority based data transmission we propose modified data frame of IEEE 802.15.4. In this frame format we add specific field which is called priority bit. If this bit is set to 1 if the data is more critical and if it is o it considered as non critical data. Basically this approach is used in the applications where some critical data need to send first over the channel. These data is produce by some events which are identifying by sensor nodes. ECIP-MAC protocol use concept of periodic sleep and wake-up schedule so receiver wake-up periodically and receives sender beacon frame and sends this frame to destination node. Receiver performs all these operations by priority bit of sender node. Here one problem done at receiver side is that if it receives more than one data packets with same priority than we solve this problem by applying first come first serve algorithm. This algorithm is implemented by using counter bit of receiver beacon frame. Lower the counter value, higher the priority to send over network. So ECIP-MAC protocol improves energy efficiency, end to end data transmission, collision avoidance and throughput.

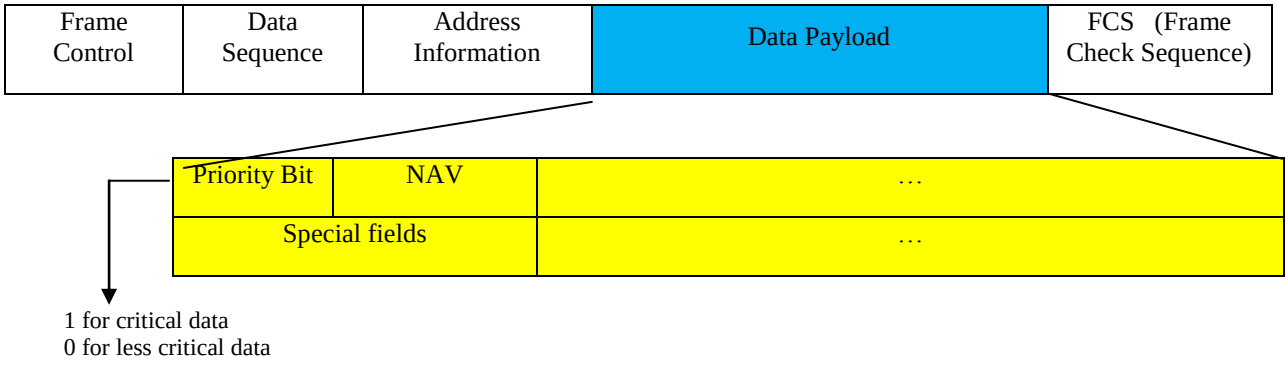

Fig 2: Sender beacon frame format

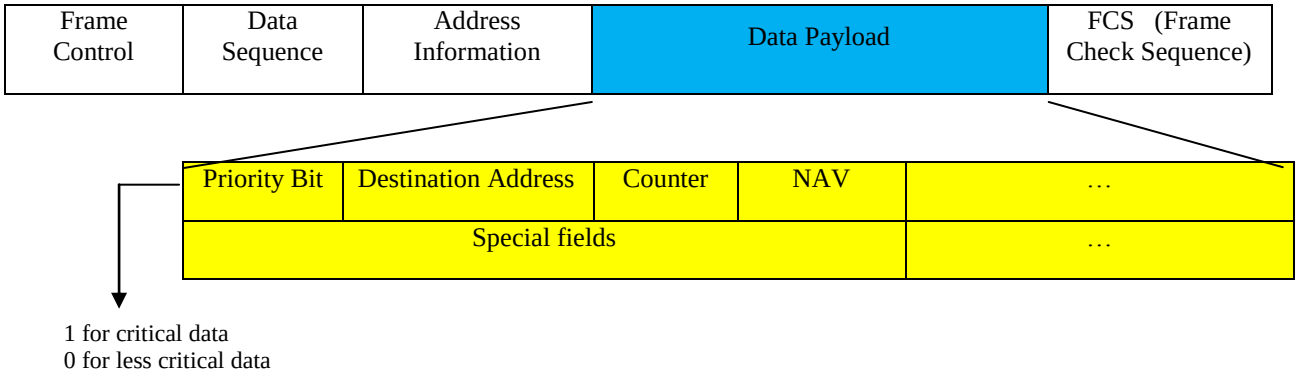

Fig 3: Receiver beacon frame format

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7. REFERENCES

[1] Thibault Bernard, Hac`ene Fouchal. 2012 A Low Energy Consumption MAC Protocol for WSN, Communications (ICC), 2012 IEEE International Conference.

[2] Zhang Haiyang. 2010 Classic Efficient-Energy MAC Protocols for Wireless Sensor Networks, Wireless Communications Networking and Mobile Computing (WiCOM), 6th International Conference.

[3] Yujun Pang, Shuai Ma, Jun Wang. 2010 A New Optimization Strategy for S-MAC Protocol, Computer Application and System Modeling (ICCASM), 2010 International Conference.

[4] Ilker Demirkol, Cem Ersoy, and Fatih Alagöz. 2006. MAC Protocols for Wireless Sensor Networks:a Survey, Communications Magazine, IEEE Journals & Magazines.

[5] Abdelmalik Bachir, Mischa Dohler. 2010 MAC Essentials for Wireless Sensor Networks Communications Surveys & Tutorials, IEEE Journals & Magazines.

[6] Nirmala.S, Nallusamy.R. 2012 An Energy-Efficient and enhanced QoS aware of MAC application specific protocol in the distributed Wireless Sensor Networks, Advanced Computing (ICoAC), Fourth International Conference.

[7] Ibrahim Amadou, Guillaume Chelius, Fabrice Valois. 2011 Energy-Efficient Beacon-less Protocol for WSN, Personal Indoor and Mobile Radio Communications (PIMRC), 2011 IEEE 22nd International Symposium.

[8] Messaoud Doudou, Djamel Djenouri, Nadjib Badache, Abdelmadjid Bouabdallah. 2012 Slotted Contention-Based Energy-Efficient MAC Protocols in Delay-Sensitive Wireless Sensor Networks, Computers and Communications (ISCC), 2012 IEEE Symposium

[9] Sricharan Madduri, Kamran Arshad. 2013 Experimental Validation of an Energy Efficient MAC Protocol for Wireless Sensor Network, Communications, Signal Processing, and their Applications (ICCSPA), 2013 1st International Conference.

[10] Seong-cheol kim, Yeong-joon kim. 2012 EEP-MAC: An energy efficient priority-based MAC protocol for wireless sensor networks, ICT Convergence (ICTC), 2012 International Conference

[11] Cedric RAMASSAMY, Hacene Fouchal, Philippe Hunel. 2012 Impact of Transmission Range in 802.15.4 with Usual Routing Protocols, Wireless Communications and Mobile Computing Conference (IWCMC), 8th International

[12] Wei Ye, Heidemann, J. , Estrin, D. 2004 Medium Access Control With Coordinated Adaptive Sleeping for Wireless Sensor Networks, Networking, IEEE/ACM Transactions.