ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

ICRITCSA

M S Ramaiah Institute of Technology, Bangalore

Vol. 5, Special Issue 2, October 2016

Energy Efficient and Reliable Routing Protocols In Wireless Sensor Networks- An Outlook

Waseem Ahmad Mir[1], Jameel Ahmad[2]

Student M-Tech, Department of CSIT, Maulana Azad National Urdu University, Hyderabad, India [1]

Assistant Professor, Department of CSIT, Maulana Azad National Urdu University, Hyderabad, India [2]

Abstract: Wireless sensor networks are enabling applications that previously were not practical. As new standards based networks are released and low power systems are continually developed, we will start to see the widespread deployment of wireless sensor networks in future. One of the pioneering aspects of WSNs is to provide reliable and efficient routing protocols as the networks cannot afford to waste energy at any cost and in addition to energy conservation life time of the nodes is also of primary concern. In this paper energy efficient routing protocols have been divided into four categories: Network Structure, Communication Model, Topology Based and Reliable Routing.

Keywords: Wireless Sensor Networks, Reliability, Efficiency, Routing Protocols.

I. INTRODUCTION

With the advent of Micro Electrical Mechanical Systems (MEMS), there has been an ever increasing scope for Wireless Sensor Networks. Efficient design and implementation of wireless sensor networks in the recent years have enabled their application in potentially vast fields connecting physical world to the virtual world. Sensor Networks comprises of a large number of tiny sensor nodes usually spread over wide area networked in such a manner that individual sensor nodes sense and collect data, and then transmit the processed data via neighboring nodes to the primary communication module called the sink. Sensor Networks are operation specific. Their applications span over vast areas which include household equipment, environmental applications, scientific research, military, disaster relief and rescue, health care etc. Recently, researchers have realized that to extract more realistic and precise information of the fast changing events in the real world, the abilities of traditional sensor nodes should be enhanced. So evidently, the growing pace of technological demand has worked as the driving force for designing sensors capable of sensing and producing multimedia data [1].

One of the limitations of the Wireless Sensor Networks is their inherited limited energy resources. The size of the nodes being small makes them incapable of storing large amounts of energy. Further the sensors many times are employed in harsh environmental areas where manual replacement of energy resources is practically impossible.

In addition to this constraint sensor nodes are expected to work for large amount of time in such areas, which makes their design more complex. Hence energy efficiency in Wireless Sensor Networks is hot area of research. Many solutions have been proposed to overcome these constraints which can broadly be divided into Hardware and Networking solutions. As far as Hardware solutions are concerned research is going on to equip sensor nodes with batteries which could last longer. One such approach recently employed is the use of piezoelectric devices, which has obtained good results. It is worth to mention here that hardware solutions can only help in conserving energy in the processing only, but large amount of energy which is consumed in WSN is in the process of communication. Therefore there is need to develop energy efficient protocols for communication of processed data.

In this paper, we have tried to analyse different protocols developed WSN. From the set of Protocols we have tried to focus on the protocols which have been specially designed to address the problem of energy efficiency and reliability of WSNs. Broadly, the energy efficient protocols in WSNs can be divided into four categories.

1) Network structure based protocols
2) Communication model based routing
3) Topology based routing
4) Reliable Routing

These protocols are further subdivided into many types which are below given in figure 1 below.

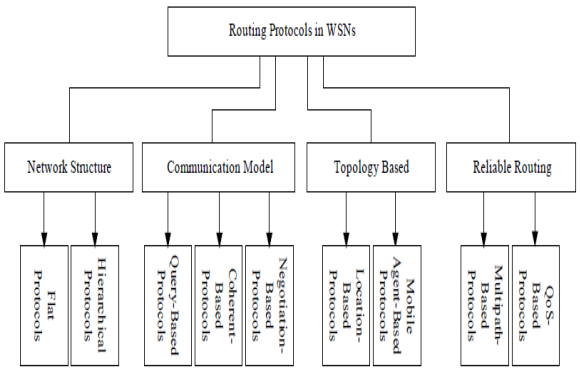

Figure 1Routing Protocols in WSN

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

ICRITCSA

M S Ramaiah Institute of Technology, Bangalore

Vol. 5, Special Issue 2, October 2016

II. ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORKS

A high efficient routing scheme will offer significant power cost reduction and will improve network longevity. Finding and maintaining routing in WSN is a major issue since energy constraints and unexpected changes in node status (e.g. inefficiency or failure) give rise to frequent and unforeseen topological alterations. Routing techniques proposed in the literature for WSNs employ some well-known routing tactics, suitable for WSNs, to minimize energy consumption [2]

1. Network Structure based Protocols:

Nodes can either be deployed uniformly (considered to be equal to each other) or may be deployed with certain distinctions, focusing mainly on the way in which nodes are interconnected. It can further be divided into following categories.

a) **Flat Protocols:** Nodes are deployed uniformly and thus play the same role. Main advantage of this deployment is minimal overhead.
b) **Hierarchical Protocols:** Nodes are deployed distinctly (no uniformly) in the form of clusters. The node with high energy is usually the cluster head. The cluster head is responsible for coordination between the nodes.

Table 1 summarizes different protocols developed in this category and eventually focus on the protocols which are reliable and energy efficient.

2. Communication based Routing Protocols:

Communication model is designed in such a way that main operation of the protocol is followed in order to route data packets in the network. More data can be delivered on a given amount of energy. Theoretical optimum in case of point to point and broadcast network can be reached in terms of energy dissemination rate.

Table 1 Network Structure Based Protocols

ROUTING PROTOCOL TYPE	PROTOCOL NAMES	Energy Efficient and Reliable Protocols	Advantages	Drawbacks	Parameters			
					Scalability	Mobility	Route Metric	Robustness
FLAT ROUTING	WRP,TBRPF,TORA,Gossiping,Flooding,RR,E-Tora,ZRP	TORA: Temperory Ordered Routing Algorithm	Minimizes Communication overload,Supports multiple routes and multicast	Doesnot multicast into basic operation	Good	Good	Shortrest Path	Low
		E-TORA: Energy Efficie	Minimizes the energy consumption and results to balance of energy consumption of nodes	Doesnot multicast into basic operation	Good	Good	Best Route	Low
Hierarchial Protocols	LEACH,LEACH C,PEGASIS,TEEN,APTEEN,VGA,TTDD,BCDCD,MIMO,HPAR,SLEEP/WAKE,GBDD,ELCH,	LEACH: Low energy Adhoc Cluster Heirarchy	Low energy, ad-hoc,	It is not applicable to networks deployed in large regions and the dynamic clustering brings extra overhead	Good	Fixed BS	Shortrest Path	Low
		VGA: Viral Grid Archite	It may achieve energy efficiency and maximization of network lifetime	The problem of optimal selection of local aggregators as master aggregators is NP- hard problem	Good	No	Greedy route selection	Good
		HPAR: High Power aware Routing	Takes into considerationboth transmitted power and minimum battery power of the node in the path	The discovery of the power estimation may result on the overhead to the network	Low	No	Intially Shortest path then optimization	Good

The main drawback of this system is that high delivery rate for data cannot be ascertained. The protocols on this scheme can be classified as follows:

a) **Query based protocols**: A query is propagated from destination (sink node) for sensing data task. The node having the required sensed data sends the data upon matching the query initiated by the destination node.
b) **Coherent and Non coherent Protocols:** Coherent means data is forwarded to aggregators after some processing (usually minimum processing). In non coherent based protocol scheme raw data is locally processed (maximum processing) and then sent to the destination node (sink).
c) **Negotiation based Routing**: Here redundant transmissions are reduced by the use of Meta data negotiations.

Table 2 highlights the protocols of this category and specially focuses on energy efficient and reliable protocols of this category

Table 2 Communication Based Routing Protocols

ROUTING PROTOCOL TYPE	PROTOCOL NAMES	Energy Efficient and Reliable Protocols	Advantages	Drawbacks	Parameters			
					Scalability	Mobility	Route Metric	Robustness
Query Based Routing	DD, COGAR,ACQUIRE	COUGAR	It provides energy efficiency when generated data is huge	Overhead, complexity of the synchronization in network data computation	Good	Limited	Best Route	Low
COHERENT AND NON COHERENT	SWE. MWE	MWE: Multiwinner Algorithm	Each sensor in the network has a set of minimum-energy paths to each source node	Long delay and low scalability	Low	Low	Shortrest Path	Low
Negotiation Based Routing	SPIN,PP,SPIN EC,SPIN BC,SPIN RL	SPIN EC: Sensor Protocols for Information via Negotiation	Whenever energy comes close to low-energy threshold, it adapts by reducing its participation	It does not prevent nodes from receiving messages such as ADV or REQ below its low-energy threshold	Good	Yes	Single Hop	Good

3. Topology Based Routing:

Topology-based protocols use the principle that every node in a network maintains topology information and that the main process of the protocol operation is based on the topology of the network [3]. The protocols on this scheme can be further classified as follows:

a) **Location based Routing Protocols**: In location-based protocols sensor nodes are addressed by means of their locations. Location information for sensor nodes is required for sensor networks by most of the routing protocols to calculate the distance between two particular nodes so that energy consumption can be estimated [4]. In location-based protocols, sensor nodesare addressed by means of their locations. Location information for sensor nodes is required for sensor networks by most of the routing protocols to calculate the distance between two particular nodes so that energy consumption can be estimated [5].
b) **Mobile agent based Protocols:** Positioning Mobile agents in the optimal locations for performing application-specific tasks. Thus saving energy by bringing computation to the data rather than requiring that the data be sent over unreliable wireless links.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering

ICRITCSA

M S Ramaiah Institute of Technology, Bangalore

Vol. 5, Special Issue 2, October 2016

Thus increasing the utility of a WSN. Agilla programs to control where mobile agent go and to maintain both their code and state across migrations[6]

Table 3 elaborates the Topology based routing techniques. The energy efficient routing protocols with their advantages and drawbacks are also shown in the table.

Table 3 Topology Based Routing Protocols

ROUTING PROTOCOL TYPE	PROTOCOL NAMES	Energy Efficient and Reliable Protocols	Advantages	Drawbacks	Parameters			
					Scalability	Mobility	Route Metric	Robustness
Location Based Routing	DREAM, GEAR,GEM,IGF,SELAR,GDSTR,MERR, OGF,PAGERM,HGR	DREAM: Distance Routing Efficient Algo for Mobility	Efficient data packet transmission	The waste of network Bandwidth	Limited	Good	Minimum Power Route	Limited
		MERR: Minimum Energy Relay Routing	Uniform Distribution of Energy across Nodes	Energy is wasted if nodes are closer to each other	Limited	Low	Minimum Power Route	Good
MOBILE AGENT BASED	MIP,IEMF/IEMA	MIP:Multi-agent based Itinerary Planning	Minimizes energy when no of nodes is large	High Delay	Limited	Good	Minimum Power Route	Good

2. **Reliable routing:** This scheme of protocols achieves load balancing routes by satisfying some QoS metrics like delay and bandwidth proving to be more plaint and resilient. The protocols are classified as follows.

a) Multipath based Protocols: They achieve load balancing and are more resilient to route failures.
b) QoS based Protocols: In addition to minimizing energy consumption, due consideration should be given to quality of services requirements in terms of delay, reliability, and fault tolerance in routing WSNs. These protocols create a balance between energy consumption and QoS requirements.

Following table 4 shows some of the Protocols designed under this category and emphasizes on the energy efficiency and reliability.

Table 4 Quality of Service based Routing Protocols

ROUTING PROTOCOL TYPE	PROTOCOL NAMES	Energy Efficient and Reliable	Advantages	Drawbacks	Parameters			
					Scalability	Mobility	Route Metric	Robustness
Multipath based Routing	ROAM,LMR,GRAB,HMRP,CBMPR,DGR,DCF,RPL	RPL: Routing Protocol for Low and Lossy Networks	Low energy consumption	Supports only Unicast	Good	Good	Shortrest Path	Good
QOS Based Routing	SAR,SPEED,MMSPEED,MGR	SAR:	Low energy consumption and maintains multipath to destination	Overhead maintaining tables and states at each node when node size is large	Limited	No	Average	Low

Keeping in view the above mentioned outcomes and constraints, there is a need for improvement in self adaption as far as Energy-Balanced cross-layer Optimization is concerned. There are frequent transient faults in WSNs when they are employed in harsh environmental conditions; therefore there is scope for improvement as far as reliability and energy efficiency is concerned [7].

III. CONCLUSION

The WSNs have gained wide popularity and have increased tremendously in recent time due the growth in Micro Electrical Mechanical Systems (MEMS) technology. Many researchers have proposed different protocols for energy efficient and reliable routing in WSNs. As new standards based networks are released and low power systems are continually developed, we will start to see the widespread deployment of wireless sensor networks. Sensor nodes can be imagined as small computers, extremely basic in terms of their interfaces and their components. The new trends in energy efficiency and reliability can be better understood by looking into the parameters that are being analysed using different protocols in the recent past. In computer science and telecommunications, wireless sensor networks are an active research area with numerous workshops and conferences arranged each year [8]. All of this sensor network research is producing a new technology which is already appearing in many practical applications. The future should see an accelerated pace of adoption of this technology and with this growth protocol design and development has its own scope.

REFERENCES

[1] Ehsan, Samina . Hamdaoui, Bechir "A Survey on Energy- Efficient Routing Techniques with QoS Assurances for Wireless Multimedia Sensor Networks" IEEE COMMUNICATIONS SURVEYS & TUTORIALS, VOL.14, NO. 2, SECOND QUARTER 2012.

[2] Nikolaos A. Pantazis, Stefanos A. Nikolidakis and Dimitrios D. Vergados, Senior Member, IEEE "Energy-Efficient Routing Protocols in Wireless Sensor Networks: A Survey" IEEE COMMUNICATIONS SURVEYS & TUTORIALS, VOL. 15, NO. 2, SECOND QUARTER 2013

[3] Goyal, Deepak. Tripathy, Malay Ranjan." Routing Protocols in Wireless Sensor Networks: A Survey" 2012 Second International Conference on Advanced Computing & Communication Technologies

[4] Nikolaos A. Pantazis, Stefanos A. Nikolidakis and Dimitrios D. Vergados, Senior Member, IEEE "Energy-Efficient Routing Protocols in Wireless Sensor Networks: A Survey" IEEE COMMUNICATIONS SURVEYS & TUTORIALS, VOL. 15, NO. 2, SECOND QUARTER 2013

[5] Shio Kumar Singh, M P Singh, D K Singh "Routing Protocols in Wireless Sensor Networks –A Survey", International Journal of Computer Science & Engineering Survey (IJCSES) Vol.1, No.2, November 2010

[6] J. Yick, B. Mukherjee, D. Ghosal, "Wireless Sensor Network Survey," Computer Networks, 2008, Vol. 52, Issue 12, pp. 2292-2330.

[7] Jiang, D., Ying, X., Han, Y. et al. Wireless Pers Commun (2016) 86: 901. doi:10.1007/s11277-015-2961-6; "Collaborative Multi-hop Routing in Cognitive Wireless Networks"; January 2016, Volume 86, Issue 2, pp 901– 923

[8] Lan Bing., li, Bingbing., li,Xiang.; "Energy efficient routing protocol of wireless sensor network", paper published in "COMPUTER MODELLING & NEW TECHNOLOGIES 2014 18(12B) 580-584", Xidian University, Shanxi, Xi'an, 710071, China