IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.
PP 138-142
www.iosrjournals.org

Power Management in WSN using M-SPIN and SPIN Protocol

Sherin C George[1], Aparna M.S[2] ,Divya George[3]
[1]*M Tech Scholar, Embedded Systems, Sahrdaya College Of Engineering and Technology, India*
[2] *M Tech Scholar, Embedded Systems, Sahrdaya College Of Engineering and Technology, India*
[3]*M Tech Scholar, Embedded Systems, Sahrdaya College Of Engineering and Technology, India*

ABSTRACT : *Power management is an major issue in wireless sensor networks (WSNs) because wireless sensor nodes are normally battery powered, and the systematic use of the available battery power becomes an important concern specially for those applications where the system is likely to function for lengthy periods[13][11]. This requirement for energy efficient operation of a WSN has given rise to the development of novel protocols in Data link layer of the communication layer. This paper presents the proposal of a energy efficient routing protocol called SPIN and M-SPIN and also discusses about the disadvantages of the protocols which was used before M-SPIN and SPIN protocol. The SPIN protocol achieves prolonged network lifetime by decreasing data redundancy and minimizes the number of collisions which set asides the energy required to re-transmit degraded data packets. M-SPIN protocol is an improved version of SPIN protocol that routes the packets through the shortest path possible and thus reduces power consumption.*

Keywords *- Flooding, Gossiping, M-SPIN, Power Management ,SPIN*

I. INTRODUCTION

Wireless sensor network (WSN) refers to a collection of spatially spread and committed sensor nodes for observing and recording the physical circumstances of the environment and also for arranging the collected data at a central location. WSN computes various environmental conditions like temperature, wind speed direction, sound, pollution levels, pressure and humidity[2]. A WSN comprises of a few tens to thousands of sensor nodes. A sensor node comprises of sensors to sense the surroundings, processor to process information received from the sensors, communication unit to transfer information to neighboring nodes or base station, and an onboard power supply to deliver energy to other units of the sensor node[5][15].

A wireless sensor network with a huge number of small sensor nodes can be used as an active tool for gathering data in various situations. One of the important issues in wireless sensor networks is creating an energy-efficient routing protocol which can appreciably improve the overall lifetime of the sensor network. Various protocols have been designed to overcome this problem. In this paper we propose SPIN protocol and a modified version of SPIN protocol named M-SPIN protocol. Here we point out the differences in the performance level of two protocols. We find that, M-SPIN displays significant performance gains than traditional SPIN routing. The Processing unit of the sensor node is implemented using Spartan 3A belonging to Xilinx (FPGA) family.

II. EXISTING PROTOCOLS

2.1 FLOODING

In this we start with a source node sending its data to all of its neighbors. On receiving a segment of data, each node then stores and forwards a copy of the data to all of its neighbors. This is therefore a simple protocol requiring no protocol state at any node [3].

- *Overlap*
- *Implosion*
- *Resource blindness*

2.2 GOSSIPING

In Gossiping [2][3] packet is send to the arbitrarily selected neighbor which selects another random neighbor to forward the data and so on. Its benefit is that it eludes implosion and saves energy since packets are send only to one of the neighbors in its place of sending to all. However this causes delay in propagation of data amongst nodes.

III. SPIN PROTOCOL

Sensor Protocols for Information via Negotiation was designed to improve classic flooding protocols. It fit under data delivery model in which the nodes sense data and disseminate the data through the network by means of negotiation. SPIN nodes use 3 types of messages for information transfer[19]:

- ADV-When a node has new details to share; it can advertise this using ADV message containing Metadata.
- REQ-Node forwards an REQ when it needs to receive real data.
- DATA-DATA message carries real data

The SPIN [3] family of protocols integrates two key innovations that overcome deficiencies: negotiation and resource-adaptation [3].To overcome the troubles of implosion and overlap, SPIN nodes discuss with each other before transmitting data.

3.1 SPIN MESSAGES

SPIN nodes use 3 types of messages for communication:

- ADV-When a node has new details to share; it can advertise this using ADV message containing Metadata.
- REQ-Node forwards an REQ when it wants to receive real data.
- DATA- contains real data

Because ADV and REQ messages hold only metadata, they are smaller, and cheaper to send and receive, than their parallel DATA messages [19].

3.2 SPIN FAMILY OF PROTOCOLS

Heinzelman et al.and jyoti et al. in [19],[21],[8] proposed a family of flexible protocols called Sensor Protocols for Information via Negotiation (SPIN) that distribute all the information at each node to every node in the network supposing that all nodes in the network are capable BSs. This permits a user to enquire any node and get the necessary information instantly. These protocols make use of the characteristic that nodes that are closer to each other have similar data, and hence there is a need to only disseminate the data other nodes do not have. SPIN [16] is a negotiation-based information dissemination protocol apt for WSN. It is based on the thought of metadata. The SPIN family of protocols uses data negotiation and resource-adaptive procedures. Nodes running SPIN assign a top-level name to completely define their collected data (called meta-data) and perform metadata negotiations beforehand any data is sent. This ensures that there is no unnecessary data sent throughout the network. The semantics of the meta-data format is application-dependent and not specified in SPIN. For example, sensors may use their unique IDs to report meta-data if they cover a certain recognized region. In addition, SPIN has access to the present energy level of the node and adjusts the protocol it is running based on how much energy is left behind. These protocols work in a time-driven fashion and disseminate the information all over the network, even when a user does not demand any data. The SPIN family is aimed to address the deficiencies of classic flooding by negotiation and resource adaptation. The SPIN family of protocols is formed based on two basic ideas: 1) Sensor nodes operate more efficiently and save energy by transmitting data that define the sensor data instead of transmitting all the data; for eg, image and sensor nodes must observe the changes in their energy resources. 2) Normal protocols like flooding or gossiping-grounded routing protocols [22] waste energy and BW when transmitting additional and needless copies of data by sensors covering intersecting areas. The disadvantages of flooding include implosion, which is due to duplicate messages transmitted to the same node, coincide when two nodes sensing the identical region send related packets to the same neighbor, and resource blindness is consuming huge amounts of energy without consideration for energy restrictions. Gossiping avoids the problem of implosion by just choosing a random node to which the packet is sent rather than broadcasting the packet carelessly. However, this causes delays in circulation of data through the nodes. SPIN's meta-data negotiation eliminates the classic problems of flooding, thus accomplishing a lot of energy efficiency. SPIN is a three-stage procedure as sensor nodes use three types of messages, ADV, REQ, and DATA, to communicate. ADV is used to publicize new data, REQ to demand data, and DATA is the real message itself. The protocol starts when a SPIN node obtains fresh data it is willing to share. It does so by spreading an ADV message containing Meta data. If a neighbor is concerned in the data, it sends a REQ message for the DATA and the DATA is sent to this neighbor node. The neighbor sensor node then echoes this process with its neighbors. As a outcome, the entire sensor area will receive a duplicate of the data. One of the benefits of SPIN is that topological changes are localized since each node must know only its single-hop neighbors. SPIN offers more energy reserves than flooding, and metadata negotiation almost go halves on the redundant data. However, SPIN's data advertisement mechanism cannot promise delivery of data. The SPIN family of protocol is formed of four protocols, SPIN-PP, SPIN-BC, SPIN-RL, SPIN-EC and a modified SPIN (M-SPIN).

SPIN-PP-The first SPIN protocol, SPIN-PP, is enhanced for networks using point-to-point communication media, where it is likely for nodes A and B to communicate exclusively with each other without indulging other nodes. In such a point to point wireless system, the price of communicating with n adjacent nodes in terms of time and energy is n times the price with the data of node A and send advertisements of the combined data to all of its neighbors[19].

SPIN EC-The SPIN-EC protocol adds a modest energy-conservation to the SPIN-PP protocol. When energy is abundant, SPIN-EC nodes transfer using the same three-phase protocol as SPIN-PP nodes. When a SPIN-EC node realizes that its energy is approaching a low-energy edge, it adapts by decreasing its contribution in the protocol [19].

SPIN-BC-In broadcast transmission media, nodes in the system communicate using a sole, shared channel. As a result, when a node transmits a message in a lossless, symmetric broadcast network, it is accepted by all nodes within a definite range of the transmitter, irrespective of the message's endpoint.

SPIN-RL, a trustworthy version of SPIN-BC, can distribute data ably through a broadcast network, even if the network misses packets. The SPIN-RL protocol integrates two adjustments to SPIN-BC to achieve trustworthiness. First, each SPIN-RL node retains trail of which advertisements it gets from which nodes, and if it does not receive the data within a definite period of time following a demand, the node rerequests the data. It fills out the originating-advertiser field in the header of the REQ message with a endpoint, arbitrarily picked from the list of adjacent nodes that had advertised that definite piece of data. Second, SPIN-RL nodes reduces the frequency with which they will resend data.

IV. M-SPIN PROTOCOL

In few situations we need quick and reliable responses. Suppose in forest fire warning system, immediate response is needed before any accident occurs. In this case, it is desirable that data must be propagated towards the sink node very fastly. M-SPIN [1] routing protocol is better approach for such type of situations than SPIN.

In our proposed protocol, we add a new stage called Distance discovery stage to find distance of each sensor node in the network from the sink node in relations of hops. This means that nodes having greater value of hop distance are far-off from the basin node. *Negotiation* and *Data transmission* are two other phases of M-SPIN., *Negotiation* is done for sending an actual data on the basis of hop distance. Therefore, use of hop value limits dissemination of data in the network. Finally, data is sent to the sink node[1].

4.1 DISTANCE FINDING PHASE

The *Distance finding*[1] phase of M-SPIN is described below. Hop distance is estimated from sink nodes. At first the sink node transmits *Startup* packet in the network with *type, node Id* and *hop*. Here *type* intends type of messages. The *node Id* means id of the sending node and *hop* means hop distance from the sink node. Initial value of *hop* is made to 1. A sensor node stores the hop value as its hop distance from the sink node in memory after the reception of startup packet. After storing the value, the sensor node increases the hop value by 1 and then re-transmits the *Startup* packet to its adjacent nodes with modified hop value. It can also be possible for a sensor node to receive multiple *Startup* packets from different intermediate nodes. The hop distances are verified and the distances are set to the minimum, whenever a sensor node *b* receives *Startup* packets from its neighbors ai, $1 \le i \le n$ i.e[1].

Where $h(ai,b)i$, denotes hop distances in the middle of the nodes ai and b and n is the number of adjacent nodes of node *b* starting from which it accepts the startup packets. This process is unrelenting until every node in the network receives the Startup packets at least one time within the Distance discovery phase. After fruitful completion of this phase, subsequent phase will be taking place for negotiation.Some of the variables and structures used by the Distance finding and Negotiation phase is described below. *Startup Msg* arrangement holds three member variables. *Hop Table* structure has only one member called hop_t to hold the hop value at each node[1].

4.2 NEGOTIATION PHASE

The *Negotiation* stage is almost similar to the SPIN-BC protocol. The source node transmits an ADV message.On receiving an ADV message, each adjacent node verifies whether it has already received or requested the advertised data. Not only that, receiver node also verifies whether it is nearer to the sink node or not in comparison with the node that has sent the ADV message. This is the main difference between the negotiation phase of SPIN_BC and that of M-SPIN[1]. If hop distance of the receiving node (own_hop) is less than the hop distance received by it as part of the ADV message (rcev_hop), i.e.*own_hop < rcev_ho*p, then the receiving nodes send REQ message to the sending node for current data. The sending node then sends the actual data to the requesting node using DATA message. Figure 5 shows pseudo code of the *Negotiation* phase.As soon as a node gets data either from its own application or from other sensor nodes, it stores that data in its memory using the function *storepacket*. Also it uses *setCurrent* function to specify which data is presently residing in its memory. When ADV message is received, then each receiving node first checks its record to ascertain whether it already has seen that data using the function *checkHistory*. Moreover, it calls *setDesired* to indicate which DATA packet it is waiting for.The source nodes which receive the REQ use the function *getCurrent*. It helps to determine whether the received REQ isfor the stored data specified by the *setCurrent* function for which the node has sent the ADV. When a requesting node receives any data, it immediately checks whether the data is the same for which it has sent the request using *getDesired* function. The data packet contains the hop distance value along with the information about the event[1].

4.3 INFORMATION TRANSFER PHASE

Information transfer[1] stage is similar as SPIN-BC protocol.After request is received by the source node, data is immediately sent to the requesting node. If the requesting nodes are midway nodes other than the basin node then the Negotiation phase echoes. Thus, the midway sensor nodes broadcast ADV for the data with changed hop distance value. The transmitting nodes change the hop distance field with its own hop distance value and add that in packet format of the ADV message. The procedure lasts till data reaches the basin node[1].

V. CONCLUSION

In this paper, we have suggested a modified SPIN (M-SPIN) protocol using hop-count values of sensor nodes for WSN. Here also negotiation is completed before transmitting the actual data. But in our scheme, only the nodes which are nearer to sink node send REQ packets in reply to ADV packet from the source node. Therefore data is disseminated to the sink or neighbor nodes towards the sink node. M-SPIN achieves energy savings by discarding packet transmission to the opposite direction of sink node. But one crucial problem is that few sensor nodes may be used a number of times and those nodes may dissipate energy and may be damaged earlier than other nodes in the network. In future it may be possible to work on this problem associated with M-SPIN protocol and provide a better solution for it[1].

REFERENCES

[1] Zeenat Rehena,Sarbani Roy,Nandini Mukherjee ,"A modified spin for wireless sensor networks",IEEE paper,2011.
[2] Geetika Dhand,Dr.S.S.Tyagi,"Survey on data-centric protocols of wsn", International Journal Of Application Or Innovation In Engineering & Management (IJAIEM), Volume 2, Issue 2, February 2013
[3] Amitoj Kaur, Gursimrat Singh, Jagroop Kaur," Spin: A Data Centric Protocol For Wireless Sensor Networks", International
[4] Journal Of Engineering Research & Technology (IJERT),Vol. 2 Issue 3, March – 2013
[5] Ali Elkateeb,"Soft-core processor design for sensor networks nodes", International Journal Of Computer Networks & Communications (IJCNC) Vol.3, No.4, July 2011
[6] Ali El Kateeb, Aiyappa Ramesh, and L. Azzawi," Wireless sensor nodes processor architecture and design", ieee paper, 2008
[7] Geetu,Sonia Juneja,"Performance Analysis Of SPIN and LEACH Routing Protocol in WSN, International Journal Of Computational Engineering Research (IJCER) Vol. 2 Issue. 5 ,September 2012
[8] W. Heinzelman ,Joanna Kulik, and Hari Balakrishnan, "Adaptive Protocols For Information Dissemination In Wireless Sensor Networks", Proc. 5th ACM/IEEE Mobicom, Seattle, WA, Aug. 1999. pp. 174–85
[9] Philip Levis, Nelson Lee, Matt Welsh and David Culler,TOSSIM: Accurate And Scalable Simulation Of Entire Tinyos Applications.
[10] Theodore Zahariadis, Helen Leligou, Panagiotis Karkazis, Panagiotis Trakadas, Ioannis Papaefstathiou, Charalambos Vangelatos, Lionel Besson, "Design and implementation of a trust-aware routing protocol for large wsns", International Journal of Network Security & Its Applications (IJNSA), Vol.2, No.3, July 2010
[11] Madhu Rani, Arvind kumar ,"Review on Data Dissemination over Wireless Sensor Networks",International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 2, Issue 2, February 2013
[12] Ranjana Thalore , Jyoti Sharma , Manju Khurana , M.K. Jha," Qos Evaluation Of Energy Efficient Ml-Mac Protocol For Wireless Sensor,Elsevier paper,2013

[13] Neha Rathi, Jyoti Saraswat and Partha Pratim Bhattacharya,”A Review On Routing Protocols For Application In Wireless Sensor Networks”, International Journal Of Distributed And Parallel Systems (IJDPS) Vol.3, No.5, September 2012

[14] Manju, Ranjana Thalore, Jyoti, M.K Jha,Performance Evaluation of Bellman-Ford, AODV, DSR and DYMO Protocols using QualNet in 1000m×1000m Terrain Area , InternationalJournal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-6, January 2013

[15] Joanna Kulik,Wendi Heinzelman,Hari Balakrishnan,”Negotiation Based Protocols for Disseminating Information inWireless Sensor Networks”, Wireless Networks ,Kluwer Academic Publishers.

[16] http://onlinelibrary.wiley.com/doi/10.1002/wcm.743/abstract

[17] http://www.ijsce.org/attachments/File/v2i6/F1126112612.pdf

[18] Jyoti,Harkesh Sehrawat,Devender Sharma,”Energy Efficient M- SPIN Protoco”l,IJSER,Vol 3,issue 10,October 2012

[19] Jamal N. Al-Karaki, Ahmed E. Kamal**,”**Routing Techniques In Wireless Sensor Networks: A Survey**”**,IEEE Wireless Communications, December 2004.

[20] J. Kulik, W. R. Heinzelman, and H. Balakrishnan, “Negotiation- Based Protocols for Disseminating Information in Wireless Sensor Networks,” Wireless Networks, vol. 8, 2002, pp. 169–85

[21] S. Hedetniemi and A. Liestman, “A Survey of Gossiping and brocadcasting in Communication Networks,” IEEE Network, vol. 18, no. 4, 1988, pp. 319–49