Available online at www.worldscientificnews.com

World Scientific News

WSN 49(2) (2016) 236-248 EISSN 2392-2192

A study on routing problems and different routing protocols in wireless sensor networks

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ABSTRACT

Extensive utilization of WSN is the reason of advancement of numerous routing protocols. The Late advances in WSN now witness the expanded enthusiasm for the potential use in applications like Environmental, Military, Space Exploration, Health (Scanning), Vehicular Movement, disaster management, Mechanical anxiety levels of appended objects, battle field observation and so forth. Sensors are required to be remotely conveyed in unattended situations. Propels in WSN innovation has given the accessibility of little and minimal effort sensor hubs with a capacity of sensing different sorts of physical and natural environment conditions, wireless communication and data processing. Assortment of sensing capacities results in bounty of application areas. However, the attributes of WSN require more powerful strategies for data forwarding. The sensor hubs in WSN have a constrained transmission range, and their handling and capacity abilities and as well as their energy assets are also restricted. Routing protocols for WSN are in charge of keeping up the routes in the network system and need to guarantee dependable multi-hop communication under these conditions. Routing as one key innovations of wireless sensor systems has now turned into a hot examination on the grounds that the uses of WSN are all over the place, it is unthinkable that there is a routing protocol suitable for all applications. In this paper, we give an overview of routing issues routing protocols for Wireless Sensor Network.

***Keywords*:** Wireless Sensor Networks; routing protocols; routing problems

1. INTRODUCTION

WSN is generally considered as a standout amongst the most vital technologies for the twenty-first century. A WSN commonly comprises of a substantial number of easy, low-control, and multi-functional wireless sensor hubs, with sensing, calculation capacities and wireless interchanges. These sensor hubs communicate over negligible separation by means of a wireless medium and work together to achieve a common task, for instance, modern procedure control environment monitoring and military surveillance. The essential reasoning behind WSNs is that, while the capacity of every individual sensor hub is constrained, the total force of the whole system is adequate for the required mission. In numerous WSN applications, the deployment of sensor hubs is performed in an ad hoc fashion without careful arranging and building. Once sent, the sensor hubs must have the capacity to independently sort out themselves into a wireless communication system. Sensor hubs are battery-controlled and are required to work without participation for a moderately drawn out stretch of time. In most cases it is exceptionally troublesome and even more difficult to change or revive batteries for the sensor hubs.

WSNs are described with denser levels of sensor hub organization, server power, and higher unreliability of sensor hubs, memory limitations and computation. In this way, the special attributes and imperatives present numerous new difficulties for the advancement and utilization of WSNs. The traditional routing protocols have a few inadequacies when connected to WSNs, which are basically because of the vitality obliged nature of such network systems. Due to the vitality imperatives of densely deployed sensor hubs, it requires a suite of system protocols to execute different system control and administration functions, for example, synchronization and node localization. For instance, flooding is a procedure in which a given hub, shows information and control packets that it has gotten to whatever remains of the hubs in the system.

This procedure rehashes until the destination hub is reached. Note that this method does not consider the energy requirement forced by WSNs. Thus, when utilized for data routing as a part of WSNs, it prompts the issues, for example, overlap and implosion. Given that flooding is a visually impaired strategy, copied packets might keep circling in the network and henceforth sensors will get those copied packets, creating an implosion issue. Likewise, when two sensors sense the same locale and telecast their detected information in the meantime, their neighbors will get copied packets. To defeat the weaknesses of flooding, another procedure known as gossiping can be connected. In gossiping, after getting a packet, a sensor would choose arbitrarily one of its neighbors and send the packet to it. The same procedure rehashes until all sensors get this packet. Utilizing gossiping, a given sensor would receive only one duplicate of a packet being sent. While gossiping handles the implosion issue, there is a critical deferral for a packet to achieve all sensors in a system. Besides, these impairments are highlighted when the quantity of hubs in the network increases.

2. ROUTING PROBLEMS

2. 1. Limited energy capacity

Since sensor hubs are battery fueled, they have constrained energy limit. Energy represents a major test for system architects in hostile environments, for instance, a battlefield, where it is difficult to get to the sensors and revive their batteries. Besides, when the energy of a sensor achieved a specific threshold, the sensor will get to be broken and won't have the capacity to work legitimately, which will majorly affect the system execution. Therefore, routing protocols intended for sensors ought to be as energy effective as could be allowed to augment their lifetime, and thus drag out the system lifetime while ensuring great execution generally.

2. 2. Sensor locations

Another test that faces the outline of routing protocols is to deal with the areas of the sensors. The majority of the proposed protocols expects that the sensors either are furnished with global positioning system (GPS) collectors or utilize some limitation strategy to find out about their areas.

2. 3. Limited hardware resources

In addition to restricted energy limit, sensor hubs additionally constrained handling and capacity limits, and thus can just perform constrained computational functionalities. These equipment requirements present numerous difficulties in network protocol and software improvement design for sensor networks, which should consider the energy limitation in sensor hubs, as well as the capacity limits and processing of sensor hubs.

2. 4. Massive and random node deployment

Sensor hub arrangement in WSNs is application subordinate and can be either manual or arbitrary which at least influences the execution of the routing protocol. In many applications, sensor hubs can be scattered arbitrarily in an expected region or dropped greatly over a distance or antagonistic region. In the event that the resultant dispersion of hubs is not uniform, ideal clustering gets to be important to permit availability and empower energy proficient network operation.

2. 5. Network characteristics and unreliable environment

A sensor organizes normally works in a dynamic and untrustworthy environment. The topology of a network, which is characterized by the sensors and the communication joins between the sensors, changes as often as possible because of sensor expansion, erasure, hub failures, harms, or energy consumption. Likewise, the sensor hubs are connected by a wireless medium, which is time varying, noisy, and error prone. Therefore, routing ways ought to consider system topology flow because of restricted energy and sensor versatility and expanding the measure of the system to keep up particular application necessities as far as connectivity and coverage.

2. 6. Data Aggregation

Since sensor hubs may create critical excess information, comparative packets from various hubs can be totaled so that the quantity of transmissions is diminished. The Data aggregation method has been utilized to accomplish the data transfer advancement in various routing protocols and vitality effectiveness.

2. 7. Diverse sensing application requirements

Sensor systems have an extensive variety of various applications. No network protocol can meet the necessities of all applications. Therefore, the routing protocols ought to ensure information conveyance and its exactness so that the sink can assemble the required knowledge about the physical marvel on time.

2. 8. Scalability

Routing protocols ought to have the capacity to scale with the system size. Likewise, the sensors may not as a matter of course have the same abilities regarding particularly communication, energy, sensing and processing. Consequently, communication joins between sensors may not be symmetric, that is, a couple of sensors will most likely be unable to have communication in both bearings. This ought to be dealt with in the routing protocols.

3. ROUTING PROTOCOLS

Routing in WSN differs from conventional routing in altered networks in different ways. There is no framework, sensor hubs may fail, routing protocols need to meet strict energy saving necessities and wireless connections are unreliable.

Table 1. Various Routing Protocols.

Data-Centric Protocols	RR, DD, ACQUIRE, EAD.
Heterogeneity-Based Protocols	CHR, IDSQ
Hierarchical Protocols	LEACH, TEEN, PEGASIS
Location-Based Protocols	GEAR, TBF, BVGF
Mobility-Based Protocols	JMR, DATA MULES, DTDD, SEAD
Multipath-Based Protocols	SDM, BM, N TO 1 MD
Qos-Based Protocols	SPEED

3. 1. Data Centric Protocols

Data-centric protocols different from traditional address-centric protocols. That the information is sent from source sensors to the sink. In addressing-centric protocols, every source sensor that has the appropriate information reacts by sending its information to the sink independently of every other sensors. In data-centric protocols, when the source sensors send their information to the BS. The intermediate sensors can perform some type of accumulation on the information beginning from various source sensors and send the totaled information toward the sink. This procedure can bring about energy reduction because of minimum transmission required to send the information from the sources to the sink. In this area, we survey a portion of the data-centric routing protocols for WSNs.

3. 1. 1. Rumor Routing

Rumor routing is a consistent trade-off between event flooding and query flooding application plans. Rumor routing is a proficient protocol if the quantity of queries is between the two crossing points of the bend of rumor routing with those of event flooding and query flooding. Rumor routing depends on the idea of operator, which is an enduring packet that negotiate a network and appraises every sensor it experiences about the occasions that it has learned during its network navigate. An operator will venture to every part of the network for a specific number of hops and after that die. Every sensor, including the operator, maintains an event list that has where every entry in the list contains the event, the actual interment space in the amount of hops to that event from the current visited sensor and event-distance pairs. Accordingly, when the specialist encounters a sensor on its way, it synchronizes its event list with that of the sensor it has encountered. Additionally, the sensors that hear the operator overhaul their event lists as indicated by that of the operator with a specific end goal to keep up the most limited ways to the events that occur in the system network.

3. 1. 2 Directed Diffusion

It is a data-centric routing protocol for sensor query Processing and dissemination. It meets the primary necessities of WSNs such as robustness and energy efficiency. It has a few key components, namely interests and gradients, data propagation, reinforcement and data naming. A sensing function can be depicted by a list of attribute-value pairs. At the beginning of this process, the sink indicates a minimum data rate for approaching events. Then, the sink can strengthen one specific sensor to send events with a higher information rate by rescinding the first intrigue message with a smaller interim. If a neighboring sensor gets this interest message and finds that the sender's interest has a higher information rate than previously, and this information rate is higher than that of any existing slope, it will strengthen one or more of its neighbors.

3. 1. 3. Energy-Aware Data-Centric Routing (EAD)

It is a novel distributed routing protocol, which fabricates a virtual backbone composed of dynamic sensors that are in charge for in-network traffic relaying and information processing. In EAD, a network system is represented by a broadcast tree spanning all sensors in the network system and established at the gateway, in which all leaf hubs' radios are turned off while other hub relate to dynamic sensors forming the backbone and therefore their radios are turned on. In particular, EAD endeavors to build a broadcast tree that approximates an ideal spanning tree with an at least number of leaves, thus decrease the size of the backbone formed by dynamic sensors. EAD methodology is energy awareness and helps widen the network lifetime. The gateway assumes the part of an information sink or event sink, while every sensor goes about as an information source or event source.

3. 1. 4. Active Query Forwarding in Sensor Networks (ACQUIRE)

It is another data centric querying component utilized for querying named information. It gives better query optimization to answer particular type of queries, called one-shot complex queries for reproduced information. This query comprises of a few sub queries for which a few straightforward responses are given by a few pertinent sensors. Every sub-query is addressed based on the at present stored information at its significant sensor. ACQUIRE permits a sensor to infuse a dynamic query in a system following either an irregular or a predefined direction until the query gets replied by a few sensors on the path utilizing a confined upgrade component. Not at all like other query methods, ACQUIRE permits the querier to infuse an intricate query into the system to be sent stepwise through a succession of sensors.

3. 2. Heterogeneity-based Protocols

In this sensor network design, two types of sensors in particular the battery-powered sensors having restricted lifetime, and line-powered sensors which have no energy requirement, and consequently ought to utilize their accessible energy efficiently by minimizing their capability of data computation and communication. In this segment we discuss utilize of heterogeneity in WSNs to widen network lifetime and present a sprinkling routing protocol.

3. 2. 1. Cluster-Head Relay Routing (CHR)

This protocol utilizes two types of sensors to shape a heterogeneous network with a solitary sink: a small number of powerful high-end sensors, indicated by the H-sensors, and a large number of low-end sensors a large number of low-end sensors, indicated by L-sensors. Both types of sensors are aware and static of their areas utilizing some area administration. In addition, those Land H-sensors are consistent and haphazardly conveyed in the sensor field. This protocol segments the heterogeneous network into gatherings of sensors (or groups), each being made out of L-sensors and drove by an H-sensor. Inside a cluster, the L-sensors are accountable for detecting the fundamental environment and sending data packets started by another L-sensors toward their cluster head in a multi-hop style. The H-sensors are in charge of data fusion inside their own clumps and sending aggregate information packets began from the other cluster head towards the sink with a multi-hop design utilizing just cluster heads. While H-sensors utilize long-range data communication to other neighboring H-sensors and the sink. L-sensors inside the same cluster, L-sensors utilize short-range information transmission to their neighboring.

3. 2. 2. Information-Driven Sensor Query (IDSQ)

This protocol addresses the issue of heterogeneous WSNs of minimizing detection latency and energy consumption and maximizing data gain for target tracking and localization through data routing and active sensor querying. To enhance consumes significant energy and communication between sensors is necessary and tracking accuracy and reduce detection latency. To conserve power, just a subset of sensors need to be operative when there are fascinating events to report in some parts of the network. The decision of a subset of dynamic sensors that have the most valuable data is adjusted by the communication cost required between those sensors. In IDSQ, the initial step is to choose a sensor as pioneers from the clump of sensors. This pioneer will be charged for selecting ideal sensors in a view of some data utility measure.

3. 3. Hierarchical Protocols

Numerous exploration projects in the most recent couple of years have investigated hierarchical clustering in WSN from alternate points of view. Clustering is a vitality effective communication protocol that can be utilized by the sensors to report their detected information to the sink. In this segment, we portray a specimen of layered protocols in which a network is made out of a few clusters (or clumps) of sensors. Every cluster is overseen by an extraordinary hub, called the cluster head, which is in charge of planning the data transmission exercises of all sensors in its cluster.

3. 3. 1. Low-energy adaptive clustering hierarchy (LEACH)

LEACH protocol is the first and most famous energy productive hierarchical clustering algorithm for WSNs. It is proposed for decreasing power utilization. In LEACH, the clumps errand is turned among the hubs, in view of duration. Direct correspondence is utilized by every cluster head (CH) to forward the information to the base station (BS). It utilizes clumps to delay the life of the WSN. LEACH protocol depends on a collection (or fusion) system that joins or totals the original information into a smaller size of information that convey just significant data to every single individual sensor. LEACH protocol partitions the a system into a few clumps of sensors, which are developed by utilizing restricted coordination and control not just to reduce the measure of information that are transmitted to the sink, additionally to make routing and information dispersal more adaptable and strong. LEACH protocol utilizes a randomize pivot of high-vitality CH position instead of selecting in a static way, to allow to all sensors to go about as CHs and maintain a strategic distance from the battery exhaustion of an individual sensor and dying rapidly. LEACH Protocol is totally distributed and requires no worldwide information of the system. It reduces vitality utilization by (a) Turning off non-head hubs however much as could be expected and (b) minimizing the communication cost in the middle of sensors and their cluster heads.

Leach protocol utilizes single-hop routing where every hub can transmit specifically to the cluster head and the sink. In this way, it is not pertinent to networks conveyed in huge areas. Moreover, the dynamic clustering brings additional overhead, e.g. head changes, promotions and so forth., which may reduce the addition in vitality utilization. While LEACH helps the sensors inside their clump disperse their vitality gradually, the CHs expend a bigger measure of vitality when they are found far more distant from the sink. Additionally, LEACH clustering ends in a limited number of cycles. However does not ensure the great CH conveyance and accept uniform vitality utilization for CHs.

3. 3. 2. Threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN)

It is a hierarchical clustering protocol, which clumps sensors into groups with every drove by a CH. The sensors inside a cluster report their detected information to their CH. The CH sends collected data to larger level CH by the data achieved the sink. The sensor network design in TEEN depends on a hierarchical clustering where nearer hubs form clusters then this procedure goes on the second level until the BS (sink) is achieved. It is very useful for applications where the clients can control a trade-off between energy efficiency and data accuracy. Imperative components of incorporating its appropriateness for time basic detecting applications. Likewise, since message transmission expends more energy than data detecting, so the energy utilization in this scheme is not exactly the proactive networks. TEEN is not reasonable for detecting applications where periodic reports are required to follow the client may not get any information at all if the thresholds are not reached.

3. 3. 3. Power-Efficient Gathering in Sensor Information System protocol (PEGASIS)

PEGASIS is an expansion of the LEACH, which frames, chains from sensor hubs so that every hub transmits and gets from a neighbor and one and only hub is chosen from that affix to transmit to the base station (sink). The information is accumulated and moves from hub to hub, amassed and in the long run sent to the base station. The chain development is performed greedily. In PEGASIS, the development stage except that every one of the sensors have worldwide information about the system, especially, the positions of the sensors, and utilize a voracious methodology. When a sensor comes up short or bites the dust because of low battery control, the chain is developed utilizing the same methodology by bypassing the fizzled sensor. In each cycle, a haphazardly picked sensor hub from the chain will transmit the totaled information to the BS, subsequently decreasing the per round vitality expenditure contrasted with LEACH. PEGASIS can build the lifetime of the system twice as much the lifetime of the system under the LEACH.

3. 4. Location-based Protocols

In this protocol, sensor hubs tend to by method of their areas. The location information for sensor hubs is required for sensor network systems by a large portion of the routing protocols to calculate the distance between two specific hubs so that energy expenditure can be evaluated. In this segment, we display a sample of location-aware routing protocols proposed for WSNs.

3. 4. 1. Geographic and Energy-Aware Routing (GEAR)

GEAR is proposed for routing queries to target districts in a sensor field. In GEAR, the sensors should have localization, hardware equipped. Moreover, the sensors are aware of their lingering energy as well as the locations and the leftover energy of each of their neighbors. GEAR utilizes energy aware heuristics that depend on topographical information to choose sensors to route a packet toward its destination locale. GEAR utilizes a recursive geographic forwarding calculation to disseminate the packet inside the target area.

3.4.2 Trajectory-Based Forwarding (TBF)

This protocol requires an adequately the presence of a coordinate system and dense networks, for instance, a GPS, so that the sensors can position themselves and appraisal separation to their neighbors. The source determines the direction in a packet, however, does not expressly demonstrate the path on a hop-by-hop basis. Route maintenance in TBF is unaffected by the sensor. Based on the location information about its neighbors, a forwarding sensor makes an intemperate decision to divine the next hop that is the nearer to the trajectory fixed by the source sensor. TBF can be used for resource discovery. Another important application of TBF is securing the perimeter of the network. TBM can be used for implementing networking functions, for example, network management, flooding, and discovery.

3. 4. 3. Bounded Voronoi Greedy Forwarding (BVGF)

BVGF utilizes the idea of Voronoi graph in which the sensors ought to know about their geological positions. In BVGF, a system is demonstrated by a Voronoi graph with locales representing to the areas of sensors. In this sort of greedy geographic routing, a sensor will constantly forward a packet to the neighbor that has the most limited separation to the destination. The sensors qualified for acting as the next hops are the ones whose Voronoi regions are navigated by the portion line joining the source and the destination. This protocol picks as the next hop the neighbor that has the shortest Euclidean separation to the destination among all qualified neighbors. It doesn't help the sensors, exhaust their battery control consistently. Every sensor really has one and only next hop to forward its information to the sink. Therefore, any information dispersal way between a source sensor and the sink will dependably have the same chain of the next hops, which will extremely experience the ill effects of battery force consumption. This protocol does not consider vitality as a metric.

3. 5. Mobility-based Protocols

Mobility conveys new difficulties to routing protocols in WSNs. Sink mobility requires energy effective protocols to ensure information conveyance began from source sensors toward portable sinks. In this area, we examine sample mobility-based routing protocols for mobile WSNs.

3. 5. 1. Joint Mobility and Routing Protocol

A system with a static sink experiences an extreme issue, called vitality sinkhole problem, where the sensors situated around the static sink are vigorously utilized for sending information to the sink for the benefit of different sensors. Therefore, those vigorously loaded sensors near to the sink, exhaust their battery control all the more rapidly, subsequently disconnecting the system. This issue exists notwithstanding, when the static sink is situated in its ideal position relating to the center of the sensor field. To address this issue, a mobile sink for gathering detected information from source sensors was recommended. For this situation, the sensors encompassing the sink change after some time, allowing to all sensors in the system to act as information transfers to the mobile sink and accordingly adjusting the load of data routing on every one of the sensors. Under the shortest-path routing technique, the normal load of data routing is lessened when the directions of the sink mobility compare two concentric circles. Specifically, the mobility technique of the sink is a symmetric methodology in which the direction of the sink is the periphery of the system. The direction with a radius equivalent to the range of the sensor field augments the separation from the sink to the center point of the system that represents to the problem area.

3. 5. 2. Data MULES Based Protocol

This protocol is proposed to address the need of ensuring cost-effective connectivity in an inadequate network while decreasing the energy utilization of the sensors. It is a three-tier architecture and it’s based on mobile elements, this is called mobile ubiquitous LAN extensions (MULE). The MULEs methodology has three fundamental layers. The top layer incorporates WAN associated gadgets and access focuses/focal vaults for examining the detected information. These entrances focus communicate with a focal information central data warehouse empowering them to synchronize the gathered information, recognize repetitive information, and recognize the receipt of the information sent by the MULEs for dependable information transmission. The center layer has portable elements (MULEs) that move in the sensor field and gather detected information from the source sensors when in closeness convey them to those entrances focuses when in short proximity. The base layer contains static remote sensors that are in charge of detecting a situation. The MULE design helps the sensors, spare their energy as much as possible and extend their lifetime. The MULE design has low infrastructure cost, because of the direct communication between the MULES and the source sensors.There is no routing overhead that would drain the energy of the sensors. MULE design is scalable, very robustness and fault tolerance.

3. 5. 3. Dynamic Proxy Tree-Based Data Dissemination

This protocol framework was proposed for maintaining a tree interfacing a source sensor to various sinks that are occupied in the source. This helps the source spread its data specific to those mobile sinks. In this protocol framework, a network system is composed of several mobile hosts and stationary sensors, called sinks. The sensors are utilized to distinguish and persistently monitor some mobile targets, while the mobile sinks are utilized to gather information from particular sensors, called sources. Which may recognize the objective and occasionally generate sensed data from a subset of sensors. A source may change and another sensor nearer to the target may turn into a source because of target mobility. Every sink is represented by a stationary sink proxy and every source is represented by a stationary source proxy. The sink and source proxies are temporary. A sink will have another sink proxy only when the distance between the sink and its current proxy surpasses a certain threshold. Moreover, A source will have another source proxy only when the separation between the source and current proxy surpasses a certain threshold. The architecture of such proxies decreases the cost of data to and querying data from the source and sinks proxies.

3. 5. 4. Scalable Energy-Efficient Asynchronous Dissemination (SEAD)

It is self-organizing protocol, which was proposed to exchange off between energy savings and decreasing the forwarding delay to a mobile sink. This protocol considers data dissemination in which a source sensor reports its detected data to different mobile sinks. It consists of three fundamental components, namely maintaining linkages to mobile sinks, dissemination tree (d-tree) construction, and data dissemination. It expects data dissemination tree rooted in itself and all the source sensors of all the dissemination trees are constructed independently. This protocol can be seen as an overlay network that sits on top of a location-aware routing protocol (example- geographical forwarding).

3. 6. Multipath-based Protocols

Considering data transmission between the source and the sink sensors, there are two routing paradigms: multipath routing and single-path routing. In multipath routing strategy, every source sensor finds the first k shortest paths to the sink and separates its load evenly among these paths. In single-path routing, every source sensor transfers its data to the sink via the shortest path. In this segment, we examine a sample of multipath routing protocols for WSNs.

3. 6. 1. Disjoint Paths

It is a multipath protocol that helps discover a diminutive number of interchange paths that have no sensor in common with the primary path and with each other. In this routing, the primary path is finest obtainable whereas the alternate paths are less enviable as they have long latency. The disjoint makes those alternate paths self-sufficient of the primary path. Thus, if a stoppage occurs on the primary path, it residue local and does not change any of those alternate paths. The sink can decide which of its neighbors can provide it with the highest eminence data characterized by the lowest delay after the network has been inundated with some low-rate samples. Even though, disjoint paths are more flexible to sensor failures, they can be potentially longer than the primary path and less energy proficient.

3. 6. 2. Braided Paths

It is an inside part disjoint path from primary one subsequent to unwinding the disjointedness constraint. To build the braided multipath, a primary path is processed. Next, for every hub on the primary path, the best path from a source sensor to the sink that does not exclude that hub is processed. Those best substitute paths are not necessarily disjoint from the primary path and that are called idealized braided multipath. In addition, the connections of each of the other paths lie either on or topographically near to the primary path. Therefore, the energy utilization of the primary and substitute paths seems to be comparable as opposed to the scenario of Mutually Ternate. The braided multipath can also be developed in a localized manner, the sink transfer out a primary-path reinforcement to its initially preferred neighbor and substitute-path reinforcement to its second preferred neighbor.

3. 6. 3. N-to-1 Multipath Discovery

It depends on the simple flooding started from the sink. It is composed of two stages, in particular, branch aware flooding (or stage 1) and multipath extent of flooding (or stage 2). Both stages utilize the same routing messages whose arrangement are given by {mtype, mid, nid, bid, cst, path}, where mtype alludes to the type of a message. This protocol creates multiple node-disjoint paths for each sensor. In multi-hop routing, a dynamic for per-hop packet rescuing procedure can be received to handle sensor failures and upgrade system reliability.

3. 7. QoS-based Protocols

Minimizing energy utilization, it is also important to consider the quality of service (QoS) prerequisites regarding fault tolerance, reliability, and delay in routing in WSNs. In this segment, we describe a sample QoS based routing protocols that discover a balance between energy utilization and QoS prerequisites.

3. 7. 1. SPEED

This protocol is a QoS routing protocol for sensor networks that provides soft realtime end-to-end guarantees. The protocol requires every node to maintain information about its neighbors. It utilized geographic forwarding to discover the paths. SPEED can present congestion avoidance when the network is congested. The routing module in this protocol is called Stateless Geographic Non-Deterministic forwarding (SNFG) and it works with four other modules at the network layer. Delay estimation at each hub is essentially made by calculating the elapsed time when an ACK is received from a neighbor. When contrasted with Ad-hoc on-demand vector routing (AODV) and Dynamic Source Routing (DSR), SPEED performs better in terms of end-to-end delay and miss ratio. Additionally, the total transmission energy is less due to the ease of the routing algorithm. SPEED does not consider any auxiliary energy metric in its routing strategy. Therefore, for more realistic comprehension of SPEED's energy utilization, there is a required for contrasting it with a routing protocol, which is energy-aware.

4. CONCLUSION

One of the major challenges in the architecture of routing protocols for WSNs is energy productivity because of the rare energy resources of sensors. A definitive goal behind the routing protocol architecture is to keep the sensors working for as long as possible, thus broadening the network lifetime. The energy utilization of the sensors is commanded by data transmission and reception. Routing protocols intended for WSNs should be as energy production as could be expected under the circumstances to prolong the lifetime of individual sensors, and henceforth the system lifetime. In this paper, we have discussed a sample of routing protocols by considering a few characterization criteria, network layering, including location information, data centricity and path redundancy, in-network processing, network dynamics, network heterogeneity and QoS requirements. For each of these classes, we have discussed a few illustration protocols

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(Received 14 May 2016; accepted 31 May 2016)