A PERSPECTIVE SURVEY ON LOAD BALANCING TECHNIQUES IN WIRELESS SENSOR NETWORKS

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ABSTRACT

The definition of Wireless Sensor Networks (WSNs) is termed as collection of nodes which has a sensing capability, energy computation and able to communicate with other nodes without any physical connection. So many research works are done on the WSN to enhance its routing capability, managing energy and propagation of data. Most of the work depends on overcoming the issues in energy consumption based routing protocols. The nature of route selection varies on the nature of the application and the design of the network. This study presents a survey on various existing works done on load balancing based reliable route selection in the wireless sensor networks. The discussion is mainly focused on five different important issues namely energy consumption, link stability, collision detection, bandwidth usage and fault tolerance which should be handled for efficient routing protocol development based on load balancing.This survey first outlines the challenges in protocol design for route discovery in WSN and discusses a detailed survey on the above mentioned terms. The highlight of this study relies on the survey of existing works aim of impact on consumption of communication overhead with energy consuming based routing model. The merits and demerits of each routing technique studied under this review are also considered. This paper bring a close outlook of major issues due to the five major factors which affect the load balancing mechanism in an efficient route discovery process.

I. INTRODUCTION

Scattered networks consist of huge volume of dispersed, identity directed, small in size, very low power storage devices are known as sensor nodes which communicates in wireless and such network is termed as Wireless Sensor Network (WSN). In nature WSN comprises huge number of geographically distributed, elfin, operated using battery, surrounded device which are gathered together and function as a network in order to gather data packets, processing it in some form and transferring the data packets to the end users in midst of limited capability of processing and computing resources in WSN. Small capability computers are

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termed as motes and they gather together to frame a network. In-general they are multi-functional and efficient energy consumption wireless devices.

In industrial based applications there is a essential need of the motes. The motes gathered as a group and they pull together the data from their surroundings to achieve a significant aim of application. They hold various configurations to connect with other nodes in order to produce utmost recital. Transceivers are used as communication aid among the nodes. These modes are termed as sensor nodes which range from 100 to 1000 in numbers. The comparison among WSN and Ad hoc Networks are portrayed in the Table 1.1.In recent years due to the rapid advancement in development of processor, less battery usage based devices and less communication overhead based wireless networks become famous and high demanding and its well-liked services make the industrial and commercial applications rely on such network. This type of nodes has the capability to observe the surroundings adversial conditions. Sensor nodes acts on different roles like sensing traffic smartly, efficient data storage and forwarding, determining the nearest neighboring nodes, tracking target, effective route discovery among nodes and base station and observing collision in real time.

Table 1.1 Comparison of Ad hoc Networks and WSN

Factors	WSN	Ad-Hoc Networks
Size of sensor nodes	High	Average
Exploitation	Closely deployed	Disposed
Rate of failure	Possibility of failure	Failure is very limited
Topology	Changes often	Limited
Battery	Cannot be replaced	Can be replaceable
Identifiers	There is no distinct identifiers	Unique identifiers
Centric	Data	Address
Fusion /aggregation	Possible	Not adequate
Computational capacities, and memory	Controlled	Un controlled
Data rate	Small	Large
Redundancy	More	Less

Main basic goals of a WSN are to:

(1) Monitor the specific selected area.

(2) Record the occurrence of events.

(3) Measure the required parameters.

WSNs deploy a method that there is presence of

microcontroller which control monitoring, radio transceiver for generating radio waves, wireless sensors for communication with energy source of battery. Wireless sensors need delay free data for less energy consumption [45].

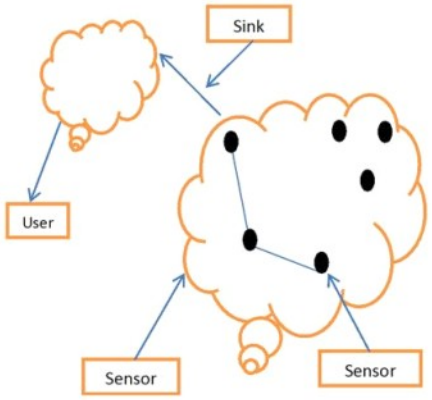

Figure 1.1 Wireless Sensor Network

II. Relevant Works on Load Balancing using Energy Consumption

In [1], S. Olariu and I. Stojmenovi_c, 2000, proposed the model which overcomes the depletion occurred in the sink node. The network was assumed to be unevenly spreaded sensor nodes which repeatedly sense duplicated message to the nearest sink.

In [2], X. Wu and G. Chen, and S.K. Das,2008, investigate the problem of avoiding energy holes in WSN. They overcome this problem by regulating the nodes and adapts dispersed rooting algorithm to find shortest path in case of uneven sensor nodes distribution it also handles unbalanced energy consumption within the network.

In [3], J. Li and P. Mohapatra, 2003, state that energy inefficiency is treated well using the relevant factor of the consumption energy andv in this technique each node produce bit rate on data packets and transmits to a single sink by adapting multi hop transmission.

In [4], J. Pan, *et al*.2003, it worked under two tier architecture of WSN which holds sensor cluster and base stations which are moveable with more number of nodes which are involved in encoding and transmitting information from the desired location and the environment holds single application node which receives packets from sensor node, and aggregates them to base station this technique directly affects both nodes and network life time of WSN due to high consumption of energy and battery power.

In [5], W.Wang, *et al*. 2005, heterogeneous architecture based WSN is considering for investigated. In this limited number of mobile nodes and enormous amount of simple static nodes are considered. The role of mobile nodes are assumed either relay or sink which calculates the network life time with the aides of three different rooting algorithms which satisfies the conditions of like networks to be static, sink or moveable and relay of mobile.

In [6], J. Luo and J.P. Hubaux. 2005, proposed a conservation of energy based protocol was designed to control the topology design. This technique is

emphasis of sensor nodes in case of unbalanced data transfer this is achieved by updating the position of the base station frequently and finds best routing mechanism.

In [7], M. Haenggi.2003, Analyzed five different factors for balanced consumption of energy of nodes to extend the life time of network using compressed data, shortest rooting and variation of distance, with balanced data transferred to decrees significant delay in transmission. It is achieved by adaptive white Gaussian noise and ray leigh fading model.

In [8], W. Heinzelman, *et al.*2000, observed communication based protocols that have noticeable degree of global dissipation of energy in WSN. They utilized local clustering of base stations to avoid direct transmission and evenly distribute the energy load between the sensors. It adapts reliable dynamic network using localized coordinate which incorporates fusion of data to lessen the volume of data packet transferring to the base station.

In [9], A. Basu, A. Lin, and S. Ramanathan, 2003, structuring on rooting to transfer data packets with the steepest gradient search technique it works by assigning network scalar potential and transfer data packets which has high positive force this technique is loop free and utilized shortest path routing algorithm in special occasion. This leads to advancement in end to end delay by adopting traffic aware rooting algorithm which also improves the jitter performance in terms of limited control.

In [10], A. Papadoulos and J.A. Mccann, 2004, the energy of motes and capability of storage are the basic measures for constructing this protocol. This technique implemented a hierarchy adaptive light weight location service supporting root strategy which supports energy conservation in a balanced manner.

In [11], S.J. Baek and G. de Veciana, 2007, proactive multi path routing is designed to attain efficient energy processing of adhoc wireless networks. First it develops multipath rooting by calculating nodes proximity and then integrating geometric queuing system to design a network model by considering energy and storage capability replacing or not. The result shows reduced depletion of energy and the finding is the best shortest path.

In [12], A. Giridhar and P.R. Kumar, 2005, focus on two different topologies are considered namely regular two dimensional and linear array networks. In later case the network life time is increased by deriving potential communication strategy accurately. Finally it shows that avoiding complex schemes for transmitting data only to nearby neighbors produces a potential sense of scaling

III. Relevant Work on Load Balancing Based on Collision Occurrence Detection:

In [13], Marti, S *et al.*2000, deals in identifying the nodes which aggress to forward packets but get compromised to do so. To avoid such compromised nodes the watchdogs are to determine such misbehaving nodes in an addition a path rater is used to assist in selection of such malicious nodes during

route discovery. By observing the next nodes very carefully the watch dog decides whether packets are delivered from it or not, by analyzing its broadcast transmission. In case the next node does not forward the packet then it is identified as malicious node by the watchdog. Whenever a node fails to transfer a packet received by it then the watch dog will increment the count of failure. Once the failure rate exceeds a specified threshold, then the particular node is labeled as malicious node and it is kicked out using the aid of path rater. The rater integrates the link reliability of data with the malicious node to choose the most reliable route. Here every node holds a rating value of each other neighboring node known in the wsn. The metric of path is computed using the find mean value of the node rating of the concern path.

In [14],Buchegger *et al*.2002, by observing the various types of attacks in existing networks they devised a new techniques to detect the malicious nodes. The idea behind this concept is that finding the route surrounding the malicious nodes and to detach them from the entire network. This allows nodes to find routes around misbehaving nodes and to isolate them from the network. Each node observes with the help of monitor and maintains two records namely reputation and trusted. To control the received warnings trust records are used and reputation record is analyzed by the path manager to adapt the reputation of other nodes behavior.

In [15],Michiardi *et al*.2002, in his work used watchdog component for collaborative reputation technique. This mechanism distinguishes the type of reputation as subjective, indirect and functional. They are used to make a decision about a node whether it has to be isolated or not depending on the summing up the weight of all the above reputation types.

In [16], Huang *et al*.2004,adapted a techniques which consist of a specific node acting as a monitor and each cluster holds one specific monitor. The monitor node has to be active always. The monitor performs utmost work in network, but at the same time if the monitor run out of energy then wsn might be under risk while the networks are under portioning process. Most of the existing approaches on monitoring based techniques fail to attain the aim of increasing the lifetime of WSN because of its limited energy and batter power.

IV. Survey on Load Balancing Using Link Stability

In [17], Lue *et.al,2011,* adapted a model for handling load balancing in a huge voluminous system using Join Idle Queue. Equal cost multi path is utilized for dispatching the packets in random order. The technique considerably minimizes the cost of communication. This is not suitable for MANET.

In [18], Li.X *et.al*.2013,proposed a multiple loop free path selection mechanism and the hop count and trust values are used for finding the shortest path routing. The protocol is termed as AOTDV ob and also known as Adhoc On-demand trusted path Distance Vector.Sheikhan and Hemmati devised a

procedure for determining the backup path in a reliable manner In [19], Seok K, *et al.*2007, By estimating the link expiration time among the nodes the link stability is computed. In addition it also identify the alternative routing path in case of disjoint of node and link.

In[20],Siguang and Meng.2011, proposed a anonymous multipath route selection protocol for sharing the secret publicly and to determine the active attack with the aid of hash function.

In [21],Yi *et.al.2011,* initiated a new technique using Multipath Dijkstra Algorithm for multipath selection. Various link metrics and function of cost is used to produce a flexible and extensible path in multi routing.

In [22],Argyriou and Madisetti,2006, overcome the problem of path failures and load balancing efficiently by enhancing the reliability of path selection and dispersing the load among the nodes evenly. The disjoint path is discovered using two different protocols namely dynamic sourcing routing and stream control transmission

Hwang and Kim used the duration of link and compute the settling time for movement of node using markov model and they predict the link connectivity at t+1 time In [23],Seok K *et al*.2007.

In [24],NityanandaSarma and Sukumar Nandi . 2009,devised a new protocol which calculates the stability of link and route using received signal strength and proposed QOS Routing Protocol for route stability .

The work given in [25], T. Senthilkumaran, V. Sankaranarayanan.2012, is proposed to a overcome the congestion occurred in the WSN by estimating the average queue length at each level of node and it also determines the level of congestion on a particular level of node and it forwards the message with warning to other nearby nodes. The congestion detection process is dynamic with limited routing method.

In [26], Doo Ho Lee and Won seok Yang.2013, a special technique for power saving in queue ad to disaster based discrete time queue is adapted using N-policy in wireless sensor networks.

The proposed work given in [27], Emre Atsan and Oznur Ozkasap.2013, increases the availability of data by introducing the reactive replication of data with the aid of items used frequently. The SCALAR technique is able to handle both the fault failure and balancing of load which is applied on virtual structure backbone to better produce the replication operation and outlook of data.

In [28], Chen *et.al.2011,* introduced a model in order to choose the stable link using the metric of routing based on channel average non- fading duration and named it as Channel -Aware AOMDV.

A multi objective approach for determining link stability is proposed in [29], Xin Ming Zhang *et al*.2010, with the aid of cost of energy, life time of link and queuing delay average.

The proposal given in [30], Kamesh Namuduri and Ravi Pendse path.2012, devised a duration of path

by estimating the density of node, nodes velocity , range of transmission and hop count in order to produce a link between paths.

In [31], Llewellyn *et.al.2011,* proposed a clustering approach for both fault tolerance and QoS by evaluation the failure of link using recovery time of failure, dropped packet, its throughput and bandwidth flow.

In [32], Floriano De Rango *et al.2012,* state that a bi-objective potential link stability named as Link-stability and Energy aware Routing Protocols. Which results in lessen consumption of energy and link stability is gradually high.

In,[33], Shengming Jiang *et al.2005,* devised a new approach by estimating the reliability of paths using number of stable links and predicts the link availability in advance .

The approach [34], Abbas Nayebi mand Hamid Sarbazi-Azad.2012, takes two metrics namely nodes mobility estimation rate and drain rate of energy which increases the lifetime of both node and link. The routing technique used for testing is Dynamic Source Routing (DSR) which utilized the prediction of life time and stability of signal in adaptive manner.

The authors presented an approach [35], Giovanna Carofiglio *et al*.2009, which considerable decreased the overhead and latency by selecting the stable path for enhancing the process of routing. The implementation was performed on random direction model which selects the optimal path based on the availability of paths.

In [36] ZhihaoGuo *et al.2010,* a multi objective based technique for finding stabilized link using the metric of cost of energy, life time of link and averaging delay of queue.

V. Survey on Load Balancing Using Bandwidth

The advancement in growth of mobile apps in MANET, there is a rise for QoS Guaranteed based service. This mechanism mainly relies on computing the resources availability to reach a best performance on servicing over the need of networks. The key factor in network is the bandwidth which often influences the quality of service. It is a toughest work to estimate the bandwidth availability in multihop environment. The maximum throughput of data packets transmitted between two nodes without disturbing the already ongoing process in the WSN is termed as available bandwidth on [37] IEEE 802.11.2007. Due to the changes in topology and mobility in wireless network it is very hard to estimate the bandwidth availability. In case of MANET it is much more difficult in case of nodes with high speed and pruned to often disruption in routing path.

A very few authors worked in the estimation of bandwidth in WSN. QoS AODV [38], Cheikhsarr *at al*.2008, state that utilized the bandwidth efficiency ratio for calculating the available bandwidth by finding the ratio among the number of received and transmitted packets per node and it is named as QoS AODV

In [39], Chikusarr *at al*.2007, using the knowledge of back off and collision occurrence the bandwidth availability is estimated. Depending on the ratios of channel utilization and synchronization of idle period the bandwidth availability is computed. It also considers the probability of collision occurrence for estimation process.

QoS-aware routing protocol in [40], L. Chen and W. Heinzelman.2005, incorporates unused bandwidth estimation and an admission control scheme. But there is no measure to predict a route break.

Using Binary Exponential Back off Mechanism the mobile nodes enter into a deferral period to avoid the collision when the transmission is already in progress. The nodes listen to the transmitting medium whether the path is free and then it forwards the packets by CA portion of the proposed mechanisms. This technique picks a random number to determine the amount of time which must be allotted for transferring data when the path is free. The random number generated is used for designing the size of contention window which gets doubles when attempting to transfer data deferred still it reaches the utmost size for the given range. The range is reduced after every successful transmission of the selected path. The contention window size varies from min to max depending on the PHY. Though, the values may fluctuate from one PHY to a different. In the precedent, more than a few back off schemes is adapted to progress CSMA/CA for the IEEE 802.11 which have been proposed in [41] [42] [43] [44].

In [41], Elsevier Journal,2011 adapted a novel back off technique by increasing the size of contention window multiplicatively for colliding nodes and decrease the window contention linearly instead of minimizing the contention of window after every successful data transmission and the proposal is termed as MACAW. Each nearby nodes copies the contention window using a back off copy of the particular successful node.

The work presented in proposed [42], R. S. Prasad *et al*.2003, utilizes an Exponential Increase Exponential Decrease (EIED) back off mechanism. Every time data packet is delivered successfully by a node then its contention size is divided by de-facto number at the same time if the data packets of node gets collision then the window size will be increased in inc-factor times.

In [43], CheikhSarr *et al*, 2008,presented a new approach on collision avoidance mechanism by introducing, the Multiplicative Increase and Multiplicative Decrease rear off algorithm and Markov chain representation to examine the result of MIMD.

The other paper [44], CheikhSarr *et al*.2007, demonstrates that the presentation of these back off system are tranquil fairly distant from the utmost consumption of the IEEE 802.11 MAC plan and put forward the Linear/Multiplicative a large and Linear Decrease (LMILD). In this backoff method crash nodes amplify their contention window multiplicatively, while further nodes listen in the collisions raises their size of contention windows

linearly. Nevertheless, the majority of the preceding learning's principally listening carefully on setting the size of contention window. The neighboring nodes in WSN can hear the transmission in progress but cannot able to utilize the history of transmission.

In [46],V.Thirumalai Selvi and E.J.Thomson Fredrik,2016 Proposed safe routing techniques for wireless Ad-hoc network.That proposed method is to secure transmission of data with out any loss the proposed approach is better suited to supported Qos for Ad-hoc networking environment.

In [47] the authors Manju Priya and Karthikeyan, 2012 has proposed a clustered Multipath Routing to improve lifespan in WSN. According this method by using the neighbour node list the optimal route can be found out.

In[48], G.Anitha and M. Hemalatha proposed protocol for VANET which provides message authentication and efficient certificate revocation list management by replacing the time-consuming CRL checking process with a fast revocation checking process with Bloom filter. And also, CRL distribution is performed using the modified flooding method. By this, Instead of sending the CRL to all the OBUs in the region, it sends to the only one nearest OBU on the road. It reduces message loss ratio and space complexity in RSU and OBU by introducing region-based revocation checking process.

This paper concentrates on surveying the estimating node emission capabilities, link available bandwidth, idle time synchronization between source and destination, evaluating collision probability, backoff mechanism and overhead due to backoff mechanisms. Finally, planned to propose an enhanced routing scheme to overcome above set offs in WSN.

VI. Conclusion

The rapid advancement in the growth of electronic environment, the applications and examination of the WSNs have also increased. WSNs are susceptible owing to a variety of physical uniqueness of environments and campaign itself. This work put forth the design and development of existing protocols focused on load balancing with failure tolerance in WSN.

The set of paths for transferring the data packets was identified by the source node to destination node the transfer begins with the strategy of controlled traffic and balanced loading. These two metrics finds in which way the data is scattered between the paths. The main problem relies on how the data packets have to be allocated in each selected path. The proposed study anticipated in designing the optimized load balancing in wireless sensor network for multipath routing.

Next objective is to overcome the problem of failure tolerance in case of node failure in multipath routing and leads to salvaging of packets. With packet recovering, intermediates nodes preserve several routes to the destination and a REER note broadcasts simply in anticipation of a midway node cannot ahead the packet beside an alternating path. This

leads to many existing work overhead in scheming a well-organized fault tolerance system to reduce the route discoveries in WSN. Thus this survey put forth the various dimension of issues in optimal route finding incase of load balancing in WSN.

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