Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 78 (2016) 756 – 762

Procedia Computer Science

International Conference on Information Security & Privacy (ICISP2015), 11-12 December 2015, Nagpur, INDIA

A Survey On Scheduling Schemes With Security In Wireless Sensor Networks

Rashmi Mahidhar[a], Archana Raut[b]

[a] *M.E.Student, Department of Computer Science and Engineering, GHRCE, Hingna road, Nagpur, 440016, India*
[b] *Assistant Professor,Department of Computer Science and Engineering, GHRCE,Hingna road,Nagpur,440016,India*

Abstract

Wireless Sensor Network (WSN) is highly distributed network of small and light weight node. The node has the limited battery lifetime. Packet scheduling is important in WSN to maintain fairness based on priority of the data and to reduce the end to end delay. Existing packet scheduling algorithm used were First Come First Served (FCFS), Preemptive, Non-Preemptive.
In this paper Dynamic Multilevel Priority (DMP) Packet Scheduling Scheme with the Bit Rate classification is proposed. The threshold value check mechanism is also proposed to prevent the deadlock situation. To provide security we will be implementing the RC6 security algorithm.

Peer-review under responsibility of organizing committee of the ICISP2015

Keywords: WSN; DMP; End to End Delay; FCFS; RC6

1. Introduction

Wireless Sensor Network consists of various number of the nodes which are capable to collect the information from the environment and communicate through the wireless transceivers. The collected information is send to the sink node generally via multi hop communication. Sensor nodes are resource constrained in terms of energy, memory, processor, low range communication and the bandwidth. The nodes have the limited battery life time since they are charged through battery power[3]. Sometimes it becomes really difficult to replace the node in a hostile environment when the node is dead. This affects the network performance, so the sensor node energy is considered to be the most precious resource in the wireless sensor network, and efficient utilization of energy is needed to prolong the network life time which has been the focus of much of the research in the WSN. Sensor node spend their energy in transmitting the data, receiving the data and also in the relaying of the packets. Hence the important consideration is to design the routing algorithm that maximize the life time of the network.

* Rashmi Mahidhar. Tel.: +91-705-761-6175.
E-mail address: rashmimahidhar@gmail.com

Peer-review under responsibility of organizing committee of the ICISP2015
doi:10.1016/j.procs.2016.02.049

One another important consideration in real time data transmission of WSN is to schedule the packets at the sensor node which ensures delivery of different packets based on their priority and fairness without any delay. This results in saving the battery energy. Schedulers like First Come First Served (FCFS)[13] process the data packets in the order of their arrival time and thus require lot of time to be delivered to the relevant base station (BS). However the main constraint is the sensed data should be delivered to the base station at the specified time period or before the expiration of the deadline.

The scheduling algorithms like sleep/wake scheduling can be classified based on different aspects which are as follows centralized, distributed, random and deterministic. The centralized scheduling requires a central node with sufficient computational capacity, in distributed scheduling the task is performed in a distributed manner so require low energy consumption, in the randomized scheduling the time is divided into periods and the deterministic approach is to decide whether a sensor should be active or at the sleep condition. So the sleep scheduling can be applied to the node when it has no task to perform in order to save the energy consumption of the node[1,2].

To provide the security in the system RC6 security algorithm is used, it is simple, fast and secure. It is an improvement of the RC5 algorithm. It is designed to achieve increased security and better performance.RC6 makes use of data dependent rotations. One new feature of RC6 is to use four working registers instead of the two, RC6 is modified it is designed to use four 32-bit registers rather than two 64-bit registers. This has the advantage that it can perform two rotations per round rather than the one found in a half-round of RC5[14,15].

The rest of the paper is organized as follows in section II we have discussed various existing real time scheduling scheme. Section III presents the literature survey. Section IV represents the proposed plan and the flow chart of the proposed plan. Section V concludes the paper.

2. Existing Real Time Scheduling Scheme

There are various existing real time scheduling scheme which are as follows:
2.1 Dynamic Conflict Free Transmission Scheduling (DCQS): It is a query based novel scheduling technique in Wireless Sensor Networks, it is designed to support in network data aggregation and in response to the workload changes it can dynamically adapt to the transmission. The advantage of the scheme is it has maximum query rate, low run time overhead and good rate control. The drawback of the scheme is throughput and query rate reduction[9,10].

2.2 Nearest Job Next (NJN): It consists of the mobile element (ME) server and the client. The client is the one which request the service and it is a simple and intuitive discipline which is adopted by the ME to select the next to be served request i.e. client .The advantage of the scheme is it has reduced travel distance, and the structure of the network is clustered. The drawback of the scheme is light traffic intensity should be considered[11].

2.3 Traffic Pattern Oblivious Scheduling (TPO): It can efficiently handle a wide variety of the traffic pattern by using a single TDMA schedule. The advantage of the scheme is less energy consumption, and it deals with any network full traffic pattern. The drawback of the scheme is the performance decreases with increasing traffic load[12].

2.4 Dynamic Multilevel Priority Packet Scheduling (DMPPS): It has three levels of the priority queues, based on the priority the data is placed in the priority queue, the last level of the virtual hierarchy does not have the priority queue and the levels are formed based on the hop distance from the base station.The advantage of the scheme is it is dynamic to the changing requirement and it is virtually organized. The drawback is that the packet priority cannot be changed during the execution time[3].

2.5 First Come First Serve (FCFS): It is the simplest packet scheduling algorithm in which packets are processed as they come. The advantage of the scheme is it has minimal overhead, and no starvation. The drawback of the scheme is it is not stable and it gives poor performance[13].
Out of all these schemes DMPPS is better scheme when compare to other schemes.

3. Literature Review

Table 1. Literature review

Title	Year	Author Name	Objective	Key Issues	Advantage
Dynamic Multilevel Priority Packet Scheduling Scheme for Wireless Sensor Network [3]	2013	Nidal Nasser, Lutful Karim, and Tarik Taleb	The main aim is to reduce processing overhead and to save the bandwidth	To reduce the end to end delay the scheduling scheme does not consider the variable number of queues	Energy efficient system
Dynamic sleep scheduling for minimizing delay in wireless sensor network [4]	2011	B. Nazir and H. Hasbullah	To reduce the end to end delay and to minimize energy per packet	When the nodes have the same wake interval the problem arises in heavy traffic the packets have to wait for longer time	It minimizes delay at the nodes
Joint routing and sleep scheduling for lifetime maximization of wireless sensor networks [5]	2010	F. Liu, C. Tsui, and Y. J. Zhang	To maximize the lifetime of the sensor nodes	The effect of collisions was not considered on the routing and the sleep scheduling	It is a collision free system
Optimal period length for the CGS sensor network scheduling algorithm[6]	2010	G.Bergmann, M.Molnar, L.Gonczy, and B. Cousin	To increase network lifetime	In a random scenario the local optima is completely unfeasible and the distributed nature of the system gets broken at the optimization after placement	It reduces the possibilities of the node deaths.
An energy aware routing protocol with sleep scheduling for wireless sensor networks [8]	2010	A.R.Swain, R.C.Hansdah, and V.K.Chouhan	The aim is to reduce average energy consumption rate of each node	Depending on the input rate it cannot adaptively adjust the period of the tree reconstruction	The energy consumption of the node is balanced

The author proposed the Dynamic Multilevel Priority packet scheduling scheme[3] in which it has three levels of the priority queues, the last level of the virtual hierarchy does not have the priority queue. The topology used was zone based topology. The data packet classification is done as i) real time data given as priority 1, ii) non real time remote data given as priority 2, iii) non real time local data given as priority 3.The non real time remote data is received from the lower level nodes and the non real time local data packet is sensed from the node itself. TDMA scheme is used to process the data packet sensed by the node which are at the different levels. The drawback is that the packet priority cannot be changed during the execution time.

In 2011, the author proposed Dynamic Sleep Scheduling[4], which identifies nodes at two levels for different sleep/wake time according to their traffic load. The DSS protocol has four steps which are as follows: i) Setup phase
ii) Operation phase iii) Sleep wake scheduling and iv) Event reporting. In the event reporting phase the data forwarding is done to the base station in a timely manner on the occurrence of the event. The setup phase is again classified into two categories as setup phase initialization and the route update, the initialization phase is done to know the neighbor nodes and the route update is carried out to update the information of the transmission. The drawback is in the heavy traffic the packets have to wait for the longer time when the nodes have the same wake interval.

The author addressed the lack of the joint routing and the sleep scheduling scheme[5], by the design of the one optimization frame which is formed by the two components. Joint routing and sleep scheduling is a non convex problem which is difficult to solve. The problem was handled by transformation of it into an equivalent signomial program (SP) by performing the relaxing of the flow conversation constraints. Iterative geometric programming (IGP) is used to solve the SP problem which maximize the network lifetime. The sensor node has two periods active period and the sleep period. The active period means the node is in active state and performing some tasks and the sleep period means the node has no task to perform and hence it is in sleep condition to save the energy. The active period is further classified as an idle listening slot, a data reception slot or the data transmission slot. The active period consists of two parts as RF initialization and the channel detection. The drawback is that the collision effect was not considered on the routing and the sleep scheduling.

From any node to sink node the author proposed the definite path[6]. The proposed algorithm was the synchronized algorithm and the name of the algorithm is the Control Greedy Sleep algorithm. The work of the internal nodes of the tree is to remain awake and the leaf nodes have to perform the sleep. Here the tree reconstruction is performed periodically considering the remaining energy of the node with a view to balance the energy consumption of the node. The theoretical and the experimental analysis are carried out for the choice of the period length of the CGS scheduling algorithm. The drawback is that in a random scenario the local optima is completely unfeasible and the distributed nature of the system gets broken at the optimization after placement.

In 2009, the author proposed an energy aware routing protocol with the sleep scheduling[8], for WSN. Here first the construction of the broadcast tree is performed the tree will have some internal nodes and some leaf nodes based on the condition. These things were ensured before the broadcast the first one is the number of broadcast should be as minimum as possible to minimize the energy consumption during the tree construction phase. The second one is there are two branches from each node of the tree towards the sink node to provide support for the fault tolerance. After the construction of the tree each node identifies itself to be as the internal node or the leaf node of the tree. The tree reconstruction is done at the beginning of each period so that none of the nodes die before the other nodes. In this case the leaf node mechanism is highly efficient as more number of the nodes are able to sleep which will help to prolong the network lifetime. The drawback is depending on the input rate it cannot adaptively adjust the period of the tree reconstruction.

The author proposed ASLEEP protocol[7]. The Adaptive Staggered Sleep Protocol is efficient for the power management in wireless sensor network. This protocol dynamically adjusts the sleep schedulers of the node to match the network demand. The node adjusts its active period dynamically. The Beacon protection mechanism and the Beacon loss compensation mechanism is introduced, the beacon protection helps to increase the probability of successful beacon reception at the sensor node and the beacon loss compensation mechanism is to offset the negative effects of the direct beacon losses. The drawback is ASLEEP is more complex than the non adaptive staggered schemes.

4. Proposed Plan

4.1 Problem Statement

The processing overhead were increasing due to long end to end data transmission by using the First Come First Served (FCFS) concept and the FCFS and other scheduling algorithm were not dynamic to the changing requirement of the Wireless Sensor Network application. The deadlock situation was also one of the issues to be solved.

Hence in order to overcome these problems we have proposed the DMP scheme with the bit rate classification.
To prevent the deadlock situation we have also proposed the threshold value check mechanism at the priority level of the data rate.

4.2 Proposed Scheme

Existing paper provides many packet scheduling scheme out of which few were dynamic, but this paper provide dynamic scheme.

First based on the Bit Rate the data is divided into three categories as i) High bit rate ii) Moderate bit rate iii) Low bit rate.
The proposed scheme works as follows:

- In phase 1: First the data is given as the input on the scheduler.
- In phase 2: It is passed to the bit rate analyzer which consist of the zero crossing detector type sensor it senses how many times the data is going from 0 to 1 in a particular time frame and find out the bit rate from it.
- In phase 3: The data classification is done based on the bit rate concept in which data is divided into three categories as high bit rate , moderate bit rate, low bit rate. After this process Dynamic multilevel priority packet scheduling scheme is implemented. Data packet that arrive at a node are scheduled amongst all the levels in the ready queue Pr 1 queue is meant for the high priority data, Pr 2 queue is meant for the moderate priority data, and Pr 3 queue is meant for the low priority data.
- In phase 4: The mapping is performed at this stage.

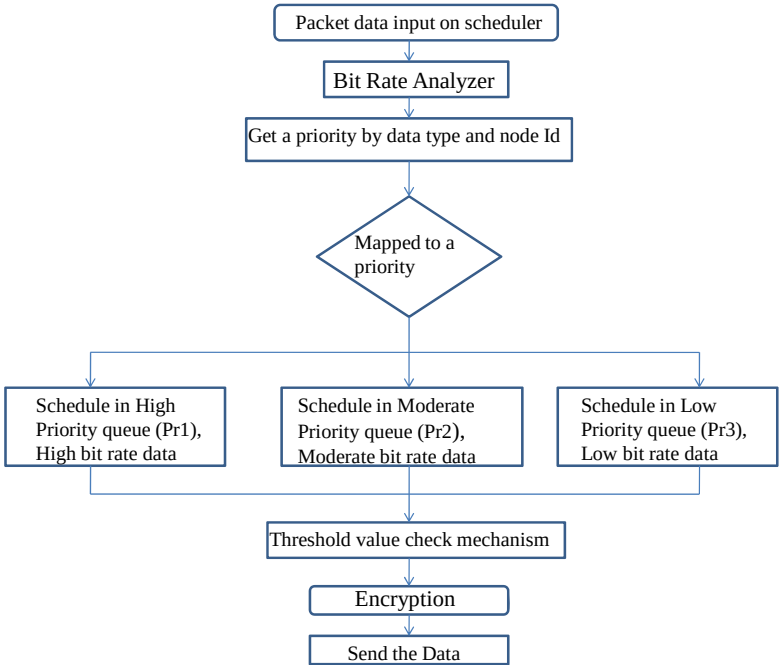

Fig 2: Flow chart of proposed plan

- In phase 5 : In this stage high priority data is placed at the high priority queue Pr 1, moderate priority data is placed at the moderate priority queue Pr 2, and the low priority data is placed at the low priority queue Pr 3.

- In phase 6: When the data arrives at the high priority queue then the time period is checked based on the threshold value if it requires more time to finish the task then it is allowed to wait and the chance is given to the low or moderate data to transmit according to the priority.

- In phase 7: At this stage the RC6 Encryption algorithm is applied and finally this encrypted data is transmitted to the destination.

The threshold value is calculated by using the following formula:

$$Threshold = \frac{Packets\ in\ Low\ priority\ queue + Packets\ in\ Moderate\ priority\ queue}{Packets\ in\ High\ priority\ queue}$$

If the threshold value is more than two then we can directly process the moderate priority and low priority queue.

In this paper various scheduling schemes in wireless sensor network is discussed. The proposed scheme in the paper will help to prevent deadlock situation. The objective is to increase the packet delivery ratio in wireless sensor network and to reduce the end to end data transmission delay by using dynamic multilevel priority packet scheduling scheme.

4.3 RC6 Security Algorithm

We will be using the RC6 security algorithm while transmitting and receiving the data. At the time of the data transmission the encryption is applied and at the time of the reception of the data decryption is done. RC6 is specified as RC6-w/r/b where w stands for bits, r stands for number of rounds, and b denotes the encryption key length in bytes. RC6-w/r/b operates on four w-bits words using the following six basic operations:
a + b: Integer addition modulo 2^w
a – b: Integer subtraction modulo 2^w
a ⊕ b: Bitwise exclusive-OR of w-bit words
a × b: Integer multiplication modulo 2^w
a < < < b: Rotate the w-bit word a to the left by the amount given by the least significant log w bits of b.
a > >> b: Rotate the w-bit word a to the right by the amount given by the least significant log w bits of b (where log denotes the base-two logarithm of w).

RC6 encryption algorithm has the following steps:
Encryption with RC6-w/r/b:
Input: Plaintext stored in four w-bit input registers A,B,C,D.
Number of rounds, r.
w-bit round keys S[0,1,…..,2r+3].
Output: Cipher text stored in A,B,C,D.
Procedure: B= B+ S [0]
D= D+ S [1]
For i= 1 to r do
{
t = (B × (2B+1)) < < < log w
u = (D × (2D+1)) < < < log w
A = ((A ⊕ t) < < < u)+ S [2i]
C = ((C ⊕ u) < < < t) + S [2i + 1]
(A,B,C,D) = (B,C,D,A)
}
A= A + S [2r +2]
C= C+ S [2r + 3]

Decryption: The Decryption is the reverse process of the Encryption. At this stage we will have the key to decrypt the data after the decryption of the encrypted data we will be able to see the original data. Thus the communication between the nodes will be done in a secure manner.

5. Conclusion

As we have studied different scheduling scheme, each scheme has its own advantage and drawback. The Dynamic Multilevel Priority packet scheduling scheme is dynamic to the changing requirement of the Wireless Sensor Network application it is one of the advantage of the scheme. In this paper we have proposed Dynamic Multilevel Priority packet scheduling scheme with the Bit rate classification which will help to reduce the end to end delay.
We have also proposed a threshold value check mechanism at the time of the priority level when the data arrives at the high priority queue then the time period is checked based on the threshold value. If it requires more time to finish the task then it is allowed to wait and the chance is given to the low or moderate data to transmit according to the priority this will help to reduce the deadlock situation. The security can also be achieved with this system by the implementation of the RC6 security algorithm while transmitting and receiving the data.

References

1. B. Chen, K. Jamieson, H. Balakrishnan, and R. Morris. Span: an energy-efficient coordination algorithm for topology maintenance in ad hoc wireless networks.*Wirel. Netw.*, vol. 8, no. 5, pp. 481–494; 2002.
2. C. F. Hsin and M. Liu. Network coverage using low duty-cycled sensors: random & coordinated sleep algorithms. in *IPSN '04:Proceedings of the 3rd international symposium on Information processing in sensor networks*. New York, NY, USA: ACM; 2004, pp.433–442. [Online]. Available: http://dx.doi.org/10.1145/984622.984685.
3. Nidal Nasser, Lutful Karim, and Tarik Taleb. Dynamic Multilevel Priority Packet Scheduling Scheme for Wireless Sensor Network. *IEEE Transactions on wireless communications*. Vol.12,no.4; april 2013.
4. B. Nazir and H. Hasbullah. Dynamic Sleep Scheduling for Minimizing Delay in Wireless Sensor Network. *in Proc.2011 Sadi International Electron, Comminications Photon. Conf,pp.1-5.*
5. F.Liu, C. Tsui, and Y. J. Zhang. Joint Routing and Sleep Scheduling for Lifetime Maximization of Wireless Sensor Networks. *IEEETrans.WirelessCommunication*,vol.9,no.7,pp.2258-2267; july 2010.
6. G.Bergmann, M.Molnar, L.Gonczy, and B. Cousin. Optimal Period Length for the CQS Sensor Network Scheduling Algorithm. *in Prac.2010 International Conf. Netw.Services*,pp.192-199.
7. G.Anastasi, M. Conti, and M. Di Francesco. Extending the Lifetime of Wireless Sensor Networks through Adaptive Sleep. *IEEE Trans.Industrial Informatics*, vol.5,no.3,pp.351-365; 2009.
8. A.R.Swain, R.C.Hansdah, and V.K.Chouhan. An Energy Aware Routing Protocol with Sleep Scheduling for Wireless Sensor Networks. *in Proc. 2010 IEEE International Conf.Adv.Inf.Netw.Appl*,pp.933-940.
9. R. Gomathi and N.Mahendran. An Efficient Data Packet Scheduling Scheme in Wireless Sensor Networks. *IEEE 2nd international conference on electronics and communication system(ICECS)2015.*
10. John A. Stankovic and Catalin-Gruia Roman. Dynamic Conflict-Free Transmission Scheduling for Sensor Network Queries. *IEEE Transactions on mobile computing*,vol. 10,no. 5; May 2011.
11. Liang He and Zhe Yang. Evaluating Service Disciplines for On-Demand Mobile Data Collection in Sensor Networks. *IEEE Transactions on mobile computing*, vol .13,no. 4; April 2014.
12. Arun Somasundara,A.and Aditya Ramamoorthy. Mobile Element Scheduling for Efficient data collection in wireless sensor network with Dynamic Deadline. Department of Electrical Engineering, *IEEE International Real-Time Systems Symposium*, PP. 1052-8725; 2004.
13. Guner D. Celik and Eytan H. Modiano. Controlled mobility in stochastic and dynamic wireless networks. *IEEE CDC'10*; May 2012,pp. 251–277.
14. Deepika Thakral, Neha Dureja. A Review on Security Issues in Wireless Sensor Networks. *International Journal of Advanced Research in Computer Science and Software Engineering*, Volume 2, Issue 7; July 2012.
15. R. L. Rivest. The RC5 Encryption Algorithm. *In Proc. 1994 Leuven Workshop on Fast Software Encryption* ; 1995, pp. 86.96.

.