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Energy-Efficient Routing to Enhance Network Lifetime in Wireless Sensor Network: A Review

[1]P.Suman Prakash,[2]R. Anil Kumar[3]Dr. D. Kavitha

[1]Associate Professor,G.Pullaiah college of Engineering and Technology,Kurnool, [2]Professor,G.Pulla Reddy Engineering College,Kurnool

[1]sumangpcet@gmail.com,[2]anilkumar.cse502@gmail.com,[3]dwaramkavithareddy@gmail.com

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Abstract
Over the past decade, the progress of low-cost sensors has made Wireless Sensor Networks (WSN) a very popular research area. This network can capable to operate in insensitive environments. WSNs facing many problems as sensors once being deployed cannot be replaced and recharged. WSN nodes are typically battery-powered devices which make them limited battery power operative. It is therefore important to have an energy-efficient path that maximizes the life of these nodes using minimal energy in different paths. Traditional energy efficient routing algorithms opt for the efficient path for data communication and less energy consumption. However, using a particular path can result in additional load on a particular node, reducing its lifetime and longer service. In this paper, we will review the issues and challenges of WSN which influencing the energy-efficient routing protocols (EN-EF RP) and different kinds of energy routing protocols to investigate the minimize energy utilization and increase the lifetime and QoS in WSNs.

Keywords: *Energy efficient routing, Network Lifetime, Wireless Sensor network.*

I. INTRODUCTION

The advancement of WSNs, has led the researchers to develop novel protocols to meet the rigorous necessities of the WSN. The recognition of routing protocols is believed to be the most essentialconcernsince it relies on application design and planning. The WSN system collects data from several sensors nodes (SN) and monitors some areas. Networking and supervision of these sensors is a complexjobas a result of the differentlimitationenforced on these small nodes. These small and inexpensive sensors have small batteries, low memory,and inadequate processing power. Sensors collaborate in an environment where information is sensed, collected, and transmitted to the main station. Many WSNs consist of several nodes or thousands of nodes placed statically (manually) or randomly. They have toestablish the network prior to exchanging information.

WSN application development is increasing day by day and All have diversenecessities. This is because of the variety of necessities, various designs of networks, various communication protocols and various approachesfor the needs. For example, it can be deployed in severalkinds of the situation because it decreases the deployment delay and costs in compared to the traditional sensor networks that cannot be installed in the deep sea, battle area, outer space,and unacceptable environment. However, WSN's nodes are battery controlled and have extremelyinadequate battery

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ability. This characteristic presents new hurdles in the advancing software and hardware. New improvements in the design of transmission protocols and networks are required to address this inadequate energy competence of SNs.

In the past various routing methods are categorized according to the different application functions, nature of the routing, the operating model and the network architecture. The routing protocol (RP) indicates how the SNs correspond to cycle the sensed information in the direction of the base stations (BS) and agree to the SN to opt for the most cost-effective path to reach the BS. The route assortment is primarily determined by routing algorithms aimed in the outline of "clustering routing algorithms" [1-4] or "load-balancing tree routing algorithms" [1-8]. A cost-effective RP has been build up to maximize the steadiness of characteristics for example,"scalability", "timeliness" and "robustness". In general, it is significant that the RPhas to minimize energy utilization so that it can broaden its network life for a realisticphase of time. Therefore, routing in a WSN is a complicated task since the RPhas tostabilizefew or the entire of these for the need of QoSnecessity.

Identifying a routing strategy is an important issue for efficiently delivering packets to a destination. Also, in such a network, the practical routing schemes must guarantee theleast amount of energy utilization and thus maximize the lifetime of the network [9]. This EN-EF RP strives to enhance network lifetime byreducing the energy utilization of everySNand also balancing energy consumption effectively and uniformly.

The main reason for designing an EN-EF RP for WSN is to extend network life to maintain networkpurposes. The phrase "Network Lifetime (NLT)" is the basic factor that is often utilized to determine the Energy-Efficiency (EN-EF) of a WSN. There is another definition in the literature about the NLT of a WSNas few documents define NLT as the period until all SNs in the network are depleted or until all SNs in the network are run down. Several authors refer to the NLT as the period to deplete energy at a definite rate of SN [10-12], while others define the NLT of a WSN depend on network applications and formulas. But the commonthoughtamong the all is similar. This review defines the NLT of a WSN as the utmost time that the network can measure an actual value or event in a deployed environment.

This paper investigates WSN in section2.WSn issues and challenges are presented in section-3.section-4 presents WSN routing and challenges.section-5 elucidate the energy efficient routing and existing energy routing protocols in WSN is reported.Section-7 concludes the review.

II. WIRELESS SENSOR NETWORK

WSN compresses hundreds of SNs That exchange information and deliver to BS without utilizing the existing communication systems. WSN is installed as a workaround and the SN a self configuring.SN are positioned haphazardly in an isolated area or sensor field to structure a link to each other compute substantial values.Once these SNs are installed,it is extremely difficult to reconfigure them in undsiendly atmosphere such as mines, battlefields etc.

These SNs are arbitrarily placed in the field. They collect the data and transmit it to the sink through single hop or multiple hop communication. This information is shared with SNs with help of the Internet [13].This exchange of information supports various applications need. The "protocol stack"utilized by sink nodes and the entireSNs is shown in Fig.1. Apart from these, nodes have additional functionality in the different layers to managemobility, power, and work management. The power management is responsible for power-related tasks, for example, if the node's power drops underneath the "least threshold level", it will broadcast to the energy status and will not be able to participate in the data transmission. The left outenergywill beutilized for data detection.This helps SNs **to decreasethe, on the whole** energy utilization and subsequently increase their NLT.

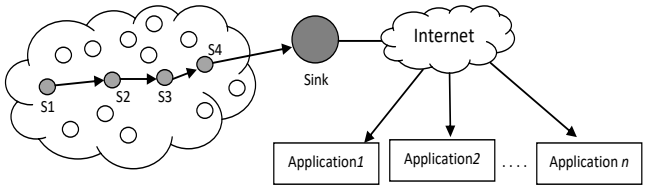

Figure. 1. A scenario of SNs communication model

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The WSN communication architecture is presented in Fig.1. The SNs "S1to S4"coordinates and transmit data to the sink. The network layer provides needed services to route data from the source to the sink. **However, the purpose of this layer is to conserves energy during transfer of the data. This layer proposed and developed A lot of protocols.The main goal of these protocols is to forward the data in an EN-EFapproach, Itexclusive ofcreatinga lot ofdelays.**Besides the interest in energy utilization, SN is primarily a battery-powered device. Therefore, to extend network life and functionality for a reasonable period of time, the energy consumption of the SN must be properly managed.

III. WSN ROUTING ISSUES AND CHALLENGES

In addition to the ongoing efforts, there are numerous current tasks to develop RPs in WSN. These protocols are enhanced according to the application requirement and network construction. However, there are essential aspects consideredwhileextending a wirelessRP. The most essentialaspect is the EN-EF of the sensor, which immediatelyinfluences the lifetime of the network.Most goals of these routing techniques are configured to avail the prerequisites of the purposes. For instance, if an application is believedto be time constraintas for the "real-time applications"then the smallest path for routing is utilized for data transfer and the linking among the nodes is necessaryto beconsistency. The following are different purposes and design concerns for routing in WSNs.

NLT maximization:

NLT is a foremostrestraint on WSN because of the battery-powered functionality of theSN. For situational applications,this issue is a major concern if the SN cannot be replaced. Intra-cluster communications between the cluster head and node must minimize energy consumption [14]. The distance among the "cluster heads (CHs)" and the node has to be decreased in order to take advantage of energy preservation [15,16]. Adaptive networking isutilized for the durability of NLT [17,18]. Through minimizing the load, optimal route setup and inter and intratransmission between nodes and CHs enhancing the NLT [19].

Appropriate delivery:

For successful data transmission, there must be a routing path between the node, the "CHs" and the "BS". For distance transmissions (satellite links), many applications require inter-cluster communication [20]. If the delay acceptance is a design concern, then "intra-clustering" communication is as wellnecessarythrough setting the number of 'J' hops allowed in the routing path. The 'J' hop clustering has been proposed to solve the appropriate delivery issue in the'J 'hopping [21-23].

Load Balancing:

It is wise to equalize the load amongst the tasks allocated to the SNs to achieve the best performance goal [24]. Smoothallotment of communication load between the nodes is necessitated for intra-level critical communication. It is important to establish clusters of equal size to prolong NLT and avoid hotspot issues due to energy exhaustion by CHs. The responsibility of the CH is to collect data, It is important to identifya number of nodes in everycluster, so as to configure merged data for additional processing at the same time without delay.

Reduction of the number of Clusters:

In a "heterogeneous cluster-based network", more number of nodes are influentialcompared to others. Network designers use a minimal count of nodes as they are very costly. In applications such as,"security surveillance" and "military reconnaissance", nodes are notnoticeably desirable, so itdoes not need to deploy more nodes with larger CHs than other nodes. If ithas a larger variety of clusters and routing channels then it will need to collect the data, which will use additional energy because of additional processing when collecting data and other tasks. So, to save energy, the most favorablecount ofCHshave to be selected [25].

Because the node's energy supply is not replaced in the WSN, the node is only involved in the network as extensive as energy is present, so

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battery energy is the most essential resource, so all nodes in the path quickly drain battery power through the least energy routeto the destination is to be critical to the network. Therefore, it is not a feasible solution, and it delivers traffic to balance energy consumption at the node instead of this solution.

IV. WSN ROUTING AND CATEGORIZATION

Data collection and processing is an important application of the sensor network, and all data from the individual SNs istransmitted to the End-User with access to the data. A number of routing technologies commenced for WSN lie on particularaspects such as "data aggregation","clustering", "role assignment of nodes", and "node locations".

In general, RPs are of three types epending on the "network structure", "EN-EF" and "reliability and "network operation". These routing categories further divided according their model of routing as, "flat based routing", "hierarchical-based routing", and "location-based routing"underneath the category of network structure based routing, "multi-hop based routing" underthe category of EN-EF [27], and"multi-path based routing"techniques underneath the reliant and network operation protocols [26] as shown in Fig.2.

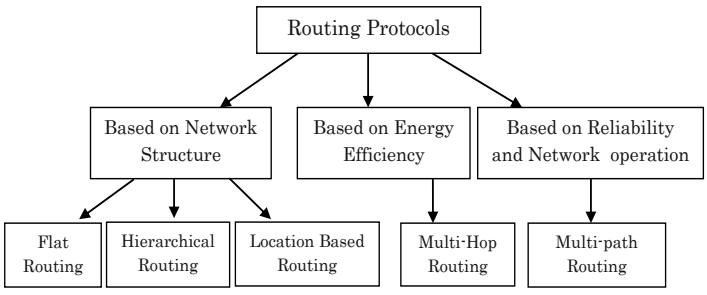

Figure 2. A generalcategorization of RPs

Every one SNs are assigned the same role or function in "plane-based routing". However, in "hierarchical routing", every node plays a different role in the network. The location of the node is used in "location-aware routing". In "adaptive routing", assured constraint is retained in manage to handle other network situations and to control EN-EF. The route configurations from node to sink be able to be categorized as "reactive", "proactive", and "hybrid routing".

In Reactive Routing, the path that is dynamic. In "proactive routing", the data is set and determined earlier than it is sent (the route is static). When retrieving routing paths from dynamic path selection, more node energy is consumed. Therefore, some protocols use hybrid routing, where a static route is selected before data transmission, but a new route can be initiated depending on the needs of the node. In collaborative or chain-based routing, nodes help each other in data transmission.

In EN-EF RP, routing is object familiarized and directional. Nodes in the communication path way accumulate energy values. A routing path that utilizes less energyopts for data communication, and this pathway selection is calculated for all nodes and all packets. The "Energy-aware routing" have a lot of benefits because traffic is distributed across multiple pathways to prevent jamming and retransmissions.Redundancies aremanaged though maintaining energy-efficient path maintenance. However, path discovery adds transmission delays, resulting in a novel trade-off linking energy and delay.

The position of the node in location-aware routing is well-known. Nodes are able to easily transfer data to neighboring nodes. Data is effortlessly transferred in a collaborative manner. Location services are more useful for mobile nodes. The location there is easy to track and follow. It can easily navigate and use information about its new neighbor nodes. Node location takes advantage of routing. The "Distance assessment" for incoming data is achievable. However, to access the node location, it must check the "received signal strength (RSS)" or use a "Global Positioning System (GPS)" antenna. GPS is a very expensive technology that applies to all SNs. It is able toexhaust the energy considerably.

In a "network-based protocol", data is sent by intervention, or on queries. All though, routing will be "source-initiated" or "destination-oriented". This type of routing considers QoS metrics, but to take advantage of all the benefits of a WSN, it must carefully review the trade-offs between all metrics.

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Routing based on network architecture has advantages in provisions of network "throughput", "latency" and "EE". However, in a flat RP, network throughput increases with higher energy consumption costs. Tiered networking introduces latency while conserving energy over the lifetime of the network. Routing protocols are scrutinized to meet the needs of WSN applications as needed.

In common, flat RPs for WSN be able to be categorized into three main categories according to their routing strategy: "proactive protocol, reactive protocol, and hybrid protocol". All of these protocols are different in variousbehavior and are designed for the same base network, but they do not exhibit the same characteristics.

According to a different categorization as certain in the literature, the flat network RP for WSN be able toclassified into "table driven" and "source driven". The subsequent sectiondescribes these protocols and categorizes them according to their features.

Pro-active Routing Protocols:

Pro-active routing functionsare similar to the wired network. Itcyclicallyexchanges routing information amongvariousnodes,every node creates its individual routing table that it can be used to search the destination path. Every node has toretain routing information to maintain one or more tables. It also responds to all alters in the network topology by sending updates and maintaining a reliable networkvision.Consequently,In some instances when the node requires a route to some destination or needs to forward a packet, the route is already known and no further delays will occur because of route discovery. Although, maintaining the information the latest requires additional battery energy, which is bandwidth intensive and inadequateto the WSN. The information may not be valid yet.Several of the existing "table-driven RPs"are, "Wireless Routing Protocol (WRP)" [28] and "Topology Dissemination Based on Reverse-Path Forwarding Protocol (TBRPF)" [29], [30].

Re-active Routing Protocols:

Table-oriented routing and other approaches are source-driven or on-demand routing Similar to the "table-drivenRP", the re-active protocol initiates the route findingprocess only whileit is required [31]. Once a path from the origin to the destination is required, a sort of comprehensivefindingprocess starts. This does not require regularinformationsend over the network, as in the pro-active protocol, but this practice causes a delaybecause of the demanded path not able to be used and must be discovered. In several situations, the looked-for path remains in the path reserve managed by the SN. In sucha case, there is no extra delay as paths are already known. The entire procedure is complete the moment a path is discovered or the entireprobable path collections are observed.A number of the proposedre-activeRPs in the past are"Temporarily Ordered Routing Algorithm (TORA)" [32], "Flooding" [33] and "Energy-aware Temporarily Ordered Routing Algorithm (E-TORA)" [34].

Hybrid Routing Protocols:

The "Hybrid RPs"integrates the benefits of "pro-active and re-active RPs". It utilizesthe pro-active routing locally and re-activated routing inter-locally. This is moderately based on two suppositions as,(a) In general communication in a WSN occurs amongthe nodes that are near to oneanother, and,(b) analteration in the topology is considerablesimply if it occurs near the node. If the connectionis unsuccessful or the node is unavailable from the opponent side of the network, it only influences the local neighborhood. The others in the network are not influenced. The "Zone Routing Protocol (ZRP)" [35] is a hybrid RP thatunites the benefits of a hybrid approach with re-activation as well as active advantages.

In similar to the"flat RPs", where every node has a distinctiveuniversalidentification and the entire nodes are as peers, nodes in a "hierarchical protocol" are combined to form clusters. Each cluster has a "cluster head (CH)", whose elections are stands on the different "CH election algorithms". CHs are utilized for high-level communications to reduce traffic overhead. Clustering can be extended beyond two levels with the same communication concepts at all levels. There are many benefits to using a routing hierarchy. Reduce the extent of routing tables to provide enhanced scalability. Some existing "hierarchical protocols" are "Low-Energy

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Adaptive Clustering Hierarchy (LEACH)" [36], [37], "Low-Energy Adaptive Clustering Hierarchy Centralized (LEACH-C)" [38] and "Power-Efficient Gathering in Sensor Information Systems (PEGASIS)" [39].

A key benefit of theseRPs is their superior performance over "traditional communication protocols"byconditioningthe"energy indulgence", "simplicity of organization", and "system lifetime"for the quality network services.

ENERGY-EFFICIENT ROUTING

Energy-efficiency (EN-EF) routing is an important issue in WSN. Traditional EN-EF RPs utilize the "residualenergy", "transmit-power", or "link-distance" as parameters to optafavorableroute. Here,itfocuses on the EN-EFrouting of the WSN, and the path opting policy that uses the new metrics to increase the path viability of the WSN. New metrics provide reliable network connectivity and reduce additional route discovery.

One moreessential feature is that SNs compriseconsiderablehanding out power in a collection, however not independently. Nodes must configure themselves and manage their networks.Managing network ismore difficult tomanaging individual devices. In addition, transformation in the material environment in which the network is installed affects the networking protocol by the node experiencing various changes in connectivity.

The foremost design purposes of the WSN are notonly to transfer data from the source to the destination, but also to enhancedone byNLT. Thisis done by using an EN-EF RP as diverse architectures and designs that is applied to the WSN depending on the application utilization. The achievement of anRPis based on both the architecture and network plan, That is essentialcharacteristic of the WSN. The function of the protocol is influences the energy consumed through the transmission of data.

In the WSN, much of the energy utilization is exhausted on three foremostactions as,"data sensing", "data processing", and "communications". Allaspects areessential and have to be measured while building the WSN protocol. The information transmissionin theSNs is a keyfactor of energy utilization. Therefore, most of the ongoing research at the WSN focuses on protocol designs that utilize as limited energy as probable during the information transmission among the nodes.The feasibleassignment of the protocol is to locatenot only the smallest energy route from the source to the destination but also the majorcompetentpath to lengthen the NLT.

A. Minimum-Cost Routing

Routing algorithms strongly relate to active programming that is based on various Network analysis and Graph Theory perceptions of data communication systems, including maximum transmit, smallest path and lowestperioddifficulty. The smallest route routing technique calculates the smallest routestartingwith a particular node to a destination node. This algorithm may also compute the least cost path if cost is correlated to each one link instead of link length. These algorithms are"centralized" or "decentralized"."Dijkstra algorithm"with" polynomial complexity" and "Bellman-Ford algorithm" are two recognized and well-identified algorithms for smallest routingfor finding the routealong theleast hops.Few minimum-cost routing algorithms proposed in the past are :

An "Efficient Minimum-Cost Bandwidth-Constrained Routing (EMCBCR)" in WSNs:

The proposed "EMCBCR" [40] is a straightforward, scalable and proficientanswer to the low-cost routing difficulty of WSNs. This is a protocol that discovers the best route to transmit data from the SN to the BS and ensures that the overhead on every wireless connection does not exceed the capacity while minimizing the overall cost of routing. The protocol derives from the "combinatorial optimization"difficultyrecognized as the least costtransmittingcomplexity in the functions. This protocol is extremely scalable since it uses a polynomial periodbased least cost transmitting algorithm.

A "Scalable Solution to Minimum-Cost Forwarding (SSMCF)" in bigWSN:

Y. Fanet al. [41],explored the least cost message delivery problem from a particular source to sinks along with a least cost route in large

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WSNs. As soon as the platform is set, a message carrying active cost messagetransmits next to the least cost route in the cost platform. The "intermediate node" delivers the informationsimply when it is in the best possibleroutedepend on the active cost state. This plan does not need intermediate nodes to upholdprecise propagation route conditions. This algorithm needs only someeasyfunctions for all network extensions.

B. Minimum Network Overhead

Overhead Energy is an important element of energy utilizationinWSNs. In an EN-EF routingdecision, if overhead energy is too low, energy usage may not be optimized. The routing algorithms must be consumed at every hop of data communication over the WSN and focused on overhead energy. If only transmit energy is considered for communication costs, the utilize of a shorter multi-hop link emerges to be a benefitssolution.

The current research has determinedand aiming atreducing the WSN overhead throughacquiring accounts ofseveralaspects for instance,"the energy consumed in detecting the environment","calculating the accumulated information", "relaying information", and "sending data" from hop-to-hop in WSN.

C. Design difficultiesissuesin EE-EF RP

Despite numerous applications, WSNs are subject to some limitations, mainly in terms of inadequate energy stocks, inadequate processing energy, and insufficient bandwidth of the wireless linking the SNs. One of the most essential design ambitions of the WSN is to provide the durability of the network at the same time through data communication and utilizean "aggressive energy management techniques" to eliminate connectivity. The propose of EN-EF RPs in a WSN is unfairthroughnumerous factors. These elements have to be done in advance ofthe proficienttransmissionoccurrence in the WSN.

The subsequentare the list of the most frequentaspects concerning the RPproposes [42] :

- *Node Installation*: This is an "application-dependent"behavior that affects RPachievement and it able toadopted or random.
- *Node/Link Diversity*: The continuation of a diversegroup of SNs should overcome and cause numerous technical difficulties associatedwith data routing.
- *Energy utilizationexclusive of Losing Accuracy*: In this situation, the energy conservation mechanism of data transmission and processing is abovethe requirement.
- *Scalability*: The WSN routing protocol have to be scalable sufficient to react toevents, in such a tremendous SNs environment.
- *Network Randomness*: SN mobility is required for numerous applications, even if the most network architectures suppose that the SNs are fixed.
- *Quality of Service*:Data must be distributed insideanassuredphase of the moment. Even though, in various applications, energy preservation, which is straightwayinterrelated to NLT, is addedsignificant than the excellence of the transmitted data. Therefore, an "energy-aware RP" is essential to understand these requirements.

V. EXISTING ENERGY ROUTING PROTOCOLS IN WSN

The routing protocol considers an attempt to enhance the lifetime of a WSN throughdesigningthebest possibleleast-hop routing and reducing the traveling distance between nodes. To construct the WSN available for a longerduration, the other issues such as, " the need to turn off the node's wireless components each time a node is idle" and "self-configure to maximize a EN-EF" are must consider. Situational circumstances also influence these nodes where it is necessary to build upnovel routing algorithms. The foremost purpose of routing is not to communicate data from "source station" to the "destination", but also, to carry out this purpose in an energy competent manner.

Because energy is aninsufficient resource that restricts the lifetime of WSN, many EN-EF RPhave recently been recommended by means of a diversity of technologies [43-44]. In the "Classical routing algorithms" it is tailored to take

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energy-associated standard din spite of classical parameters i.e for "delay" or "hop distance". The majority of the suggested,"energy aware metrics" are identified as a purpose of the energy necessary to converseover the link [1], [4], or node life tasks [44]. However, in order to reduce the comprehensive energy utilization of the opted path, major of the"minimal energy routing algorithms" [44], [45], [46] are centrally managed algorithms.

Melodia et al. [47] suggested "partial topology knowledge" forpropagatingin sensor networks, where every node opts for the "minimum-hop energy weighted path" thatdepends on local awareness of the topology. They supposed that the neighbor discovery protocol provided local information of the topology within a specific diversity for each node. They provided a linear programming formula that selects a range that decreases the energy utilized by the network. Because answerto "linear programming problem" is not really practical, ithasrecommended a "distributed protocols" for tuning to the topology awarenessscale.

Stojmenovic and X. Lin[49] proposed a "power-aware localization" that combines a cost metric based on the "*battery level*" at the node and a "*power metric*" on the transmit power associated with the inter-node distance. They demonstrate the loopless nature of their techniques and demonstrate competence through evaluations. I. Stojmenovic and S. Datta[48] merged the above process with "face routing" to ensure throughput efficiency.

J. Kuruvila et al. [50] suggested a novel"Power-Aware Localized Routing" In this power-path routing the present node selects neighbors that minimize the energy utilization and that is the ratio of distance traveled to the destination node to the responding node. This is the primary localized process based on the progress cost ratio. The author has suggested variations and has also performed regressive imulations. Stojmenovic [51] has generalized this conceptof the cost of advancement and provided a good survey of the common routing framework and also numerousrelated routing methods.

K. Seada et al. [52] recommended a "power-aware greedy routing method" that considers both the communicationenergyand theconsistency of everyconnection. Itutilizes"packet reception rate" and "distance enhancement" as novelconfined metrics for greedy routing. Ithas shown that they can considerably improve the throughput speed and EN-EF in lossyWSN. Itis believed that our model and other modified transmit power.

Li et al. [53] also believed "combined local routing" and "power control problems" below the lossy connections. By means ofanadditionalpractical model for wireless modulation and encoding, too as wireless channel fading, it derived a best possible"power control scheme" over a specifiedconnection. It suggests a "local power efficiency metric" for local routing that is similar to "energy millage". The evaluationshows that their process can have nearby achievement when compared to overall optimization.

CONCLUSION

This review is to reconsidered and explorethe variety of EN-EF RPs that aimsatenergyutilization during Data Transmission That is done to minimize network energy consumption and to support extend NLT and its functionality.Energy utilization is typically a most essential optimization issue related to WSN applications. Because SNs is primarily a battery-powered device, the energy utilization of these sensor devices has to be appropriatelysupervised to maintain network life and functions for a practicalphase of the timeperiod. Supervision the energy utilization through these SNs can be a very difficult concernbecause ofadvancednetwork arrangement and formulations. Much of the studyon this area has contributed various proposed ways to manage energy consumption during data communicationin WSN by SNs devices.

REFERENCES

[1]. Younis, O.; Krunz, M.; Ramasubramanian, S. Node Clustering in Wireless Sensor Networks: Recent Developments and Deployment Challenges. IEEE Netw. 2006, 20, 20–25.

[2]. Abbasi, A.A.; Younis, M. A survey on clustering algorithms for wireless sensor

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ISSN: 0193 - 4120 Page No. 11296 - 11306

networks. Comput. Commun. 2007, 30, 2826–2841.

[3]. Sheikhpour, R.; Jabbehdari, S.; Khadem-Zadeh, A. Comparison of Energy Efficient Clustering Protocols in Heterogeneous Wireless Sensor Networks. Int. J. Adv. Sci. Technol. 2011, 36, 27–40.

[4]. Liu, X. A Survey on Clustering Routing Protocols inWireless Sensor Networks. Sensors 2012, 12, 11113–11153.

[5]. Radi, M.; Dezfouli, B.; Abu Bakar, K.; Lee, M. Multipath Routing in Wireless Sensor Networks: Survey and Research Challenges. Sensors 2012, 12, 650–685.

[6]. Sha, K.; Gehlot, J.; Greve, R. Multipath Routing Techniques in Wireless Sensor Networks: A Survey. Wirel. Pers. Commun. 2012, 70, 807–829.

[7]. Masdari, M.; Tanabi, M. Multipath Routing Protocols in Wireless Sensor Networks: A Survey and Analysis. Int. J. Future Gener. Commun. Netw. 2013, 6, 181–192.

[8]. Anasane, A.A.; Satao, R.A. A Survey on various Multipath Routing Protocols in Wireless Sensor Networks. ProcediaComput. Sci. 2016, 79, 610–615.

[9]. Nikolaos A. Pantazis, Dimitrios D. Vergados, "A Survey on Power Control Issues in Wireless Sensor Networks," IEEE Communications Surveys, 2007, Vol. 9, Issue 4, pp. 86-107.

[10]. Dietrich, I.; Dressler, F. On the Lifetime ofWireless Sensor Networks. ACM Trans. Sens. Netw. 2009, 5, 1–39.

[11]. Kuila, P.; Jana, P. Energy efficient clustering and routing algorithms for wireless sensor networks: Particle swarm optimization approach. Eng. Appl. Artif. Intell. 2014, 33, 127–140.

[12]. Madan, R.; Cui, S.; Lall, S.; Goldsmith, N.A. Cross-Layer Design for Lifetime Maximization in Interference-Limited Wireless Sensor Networks. IEEE Trans. Wirel. Commun. 2006, 5, 3142–3152.

[13]. Akyildiz IF et al (2002) A survey on sensor networks. IEEE Commun Mag 40(8):102–111

[14]. Younis M, Youssef M, Arisha K (2003) Energy-aware management in cluster-based sensor networks. ComputNetw 43(5):649–668

[15]. Hou YT, Shi Y, Sherali HD (2005) On energy provisioning and relay node placement for wireless sensor networks. IEEE Trans WirelCommun 4(5): 2579–2590

[16]. Oyman EI, Ersoy C (2004) Multiple sink network design problem in large scale wireless sensor networks. In: Proceedings of the IEEE international conference on communications (ICC 2004), Paris, June 2004

[17]. Khanna R, Liu H, Chen HH (2006) Self-organization of sensor networks using genetic algorithms. In: Proceedings of the 32nd IEEE international conference on communications (ICC'06), Istanbul, Turkey, June 2006

[18]. Moscibroda T, Wattenhofer R (2005) Maximizing the lifetime of dominating sets. In: Proceedings of the 19th IEEE international parallel and distributed processing symposium (IPDPS'05), Denver, Colorado, Apr 2005

[19]. Dasgupta K, Kukreja M, Kalpakis K (2003) Topology-aware placement and role assignment for energy-efficient information gathering in sensor networks. In: Proceedings of 8th IEEE symposium on computers, 2003. doi:10.1109/ISCC.2003.1214143

[20]. Bandyopadhyay S, Coyle E (2003) An energy efficient hierarchical clustering algorithm for wireless sensor networks. In: Proceedings of the 22nd annual joint conference of the IEEE computer and communications societies (INFOCOM 2003), San Francisco, California, Apr 2003

[21]. Amis AD, Prakash R, Vuong THP, Huynh DT (2000) Max-Min d-cluster formation in wireless ad hoc networks. In: Proceedings of a 20th joint conference of the IEEE computer and communications societies (INFOCOM'2000), Mar 2000. doi:10.1109/INFCOM.2000.832171

[22]. Garcia F, Solano J, Stojmenovic I (2003) Connectivity-based k-hop clustering in wireless networks. TelecommunSyst 22(1):205–220

[23]. Fernandess Y, Malkhi D (2002) K-clustering in wireless ad hoc networks. In: Proceedings of the 2nd ACM international workshop on principles of mobile computing (POMC'02), Toulouse, France, Oct 2002

[24]. Younis M, Akkaya K, Kunjithapatham A (2003) Optimization of task allocation in a cluster– based sensor network. In: Proceedings of the 8th IEEE symposium on computers and communications (ISCC'2003), Antalya, Turkey, June 2003

[25]. Oyman EI, Ersoy C (2004) Multiple sink network design problem in large scale wireless sensor networks. In: Proceedings of the IEEE international conference on communications (ICC 2004), Paris, June 2004

January - February 2020
ISSN: 0193 - 4120 Page No. 11296 - 11306

[26]. Al-Karaki JN, Kamal AE (2004) Routing techniques in wireless sensor networks: a survey. WirelCommun IEEE 11(6):6–28

[27]. Pantazis N, Nikolidakis SA, Vergados DD (2013) Energy-efficient routing protocols in wireless sensor networks: a survey. CommunSurv Tutor IEEE 15(2):551–591

[28]. S. Murphy, L. Aceves, "An Efficient Routing Protocol for Wireless Networks," Mobile Networks and Applications, ACM Journal, USA, Hingham, 1996, Vol. 1, Issue 2, pp. 183-197.

[29]. B. Bellur, R. Ogier, "A Reliable, Efficient Topology Broadcast Protocol for Dynamic Networks," In Proc. IEEE INFOCOM '99, New York, USA, 1999, vol.1, pp.178-186.

[30]. R. Ogier, F. Templin, M. Lewis, "Topology Dissemination Based on Reverse-Path Forwarding (TBRPF)," RFC Editor 2004.

[31]. H. Pucha, S. Das, Y. Hu, "The Performance Impact of Traffic Patterns on Routing Protocols in Mobile Ad Hoc Networks," Computer Networks, 2007, Vol. 51, Issue 12, pp. 3595-3616.

[32]. D. Park, S. Corson, "A Highly Adaptive Distributed Routing Algorithm for Mobile Wireless Networks," In Proc. 16th Conference on Computer and Communications Societies, Japan, 1997, pp. 1405-1413.

[33]. H. Lim, C. Kim, "Flooding in Wireless Ad Hoc Networks," Computer Communications, 2001, Vol. 24, Issue 3, pp. 353-363.

[34]. F. Yu, Y. Li, F. Fang, Q. Chen, "A New TORA-Based Energy-Aware Routing Protocol in Mobile Ad Hoc Networks," In Proc. 3rd IEEE/IFIP International Conference in Central Asia on Internet (ICI), Tashkent, 2007, pp. 1-4.

[35]. Z. J. Haas, "A New Routing Protocol for the Reconfigurable Wireless Networks," In Proc. 6th International Conference on Universal Personal Communications Record, San Diego, CA, 1997, Vol. 2, pp. 562- 566.

[36]. W. Heinzelman, A. Chandrakasan, H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks," In Proc. 33rd Hawaii International Conference on System Sciences, HI, USA, 2000, Vol. 8, pp. 110.

[37]. M. J. Handy, M. Haase, D. Timmermann, "Low Energy Adaptive Clustering Hierarchy with Deterministic Cluster-Head Selection," In Proc. 4th International Workshop on Mobile and Wireless Communications Network, USA, 2002, Vol. 1, pp. 368-372.

[38]. W. Heinzelman, A. Chandrakasan, H. Balakrishnan, "An Application-Specific Protocol Architecture for Wireless Microsensor Networks," IEEE Trans. Wireless Commun., 2002, Vol. 1, Issue 4, pp. 60-70.

[39]. S. Lindsey, C.Raghavendra, "PEGASIS: Power-Efficient Gathering in Sensor Information Systems," In Proc. IEEE Aerospace Conference, USA, Montana, 2002, Vol. 3, pp. 1125-1130.

[40]. J. Chang,, L. Tassiulas, "Energy Conserving Routing in Wireless Ad-Hoc Networks," In Proc. International Conference on Computer Communications, Tel-Aviv, Israel, 2000, pp. 22-31.

[41]. Y. Fan, A. Chen, L. Songwu, L. Zhang, "A Scalable Solution to Minimum Cost Forwarding in Large Scale Sensor Networks," In Proc. 10th International Conference on Computer Communications and Networks, Scottsdale, Orlando, USA, 2001, pp. 304309.

[42]. L. Junhai, X. Liu, Y. Danxia, "Research on Multicast Routing Protocols for Mobile Ad-hoc Networks," Computer Networks, 2008, Vol. 52, Issue 5, pp. 988-997.

[43]. K. Kar, M. Kodialam, T. Lakshman, and L. Tassiulas, "Routing for Network Capacity Maximization in Energy-Constrained Ad-Hoc Networks," Proc. IEEE INFOCOM, 2003.

[44]. J.-H. Chang and L. Tassiulas, "Energy Conserving Routing in Wireless Ad-Hoc Networks," Proc. IEEE INFOCOM, 2000.

[45]. Q. Li, J. Aslam, and D. Rus, "Online Power-Aware Routing in Wireless Ad-Hoc Networks," Proc. ACM MobiCom, 2001.

[46]. Q. Dong, S. Banerjee, M. Adler, and A. Misra, "Minimum Energy Reliable Paths Using Unreliable Wireless Links," Proc. ACM Int'l Symp. Mobile Ad Hoc Networking and Computing (MobiHoc), 2005.

[47]. T. Melodia, D. Pompili, and I.F. Akyildiz, "Optimal Local Topology Knowledge for Energy Efficient Geographical Routing in Sensor Networks," Proc. IEEE INFOCOM, 2004.

[48]. I. Stojmenovic and S. Datta, "Power and Cost-Aware Localized Routing with Guaranteed Delivery in Wireless Networks," Wireless Comm. and Mobile Computing, vol. 4, no. 2, pp. 175-188, 2004.

[49]. Stojmenovic and X. Lin, "Loop-Free Hybrid Single-Path/ Flooding Routing Algorithms with Guaranteed Delivery for Wireless Networks," IEEE Trans. Parallel and

January - February 2020
ISSN: 0193 - 4120 Page No. 11296 - 11306

Distributed Systems, vol. 12, no. 10, pp. 1023-1032, Oct. 2001.

[50]. J. Kuruvila, A. Nayak, and I. Stojmenovic, "Progress and Location Based Localized Power Aware Routing for Ad Hoc and Sensor Wireless Networks," Int'l J. Distributed Sensor Networks, vol. 2, pp. 147-159, 2006.

[51]. I. Stojmenovic, "Localized Network Layer Protocols in Wireless Sensor Networks Based on Optimizing Cost over Progress Ratio," IEEE Networks, vol. 20, no. 1, pp. 21-27, Jan./Feb. 2006.

[52]. K. Seada, M. Zuniga, A. Helmy, and B. Krishnamachari, "Energy-Efficient Forwarding Strategies for Geographic Routing in Lossy Wireless Sensor Networks," Proc. ACM Int'l Conf. Embedded Networked Sensor Systems (Sensys), 2004.

[53]. C.-P. Li, W.-J. Hsu, B. Krishnamachari, and A. Helmy, "A Local Metric for Geographic Routing with Power Control in Wireless Networks," Proc. IEEE Comm. Soc. Sensor and Ad Hoc Comm. and Networks (SECON), 2005.