Survey on Performance factors in Wireless Sensor Networks

Apurva Pathak[#1], Manisha Bhende[*2]

[#]*Department of Computer Engg.*
Pad. Dr. D.Y. Patil Institute of Engineering and Techology, Pimpri, Pune
Pune, India
[*] Department of Computer Engg.
Pad. Dr. D.Y. Patil Institute of Engineering and Techology, Pimpri, Pune
Pune, India

***Abstract*— The Wireless Sensor Network has been an active research area over past few years. The diversity in the applications used in wireless sensor networks represents its great success. There are different characteristics of the topologies used in routing method. According to these characteristics the parameters of the network are also get affected. The parameters affected by the routing are performance of network, functional lifetime of network, QoS of network. In this paper we have considered different characteristics and the effect of these characteristics on the existing system.**

***Keywords*— Wireless sensor network; energy; performance; lifetime.**

I. Introduction

Wireless Sensor networks(WSN) are getting lots of popularity in recent years due to their wide applications like military and disaster surveillance, industrial product line monitoring, agriculture and wildlife observation, healthcare, smart homes etc. A large number of sensor nodes working together collect information from the environment and then transmitting this data to a base station forms the sensor network. A wireless sensor network is design for sensing and processing parameters like temperature, humidity and sound. After sensing data sensor nodes sends it through wireless channels. The sensor node structure is shown on figure 1.

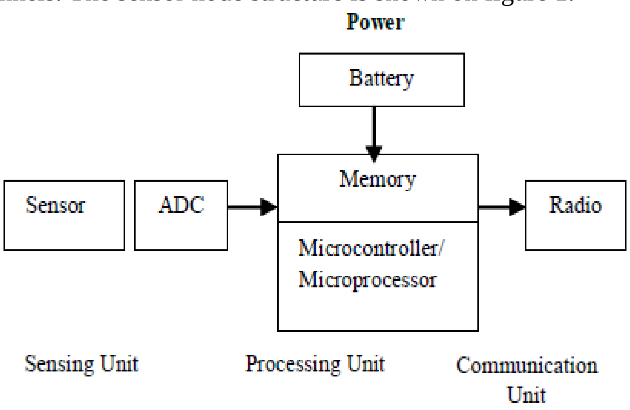

Fig 1: Sensor Node Structure

Basically, each sensor node consists of sensing, processing, transmission, mobilize, position finding system, and power units. Sensor nodes are usually scattered in a sensor field, which is an area where the sensor nodes are deployed. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor node bases its decisions on its mission, the information it currently has, and its knowledge of its computing, communication, and energy resources. Each of these scattered sensor nodes has the capability to collect and route data either to other sensors or back to an external base station. A base-station may be a fixed node or a mobile node capable of connecting the sensor network to an existing communications infrastructure or to the Internet where a user can have access to the reported data.

The main task of the wireless sensor networks is transmission of the data from the targeted source to the sink and the method used to do the data forwarding is an important issue which should considered in developing these networks. The high density of nodes, the routing protocols should route the data over long distances regardless of the network structure and size, in addition some active nodes may fail during the operations hue to the environment factors or energy depletion of sensor nodes or hardware faults but these issues should not interrupt the normal operations of the network. According to differences in the Wireless sensor networks various routing protocols were proposed over the few years to address the routing challenges introduced by the new features of the wireless sensor networks.

To improve the network life time, the technique which minimizes the energy consumption are required.

II. Issues in Wireless Sensor Network

A. Energy Conservation

Compared with competing highend technologies, e.g., personal computer, personal digital assistant, etc., sensor networks are known to be low cost, miniature, and easily deployed. These attractive merits, however, imply that resources available to each individual sensor node are severely limited. Although it is highly possible that constraints on hardware will disappear as fabrication techniques advance, the energy problem remains to be the victim of Moore's law since more transistors consume more power naturally.

B. Unstructured and Time-varying Network Topology

In principle, sensor nodes in the network might be arbitrarily placed in the field; hence, the underlying topology graph that represents communication links between nodes is usually unstructured. Furthermore, due to node mobility and/or hardware failure, the network topology may vary as time goes by. Consequently, it is important to configure serials of networking parameters appropriately.

C. Scalability

Depending on the specific application requirement, WSNs could be composed of tens, hundreds, even thousands of sensors. Thus, the scalability of the proposed protocols used in the sensor network is also a critical issue.

D. Limited Bandwidth

Similar to other wireless multihop networks, WSNs are also characterized by the limited bandwidth available to each sensor node.

III. TOPOLOGY CONTROL

For understanding topology control first of all we have to know what is the meaning of the topology. The connectivity of the wireless network and the application of routing protocols to network are considered as topology. Topology influences important features of the network like resiliency and communication cost between nodes. Current research has established efficient network energy utilization as one of the fundamental research issues in wireless sensor networks. Controlling the topology of the network has emerged as an effective solution to the above problem. Like all other aspects of wireless sensor networks, topology control protocols have to be designed and implemented subject to a severe set of computational energy constraints.

The radio in a sensor node is the primary source of energy dissipation. The radio consumes power in all of its four phases of operation namely listening, idle, transmission and reception. Some common metrics that are used for performance measurement of routing protocols in wireless adhoc networks are number of packets dropped, overhead in terms of routing messages, number of hops etc. But, compared to traditional wired and wireless adhoc networks, wireless sensor networks should be primarily evaluated in terms of energy depletion of sensor nodes. Sensor nodes have limited battery sources, moreover once deployed there is seldom any means of recharging the battery of a sensor node in a hostile environment. These limitations make the above stated energy metric a primary concern. Choosing the approach to selectively switching off the radio of sensor nodes based on the availability of alternate routing paths is one way of optimizing the energy consumption in a wireless sensor network. Switching off the radio of the sensor nodes is only possible if the topology is configured in such a way that the network is not partitioned due to those inactive nodes. Thus effectively controlling the topology of the network emerges as a solution to the problem of energy conservation for wireless sensor networks.

Topology control protocols are designed to exploit node density in the network to extend the network lifetime and provide connectivity. The following criteria have been identified as the key concepts for designing topology control protocols for wireless sensor networks.

- To reduce the energy dissipated in the network topology control protocols should take advantage of the high node density in large-scale wireless sensor networks to reduce the energy dissipated in the network.
- To accommodate changing network dynamics sensor nodes should be able to self-configure.
- Redundant nodes should be selected based on distributed localized algorithms.
- Topology control protocols must possess minimum connectivity in the network, so that the network is not partitioned.

IV. TAXONOMY OF TOPOLOGY CONTROL

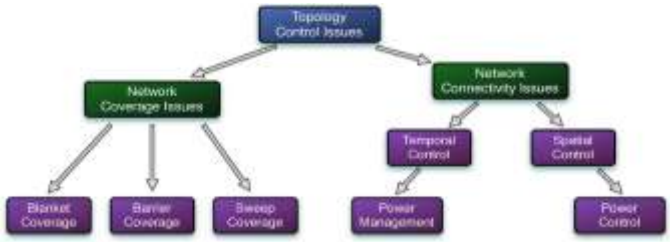

Fig 2: Taxonomy of topology control issues in WSNs

There are many issues in topology control. The two main issues are network coverage and network connectivity.

Network coverage means surveillance map of the target field which gives scenario of the sensor's placement position and communication among the sensors nodes. The quality of the coverage represents how capable the network can perform, according to network point of view.

Blanket coverage focuses on the sensing coverage of every point in the field. More precisely, each field position needs to be covered by at least on sensor node. In barrier coverage, people are interested in each crossing path, which is defined as a path that crosses the complete width of the belt-region-like field. In sweep coverage, whenever an event occurs, the sensor node that detects this event becomes a point of interest and records the sensory data in its local memory.

In network connectivity, two types of mechanisms have been utilized to maintain an efficient sensor connectivity topology: power management mechanisms and power control mechanisms.

TABLE I.
DIFFERENT PERFORMANCE FACTORS

Sr. No.	**Paper**	**Authors**	**Referred Algorithm**	**Characteris -tics**
1.	An Energy balanced routing method based on Forward Aware factor	Degan Zhang,, Guang Li, Ke Zheng, Xuechao Ming, and Zhao-Hua	BBV model, LEACH , EEUC	i)Balances energy consumption ii)Prolongs functional lifetime iii) High QoS
2.	A modified	Ioakeim K.	Device	i)Better

	DPWS Protocol stack for 6LoWPAN based WSN	Samaras, George D. Hassapis, and John V. Gialelis	Profile for Web Service	Performance
3.	Technique for Differential Timing Transfer Over Packet Network	James Aweya	TDM Technology	Differential clock recovery scheme
4.	A novel image de-noising method based on spherical coordinates system	Degan Zhang, Xuejing Kang and Jinghui Wang	Besov space norm theory	i)Simple ii)Effective
5.	Automatic Cluster Formation and Address Assignment for WSN	Prashant P.Rewagad, Harshal K.Nemade	ZigBee Scheme	i)Simple ii)Effective iii)Systematically Formation of Path
6.	Energy Efficient beaconless geographic routing in energy harvested WSNs	Oswald Jumira, Riaan Wolhuter and Sherali Zeadally	EBGR	i)Stateless ii)Loopfree iii)Energy Efficient
7.	A hybrid Multi-objective Evolutionary Approach for Improving the performance of WSNs	Flávio V. C. Martins, Eduardo G. Carrano, Elizabeth F. Wanner, Ricardo H. C. Takahashi, and Geraldo R. Mateus	Integer Linear Programming, Mono-Objective Approach	i)Improve Performance ii)Extend Lifetime
8.	On multipath Distances in Wireless Networks with Random Node Location	Serdar Vural, Member and Eylem Ekici,	Gaussian pdf	Distance Maximization
9.	Handling Inelastic Traffic in Wireless Sensor Networks	JiongJin Avinash Sridharan, Bhaskar Krishnamachari, and	CSMA MAC	i)Simplicity of queue backpressure ii)Low Complexity
		Marimuthu Palaniswami		
10.	Analysis of Per-Node Traffic load in Multi-Hop WSNs.	Quanjun Chen, Salil S. Kanhere, and Mahbub Hassan		Decreases Traffic load
11.	Scale-Free Networks: A Decade Beyond	Albert-László Barabási	./	

The table above gives the overview of the different algorithms studied by researchers. The authors in [1] have proposed the new algorithm called forward aware factor. Authors has considered BBV model for further network algorithms called LEACH and EUUC. By applying forward aware factor they have improved the performance as well as life time of the large scale networks.

A modified device profile for web services (DPWS) with its modified protocol stack is proposed in [2]. They gave the modification based on a new format for DPWS message exchanges without prohibiting the usage of the web services and the extensible mark-up language set of rules. The basis of this modified protocol is the previous version of the same protocol. The newly formed protocol improves the performance of the stack and the protocol and also it supports the low power personal area network architecture.

In [3] author gave the differential clocking which is used when there is a network interface with its own reference source clock and there is the need to transfer this clock over a core packet network to another interface. In paper authors gave servo algorithm and phase-locked loop of a method for differential clock recovery over packet network. The characteristic of this new technique is that it contains differential clock recovery clock.

A novel image de-noising method is based on spherical coordinates system was given in [4]. The authors have redefined the spherical transform in wavelet domain and the properties of spherical transform in wavelet domain. They have overcome the limitation of the traditional shrinking function by giving a novel curve shrinkage function. The new method is simple and effective.

In [5] authors gave the automatic cluster formation and address assignment for wireless sensor network. They have proved that the address assignment scheme defined by ZigBee will perform poorly in terms of address utilization. They have also contributed to show that the automatic address assignment. The proposed method is simple, efficient, systematically formation of path connected cluster and automatic address assignment.

Energy-efficient beaconless geographic routing in energy in energy harvested wireless sensor network was given in [6]. They have provided routing with minimal communication overhead without help of prior neighborhood knowledge. They have proposed method in which each node sends out the data packet first rather than control message, this neighbor selection is only done among those neighbors that successfully received the data packet. The advantage of the proposed algorithm is it is loop free, fully stateless, energy-efficient source-to-sink routing.

In [7] authors have given a hybrid multi objective evolutionary approach. The authors have proposed procedure for enhancing the performance of WSN by solving dynamic coverage and connectivity problem in flat WSN subjected to node failures. The proposed approach is compared with an integer linear programming based approach and a similar mono-objective approach with regard to coverage, network life time.

In [8] authors have proposed a method called on multi hop distance in wireless sensor network with random node locations. They have used Gaussian pdf for analytical modelling of the maximum distance distribution. They have proposed a greedy method of distance maximization and also evaluate the distribution of the obtained multi-hop distance through analytical approximations and simulations.

Authors worked by adapting a developed theory of utility proportional rate control for wired networks to a wireless setting in [9]. They have also given the mathematical framework to elegant queue backpressure algorithm. Due to this the design the first ever rate control protocol that can efficiently handle a mix of elastic and inelastic traffic in wireless sensor network. The advantages of the proposed algorithm are its simplicity and low complexity.

Authors in [10] presented an analytical model for estimating the per node traffic load in a multi hop wireless sensor network. They have considered a typical scenario in which sensor nodes periodically sense the environment and forward the collected samples to a sink using greedy geographic routing. They have come to result that the irrespective of the radio model, the traffic load increases as a function of the proximity to the sink.

In [13] authors has discussed about the energy issue in Wireless sensor networks.

V. FUTURE CHALLENGES

A. Dynamicity

The phenomena as node failure, link fluctuations, node Attacks and mobile nodes are come under characteristic Dynamicity. Dynamicity is one of the most noticeable characteristics of WSN which is also one of the biggest challenges in future. Many studies in routing, coverage, and scheduling or topology control have attempted to find solutions where these events occur, but including them in optimization problem models remains a challenge.

B. Coverage

Solving the deployment problem in the presence of obstacles, taking into account the restrictions for node placement and 3D deployments are the coverage problems. With respect to coverage problems, there are several potential directions that have not been fully explored. Cooperative decision-making strategies and opportunistic approaches also need to be modeled and examined in optimization problems, since in both areas some of the problems in the routing and topology control. But not many theoretical works have been undertaken in relation to this paradigm. Many questions remain open. For instance, in what scenarios should an opportunistic approach be favoured over other approaches? How close is an opportunistic approach solution likely to be to the optimal solution? Routing in opportunistic networks adopts a people-centric approach to model the network semantics.

C. Difference between theoretic studies and practical implementation

One of the issues is the difference between theoretical studies and practical implementations in WSN. Some theoretical studies have already presented models for cross-layer design, together with corresponding solutions. But many of them remain centralized and require off-line computation. We remark that in some mathematical formulations the variables are considered continuous, despite the discontinuous nature of the corresponding events such as power transmission and flow. On the other hand, algorithms or protocols implemented in real hardware or tested in simulations do not address cross-layer design. They aim at distributed and on-line computations and handle mostly simplified problems. Moreover, in these works the analyses that might yield an optimal solution are neglected, and it is difficult to grasp the problem complexity and to know whether there is room for further improvement. Combining these two approaches is far from straightforward and calls for substantial work.

D. Scalability

Scalability is an important issue which is frequently neglected when solution methods are proposed. The eventually changes in network dimensioning may sometimes require to resolve the problem or to sufficiently increase the computation time. This is observed particularly in relation to issues related to multi-sink/multi commodity design and network cross layer design.

E. Uncertainty

Uncertainty has received very little attention. Nonetheless, uncertainty is an important characteristic inherent in the nature of WSNs, even if it is related to different aspects such as event detection, sensor location and data delivery. Some attempts to model these situations use probabilities associated with these different kinds of events. The main difficulties in taking the uncertainty of WSNs into account are twofold. First, measuring the distribution of events is not an easy task and is both environment- and application-dependent. Another is, despite recent advances in robust optimization tackling probabilistic optimization problems is not for the faint-hearted.

VI. CONCLUSION

Wireless sensor Networks are important for the research purpose. The different factors that affect the performance are given in this paper. We have considered different algorithms related to wireless sensor networks and different factors that affect the performance in the wireless sensor network. The main issue considered is performance. The better performance results in improvement of different factors like lifetime of network, quality of service of the network etc.

REFERENCES

[1] D. Zhang, , G. Li, Ke Zheng, , X. Ming,,and Z.Hua Pan*,"* An Energy-Balanced Routing Method Based on Forward-Aware Factor for Wireless Sensor Networks*"*, IEEE transactions on industrial informatics, vol. 10, no. 1, february 2014.

[2] I. K. Samaras and G. D. Hassapis, "A modified DPWS protocol stack for 6LoWPAN-based wireless sensor networks," *IEEE Trans.Ind. Inf.*,vol. 9, no. 1, pp. 209–217, Feb. 20.

[3] J. Aweya, "Technique for differential timing transfer over packet networks,"*IEEE Trans. Ind. Inf.*, vol. 9, no. 1, pp. 325–336, Feb. 2013.

[4] D. G. Zhang and X. J. Kang, "A novel image de-noising method based on spherical coordinates system," *EURASIP J. Adv. Signal Process.*, vol. 1, p. 110, 2012.

[5] P.Rewagad and H. Nemade," Automatic Cluster Formation and Address Assignment forWireless Sensor Network", RESEARCH INVENTY: International Journal of Engineering and Science ,ISBN: 2319-6483, ISSN: 2278-4721, Vol. 1, Issue 11, December 2012.

[6] H. B. Zhang and H. Shen, "Energy-efficient beaconless geographic routing in wireless sensor networks," *IEEE Trans. Parallel Distrib. Syst.*, vol. 21, no. 6, pp. 881–896, Jun. 2010.

[7] F. V. C. Martins and E. G. Garrano, "A hybrid multiobjective evolutionary approach for improving the performance of wireless sensor Networks" *IEEE Sensors J.*, vol. 11, no. 3, pp. 545–554, Mar. 2011.

[8]] S. Vural and E. Ekici, "On multihop distances in wireless sensor networks with random node locations," *IEEE Trans. Mobile Computing*, vol.9, no. 4, pp. 540–552, Apr. 2010.

[9] J. Jin *et al.*, "Handling inelastic traffic in wireless sensor networks," *IEEE Trans. Sel. Areas Commun.*, vol. 28, no. 7, pp. 1105–1115, Jul. 2010.

[10] Q. J. Chen, S. S. Kanhere, and M. Hassan, "Analysis of per-node traffic load in multi-hop wireless sensor networks," *IEEE Trans. Wireless Commun.*, vol. 8, no. 2, pp. 958–967, Apr. 2009.

[1 1] A. L. Barabási, "Scale-free networks: A decade and beyond," *Science*, vol.325, no. 5939, pp. 412–413, 2009

[12] Boyina Vinod, T. P. Rao, " An efficient and High Performance Based Cooperative Communication in ESN", International Journal of Engineering Trends and Technology (IJETT) – Volume 15 Number 6 – Sep 2014 .

[13] Y. Mishra,, A. Singhadia, R. Pandey, "Energy Level Based Stable Election Protocol in Wireless Sensor Network", International Journal of Engineering Trends and Technology (IJETT) – Volume 17 Number 1 – Nov 2014