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Slot assignment using FSA and DSA algorithm in wireless sensor Networks

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ABSTRACT

This paper proposes a priority based slot assignment algorithm which is different from Demand based slot allocation algorithm (DSA) and Frame-slot pair assignment (FSA). Wireless sensor networks are used to monitor safety–critical work environments reliable communication, which indicates timely delivery and guaranteed delivery for the sensed data. In FSA the slot assignment is done by considering the factors such as data aggregation and filtering, in case of DSA the slot is allocated based on the demand of the nodes but the priority is used in both the algorithm. Priority based slot allocation is such a way the slot is allocated based on the priority values that are assigned to nodes. Slot assignment for the nodes is used for sending and receiving the data in an efficient manner based on the priority of the nodes. The priority is based on the data arrival at any node and the slot assignment needed for the nodes is done based on the nodes requirement. Each node is placed with two types of sensors, the priority is set based on the values arrived at each sensor. By calculating the priority values using the slot calculation technique node requirements are found out, the slots are allocated and divided for the purpose of sending, receiving and reserving for the next use.

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INTRODUCTION

Wireless sensor networks formed with a number of nodes they sense data from various environments as well as from multiple sinks, collected data are used for monitoring applications. Wireless sensor networks are used to monitor from critical environment for communication. The data communicated must consider two basic factors timely delivery and guaranteed delivery for the sensed data. WSN network are formed with number of sensors which are spatially distributed to sense based on the environment conditions. The sensors are placed in different environment based on the requirements, and various types of sensors are used according to the environment. For example, the sensors used for the commercial uses are not so difficult to maintain and they are not so expensive, the cost depends on the size of the sensors, when the sensor size is very small the cost is more, this is again a challenge. Major thing that is to be considered in the sensors are the energy conception, it plays the major role in the case of the sensors because data transmission must be done in time without any loss. Many works are related to the timely and guaranteed delivery of the data between the nodes and many protocols are developed to overcome these problems. Because of the heavy traffic in the nodes there may lose packets due to congestion or if any node is dead. Data delivery is very important in case of any nodes failures and no reliable data transmission is done between the nodes in the topology. The main features in WSNs are the design of energy efficient communication protocols is a very peculiar issue of WSNs, without significant precedent in wireless networks.

The ratio between the energy needed for transmitting and for processing a bit of information is usually assumed to be much larger than one. Mac protocol provides functionality depending on the network, Mac basically has some of the features such as framing, reliability access control finally error and flow control. Mac protocol in sensor network is basically used for the energy utilization of the nodes in an efficient manner. Data transmission can be done based on the slot assignment, So that the data transmission is done in a particular number of allocated slots in a particular duration of time Tree Mac can be considered for this purpose of using the tree for data transmission. Algorithm such as FSA, DSA are considered for the slot allocation for the nodes in the tree topology. FSA concentrates on the vertical interference clearance and the slot allocation based on it, were as DSA algorithm is mainly about slot allocation based on the demand of each node in the tree topology.

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In this paper an algorithm is proposed in such a way that the slot is allocated based on the priority values that are assigned to nodes. The priority is based on the data arrival at any node and the slot assignment needed for the nodes is done based on the nodes requirement. Each node is placed with two types of sensors, the priority is set based on the values arrived at each sensor. By calculating the priority values using the slot calculation technique node requirements are found out, the slots are allocated and divided for the purpose of sending, receiving and reserving for the next use.

Related Work:

Zlem Durmaz Incel (2012)., has focused on how fast the data can be streamed from a set of sensors over a sink in a tree based topology. Interference clearance is taken in to account and different algorithm have been proposed to clear the interference in the two major types of data collection (i.e.) aggregated data converge cast and raw data converge cast. The length is reduced while the interference is cleared by using those algorithms. Baljeet Malhotra (2011), has focused on the problem of aggregation converge cast scheduling in wireless sensor networks. Through a study of the structure and limitations of existing aggregation converge cast schemes they have proposed a new competitive aggregation converge cast scheduling algorithm which outperforms the existing schemes. In the above works they have not considered priority for the aggregation of the data and the interference clearance .converge cast is the problem that is considered in these papers.

Hoon Oh (2012)., their focus is on the demand-based slot assignment (DSA) algorithm that allocates time slots based on the bandwidth demand of each node in a tree topology. DSA is basically similar to the frame-slot pair assignment (FSA) algorithm used in Tree MAC in that it assigns multiple small size slots for sensor nodes per each data collection round. This way of slot assignment allows nodes to filter and aggregate the received packets easily before sending, resulting in efficient channel utilization and balanced power consumption. In addition, they used two control messages RTS and CTS to enable reliable transmission within a slot against link breakages and to update sync time, and employed SYNC_DELAY parameter to handle clock drift problem. This way of slot assignment allows nodes to Filter and aggregate the received packets easily. Ozlem Durmaz Incel (2009).,focus is based on addressing the fundamental limitations due to interference and half duplex nature of the radios on the nodes, this technique is explored to eliminate those limitation ,in which power control is helpful in reducing the schedule length, scheduling transmissions on different frequency channels is more efficient in mitigating the effects of interference. An optimal converge cast Scheduling algorithm is used to reduce the interference. Hoon Kim (2009)., has proposed the work based on the quality of service for MAC (PQMAC).

Data priority levels to differentiate among data transmission and they have proposed MAC protocol based on these levels. This Protocol manages scheduling by adaptively controlling network traffic and the priority levels. The main focus in this paper is to reduce the latency of the message transmission from the source to the destination. Mohammad Hossein Yaghmee (2008)., has proposed a priority-based rate control mechanism for congestion control and service differentiation in WMSNs. They have distinguished high priority real time traffic from low priority non-real time traffic, and service the input traffic based on its priority. Simulation results have confirmed the superior performance of the proposed model with respect to delays, delay variation and loss probability. Mohammad Hossein Yaghmee (2009)., has presented a new Queue based Congestion Control Protocol with Priority Support (QCCP-PS), using the queue length has an indication of congestion degree.

The rate assignment to each traffic source is based on its priority index as well as its current congestion degree. Simulation results show that the proposed QCCP-PS protocol can detect congestion better than previous mechanisms. This has a good achieved priority close to the ideal and near-zero packet loss probability, which make it an efficient congestion control protocol for multimedia traffic in WMSNs. As congestion wastes the scarce energy due to a large number of retransmissions and packet drops, the proposed QCCP-PS protocol can save energy at each node, given the reduced number of retransmissions and packet losses. As congestion is concentrated on the above papers ,by taking the congestion control based on the priority the traffic assigned based on the priority .The priority based slot assignment is not taken as a factor in these works.

Rajendran (2006)., has assumed a slotted time and employed a distributed election scheme based on the traffic information of each node to determine which node can transmit at a particular time slot to ensure that data transmission incurs no collision. Thimma V. J. (2001)., has proposed a Performance of a priority-based dynamic capacity allocation suitable for wireless ATM systems is presented. The TDMA frame is based on a priority scheme with priority given to real-time traffic over non real-time traffic. Real-time traffic exceeding the uplink capacity is lost while non real-time traffic that cannot be served is stored in a first-in first-out (FIFO) queue. An analytical model is developed to evaluate the cell loss ratio (CLR) of both real-time and non real-time traffic. Simulation results with on–off sources and approximating MMPP sources are also presented.

Proposed Model:

A Shortest path tree is considered with sink node, nodes 1, 2, 3, 4, 5, 6 & 7 links are used to connect the nodes. 4, 5 & 7 are considered as leaf nodes. Collected data from all the nodes are sent to the sink node. The links connects the parent and the children based on the structure. Based on the network, the nodes sends the packets to their desired nodes based on the requirements assigned. The packets must be sent to the nodes by considering timely and guaranteed delivery. The Tree model is as shown in fig 1.

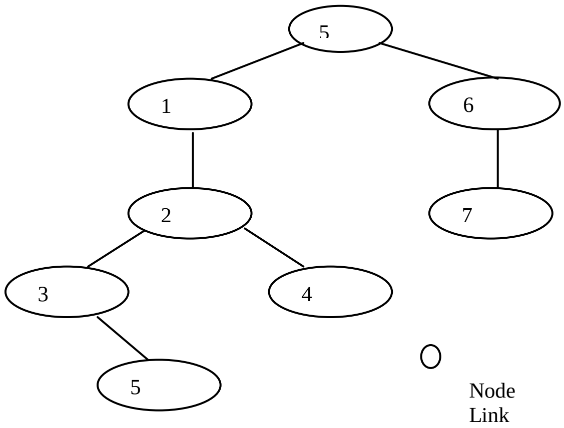

Fig. 1: Tree Model

The proposed work in this paper focuses on the priority based slot assignment for the nodes in the tree .The below Algorithm 1 is Priority Tree Algorithm were ,the priority values are calculated to each node based on the algorithm 1.Fig 2 shows how the priority values are assigned to each node.

In the below shown tree nodes requirement of slot are set based on the α and β. Where α value is the summation of α and β values of all the immediate children example consider a intermediate node 3, α and β values are (P5, P3+1) where α =P5 is required by summing the values of α and β of all the immediate children, immediate children for node 3 is node 5, values are summed and they are set as α value for node 3.similarly for β, the priority. Values of the nodes and the number of children are Summed and the value is set in β, example by considering the same node 3 as referred above β=P3+1 the priority of the node 3 (i.e) P3 and the number of children is 1.This method is done for all other nodes in the tree .Finally the sink node gets the sum of all the nodes requirement and the slots are assigned accordingly.

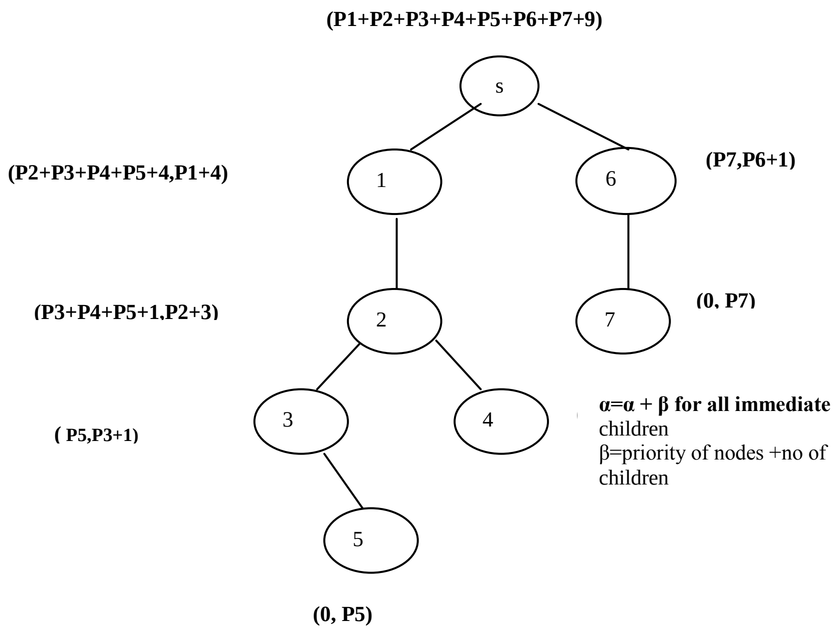

Fig. 2: Priority Based Tree

Notations:

M (i) : Intermediate node
P (i) : Priority value for the nodes
L (i) : Leaf node
N (chi): No of children

Ti : Represents Temperature priority Values
Hi : Represents humidity priority Values
S (i) : Sink Node

Priority Based Tree Algorithm1:

If node i is not a leaf then M (i)=$\sum_{chi}$(n(chi),P(i)+1) //M (i) represents the intermediate node in the tree Where priority Pi=(n(i)=m) for all nodes in the tree
m=1 to n
Pi=∑Ti+Hi
//Ti represents temperature priority values
//Hi represents humidity priority values
//Pi represents priority for the nodes
End if
Else

If it is a leaf node
Calculate L (i) with L (i) =$\sum_{chi}$ (n (chi), P(i))
//L(i) represents the leaf node in the tree
//n (chi) represents no of children in the tree
End if
Else
If it is a sink node
Calculate s (i) by summation of priority values for its immediate children in the tree
End

Table 1: Priority Values

NODE	Temperature	Humidity	Priority value
1	0	2	2
2	1	0	1
3	0	2	2
4	1	2	3
5	0	2	2
6	1	0	1
7	0	2	2

After the slot is allocated the data are sent, received and reserved based on the calculation. Algorithm 2 Explains how the data is sent and received based on the slot allocated for each node ,Where the slots required for the sink node is according to the number of children in the topology ,when the node is the intermediate node the β values transmits the data according the nodes priority ,α receives the data from β-1,finally if it is a leaf node no receiving is done since it has no children.

Priority Based slot assignment Algorithm2:

Begin
If it is a sink node // Sink node
Sink node s=$\sum_{chi}$n(chi) // slots are allocated according to ∑
Else if
Allocate slot according to the node // Intermediate Node
β->Transmits data according to the nodes priority
α->Received data from β -1 //Remaining slots are reserved for future use
Else
Allocate slot according to its β value // Leaf Node
//where α=0, since it is a leaf node it has no children
End

Mathematical Solution:

By considering the priority based constructed tree (Fig 2) calculation is carried out using the formula for the leaf, intermediate and the sink node. Slot required for each node is obtained and they are shown in the (fig 3).

Australian Journal of Basic and Applied Sciences, 8(16) October 2014, Pages: 11-17

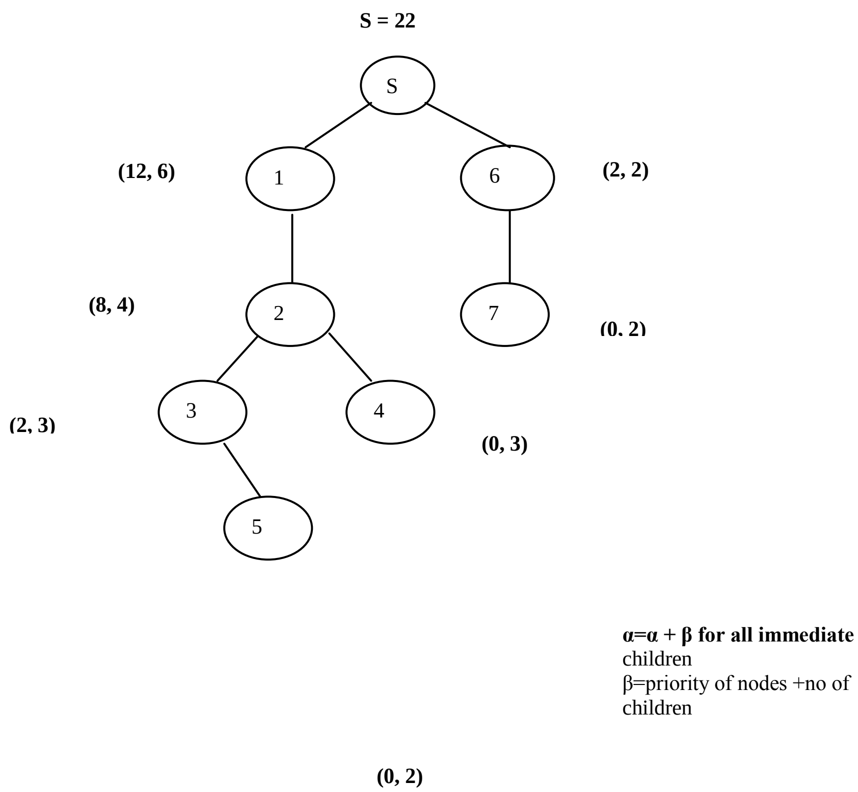

Fig. 3: Slot Calculated Tree

Calculation of priority for leaf node:

In the given topology the nodes 5, 4 and 7 are considered as leaf nodes. The node values are (α , β) where α = α + β, for all immediate children and β is the sum of priority of nodes and the number of children.

By calculation, using the formula

$L(i)=\sum_{chi}(n(chi),P(i))$

Priority values are calculated using the sensors inside the node. Based on this priority value, α and β are calculated.

L(5)=(0,2)
L(4)=(0,3)
L(7)=(0,2)

Calculation of priority for Intermediate node:

Intermediate node is calculated using the leaf node value where the priority of nodes is added is with the value of 1.

$M(i)=\sum_{chi}(n(chi),P(i)+1)$

For an intermediate node 3,
M(i)=(α,β)
M(3)=(2,3)0
α=2
β=3

Where, α is the sum of α and β of the leaf node 5(0,2), β is the nodes priority value added with 1,M(3)'s priority value is 2 added with 1.

k. Calculation for Slots required in Sink node: Sink node is calculated using the formula,
$s=\sum_{chi} n(chi)$

Where s is the summation of its immediate children. In the given example, immediate children are 1 and 6.
M(1)=(12,6)
M(6)=(2,2)

Australian Journal of Basic and Applied Sciences, 8(16) October 2014, Pages: 11-17

Therefore s=22.

Fig.3 shows how much slots are required for each node in the tree topology. α & β represent the sending and receiving slots for each node in the tree .Example consider node 2 the α & β values are (8,4) .Number of slots required for sending is 4 ,Receiving sots required for receiving is 3 as per the Algorithm 2. Similarly this process is carried out for the other nodes in the tree. When it is a leaf node the α is zero since it has no children so no receiving is carried out .Reservation of slots are also done in each node by considering the sending and receiving slot requirement. Ref Fig.4.

Slot Assignment:

Tree structure is formed by considering the priority values that are arrived at the sensors and the nodes communicate the data from the leaf towards the sink node .The mathematical solution explains how the assignment is done for the leaf, intermediate and the sink node.

Total numbers of slot that are calculated are 22 which are considered as a frame. The sending, receiving and reserving for next use is shown in the fig 4.Assignment of slot based on priority .Nodes requirement is displayed in the tree as α and β, where β represents the sending slot requirement and α is the value which is the sum of the all the children values. Receiving slot is calculated by minus of the number of slots in the β.

In assignment of slot based on priority, the nodes sending and receiving is shown in a way the data transmission is carried out in the reliable manner .for example consider the node 5 (0, 2).The number of slots for sending is two and no receiving is carried out, sending process is carried out in the first two slots in the frame.

Similarly for the node such 3 and 4 the value sending required is 3 slots and receiving is 2 slots, Parent node the above mentioned node is 2 and the sending slots required is 4 and receiving is 3 and reserving is 1. All the children of the node 2 complete its process of sending and receiving with in node 2 starts its sending process.

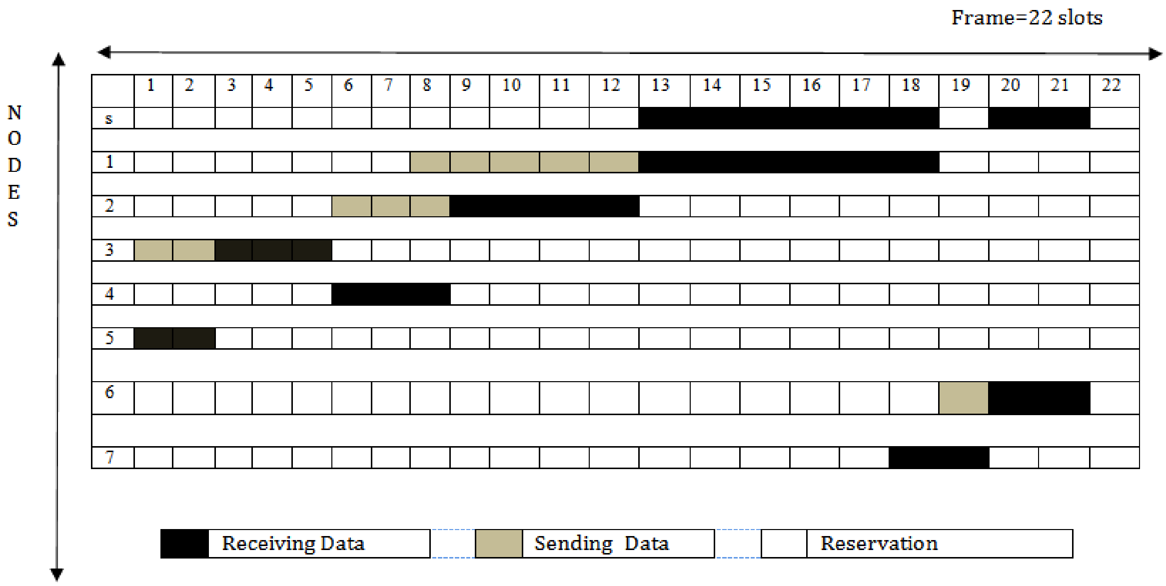

Fig. 4: Assignment of slot based on priority

Conclusion:

Slot assignment is carried out based on priority for each node in the tree .Each node in the tree represents the number of slots required for each node. This paper creates a slots required for sending, receiving and reserving for next use is allocated with the total number of slots that is calculated using the mathematical model ,by comparing the various algorithm such as FSA, DSA. The Priority based slot assignment algorithm gives the reliable data transmission based on the priority of the nodes. This way of slot assignment results in efficient channel utilization based on priority and balanced power consumption. Future study may include reducing the slots wastage.

REFERENCES

Baljeet Malhotra, Ioanis Nikolaidis, Mario A. Nascimento, 2011. Aggregation Converge cast Scheduling in Wireless Sensor Networks. Journal of Wireless Networks, 17(2): 319-335.

Dazhi Chen., Pramod K. Varshney., 2004. QoS Support in Wireless Sensor Networks: A Survey, Proc. of International Conference on Wireless Networks.

Akyildiz F. et al., 2002. Wireless Sensor Networks: A survey, Computer Networks, 38: 393-422.

Hoon Kim., Sung-Gi Min., 2009. Priority-based QoS MAC protocol for wireless sensor networks, IEEE International Conference on Pervasive Computing and Communications, 1-6.

Hoon Oh., Trung-Dinh Han., 2012. A demand-based slot assignment algorithm for energy-aware data transmission in wireless sensor networks, Journal Wireless Networks, 18: 523-534.

IEEE 802.11 WG., 2002. Draft Supplement to Part 11: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Medium Access Control (MAC) Enhancements for Quality of Service (QoS), IEEE Std 802.11e/D3.3.2,.

Caccamo., M., L.Y. Zhang, L. Sha and G. Buttazzo, 2002. An Implicit Prioritized Access Protocol for Wireless Sensor Network, Proceedings of the IEEE Real-Time Systems Symposium.

Mohammad Hossein Yaghmee., Donald A. Adjeroh, 2008. A new priority based congestion control protocol for Wireless multimedia Sensor Networks. International symposium on the world of wireless mobile and multimedia networks, IEEE Computer society, pp: 1-8.

Mohammad Hossein Yaghmaee, Donald A. Adjeroh, 2009. Priority based rate control for service differentiation and congestion control in wireless multimedia sensor networks. The International Journal of Computer and Telecommunications Networking, 53(11): 1798-1811.

Ozlem Durmaz Incel., Amitabha Ghosh., Bhaskar Krishnamachari., and Krishna Kant Chintalapudi, 2009. Multi-Channel Scheduling for Fast Convergecast in Wireless sensor network. IEEE 6th International Conference, pp: 363-372.

Rajendran, V., K. Obraczka and J.J. Garcia-Luna-Aceves, 2006. Energy- efficient, collision-free medium access control for wireless sensor networks. Wireless Networks, 12(1): 63-78.

Thimma, V.J., Ganesh Babu., Tho Le-Ngoc and Jeremiah F. Hayes, 2001. Performance of a Priority-Based Dynamic Capacity Allocation Scheme for Wireless ATM Systems. IEEE journal on selected areas in communications, 19(2).

Ye, W., J. Heidemann, D. Estrin, 2002. An energy-efficient MAC protocol for wireless sensor networks. Proceedings of the Joint Conference of the IEEE Computer and Communications Societies (InfoCom), Vol. 3.

Ye, W., J. Heidemann and D. Estrin, 2002. An energy-efficient MAC protocol for wireless sensor networks. Proceedings of the 21st Conference of the IEEE Computer and Communications Societies, 3: 1567-1576.

Zlem Durmaz Incel., Amitabha Ghosh., Bhaskar Krishnamachari and Krishnakant Chintalapudi, 2012. Fast Data Collection in Tree-Based Wireless Sensor Networks. IEEE Transaction on Mobile computing, pp: 86-99.