A Survey on Cluster Based Energy-Efficient and Fault Tolerant N-Coverage in the Wireless Sensor Network

S. Karthik
Professor & Dean
Department of computer Science and Engineering
(UG & PG), SNS College of technology
Coimbatore, India
profskarthik@gmail.com

D. Satish Kumar
Assistant Professor
Department of computer Science and Engineering,
Nehru Insitute of technology
Coimbatore, India
satishcoimbatore@gmail.com

ABSTRACT: *A wireless sensor network consists of a collection of hundreds or thousands of sensor nodes/ relay nodes with sensing, transmitting module. These sensor nodes execute tasks that were assigned to them in a hostile environment. The security feature along with the ad-hoc nature, irregular connectivity, and resource limitations of relay network result in a number of design challenges. There is currently enormous research potential in the area of WSN. In this paper we present a brief survey of Cluster based energy efficient and fault tolerant n- coverage in WSNs. First we outline the energy efficient and fault tolerant with their corresponding countermeasures in WSNs. Then we present a holistic view of cluster based energy, fault tolerant, coverage conservation and security issues in WSN. Also we highlight the various security and coverage issues in WSN. We have also pointed out the research areas in Cluster based energy efficient and fault tolerant n- coverage in WSNs.*

Keywords: Sensor Nodes, Relay Nodes, Cluster Based, Energy Efficient, Fault Tolerant, Security Issues, Coverage Conservation etc

Received: 11 March 2017, Revised 9 April 2017, Accepted 19 April 2017

1. Introduction

A wireless sensor network consists of a collection of hundreds or thousands of sensor nodes which use wireless links and mechanisms to execute the tasks related to the sending of data in a distributed manner. Each sensor node includes

a sensing module, a computing component, memory and a wireless communication module with an extremely incomplete communication range. Due to the extensive applications in the field of battlefield, monitoring environment habitual, observing biomedical changes the field of wireless sensor network has undergone extensive research work.

The main purpose for maintenance of the sensor network arises due to the limited energy available for every sensor node and the design of network wherein should be in such a way that the mobile base stations extend the lifetime of the network. At every iteration, the positioning of base station changes with time. The numeral linear program method decides on the novel positions of the base stations and with the help of the flow dependent routing protocol energy efficiency can be attained throughout each round.

Due to the nature of wireless communication, data are available in the air for any third party to acquire. The security feature along with the ad-hoc nature, irregular connectivity, and resource limitations of relay network result in a number of design challenges. For example, the accessibility of data to third parties causes numerous disasters in many military or homeland security applications. Therefore, it is critical to provide privacy and authentication while preventing data information from being compromised. Traditionally, security is provided through public key based protocols. However, network topology engages great memory bandwidth and composite mechanism.

Coverage conservation and extending the network lifetime are the primary issues in wireless sensor networks. Due to the different types of applications, coverage is focused for a wide range of interpretations. The applications necessitate that each point in the area is observed by only one sensor while other applications may require that each point is enclosed by the least number of sensors ($n > 1$) to achieve fault tolerance.

2. Energy Alert Based Fault Tolerance Relay Nodes

A sensor network comprising of a number of sensor nodes is classically required to cover a huge geographic area. D. Satish kumar and N. Nagarajan (2013) justified the review of relay technology and certain technical issues related to the physical and MAC layer of IEEE 802.16. It just forwards the data from frame structure, link adaptation, modulation and effective coding but the relay placement problem occurs. The failure duration notice and simultaneous transmissions might direct to significant network congestion. Therefore, survivability of sensor networks is a risky goal.

Moreover, energy is one of the important resource requirements in wireless sensor networks. Relay nodes are usually powered by a battery and merely last for a quite short period of time if operated at high broadcasting power levels. As a consequence, energy-efficient design with fault tolerance is desirable for prolonging the network lifetime.

2.1 Energy Alert-based WSN

Srikanth K. Iyer et al (2011) presented a novel technique to evaluate probably approximately correct (PAC) normalized histogram, which was observed using a fresh rate of certain static values per histogram and the sample is analyzed using random geometric graph consisting of noise-free links. The author presumed a time-slotted network where the sensor nodes were in a way synchronized to boundaries in the form of a slot. Next, the message- passing principle where the nodes only used the predetermined time also referred to as the oblivious schedule in a distributed environment which was highly concentrated whenever the links were noisy with the possibility of introducing errors in the network. Followed by this the schedule highly depended on the factors of node placements with the realization of random geometric graph within a specific transmission range. Due to the introduction of oblivious schedule in the network the sensor nodes can only transmit their data by excluding their address from where it originated. Though the method was securitized from where the data was transmitted remained unsolved.

Zhichu Lin and Mihaela van der Schaar (2011) presented a method for delay sensitive applications because traditional multichip networks only provided solutions for delay-insensitive applications. Several researchers also concentrated on the application of machine learning approach to increase the performance of multi-hop wireless networks. A problem was formulated using the Markov decision process to optimize the utility of network by determining routing and the transmission power to identify the optimized policy for delay-sensitive applications. The author also presented different algorithmic measures to minimize the information overhead at the cost of time resulting in the increasing of the execution time.

Yi Xu et al (2011) measured the huge scale multi-hop network deliberate on the pace boundary of information broadcast. It provides the best information transportation and liberation that a wireless network is able to accommodate. The unified speed upper bound used to offer for broadcast and unicast communique in the huge scale wireless network. While network connectivity is measured, this pace limit is a utility of node density. The pace limits placed the harsh condition on the node position to enumerate the gap between the really achieved speed and the preferred bound in random networks.

Di Wang et al (2011) provided optimal power control mechanisms to provide a significant tradeoff between energy consumption and fairness for wireless networks. In the wireless type of network where energy forms the main constraint in wireless networks, the main objectives remain in maximizing the power efficiency by reducing the power consumption. Moreover, it is highly important to distribute the power consumption in a fair manner to all the sensor nodes to increase the networks life. The author further provided a mechanism called the optimal power control in quasi-closed forms using the convex optimization problem. Further, stochastic optimization algorithms are also designed to study the behavioral patterns of wireless channels on-the-fly to address the problem related to optimal power control policy.

2.2 Fault Tolerant based WSN

Pangun Park et al (2011) presented Breath, a new type of protocol specifically designed for control applications. The most important objective to be met in a wireless sensor network is the designing of an energy-efficient, data transmission in a time manner in an area where the information regarding the plant must be available for control applications. The structuring of breath in WSN is designed in such a way that the nodes closer to the plant transmit the information through multi-hop routing to the sink node by ensuring maximum rate of packet delivery thus minimizing the delay possibilities by minimizing the consumption of energy in WSN. Moreover, the designing of protocol was based on randomized routing, medium access control, and duty-cycling by optimizing energy efficiency. Additionally, the design mechanism relied more on a constrained optimization problem, whereby the objective was minimum energy consumption with the constraints laid being packet reliability and delay but the rate at which the fault was measured to remain unaddressed.

Cheng Wang et al (2011) evaluated the multicast capacity for hybrid wireless networks. The hybrid wireless network comprises of the ad-hoc nodes and base stations designed using the Gaussian Channel model, which addresses both the unicast and broadcast capacity for hybrid wireless networks. The network session uses three multicast strategies. The first-level consists of two types of approaches such as connectivity and percolation for a multi-hop structure formed by the base station. The second level comprises of normal ad-hoc approach which is the multi-hop system not supported by the Base Station. The third level is the traditional Base Station dependent level below which any communication between two ordinary ad hoc nodes is relayed by some specific Base Stations. As a result, the attainable multicast throughput was based on the optimal decision.

Canming Jiang et al (2011) considered the multi input and multi output methods to increase the wireless network capacity. This method is used in the physical and link layers. The network layer contains the limited work in Multi input and multi output environment. The author achieved higher throughput as the number of nodes in the network increased. The MIMO network was modeled based on the spatial multiplexing and intrusion abolition. The MIMO network was based on the arbitrary situated node, each equipped with α antennas and a rate of W on each data stream, with the attainable throughput of all nodes.

Huseyin Ozgur Tan et al (2010) computed the localized, self-systematized robust and energy-efficient tree data aggregation for sensor network, which localized power efficient data aggregation protocol based on the topology methods. The real routing tree is derived over this topology with dissimilar parent strategies by creating the routing tree. The topology and parent diversity terminates the shortest path strategically over LMST structure. The protocol is well modified to cope with the remaining power stage of nodes in order to increase the networks lifetime. The LMST and RNG estimate minimum spanning tree and can be resourcefully computed using only position or distance information of one-hop neighbors.

Jaehoon (Paul) Jeong et al (2012) considered TSF, a multi-hop data delivery in vehicular ad-hoc network nodes. The system identifies the packet destination vehicle's trajectory for such a communication with the help of the vehicle for data delivery. The destination vehicle executes throughout by calculating the data delivery to the optimal value based on the packet and the destination vehicles. TSF forward the packet to the whole multi-hop network by using elected target point. The optimality is attained systematically by exploiting the packet's delivery delay distribution and the destination vehicle's travel delay distribution. As a result, TSF method offers a well-organized data forwarding for a diversity of vehicular traffic conditions.

Byonghyok Choi et al (2012) considered the communication using a high link wireless mesh or sensor network. The group of nodes is used to transmit the data by using AP (access point). When the channels from the nodes to the APs endure from vanishing direct transmissions to the APs it may result in high failure probability, and packets may need to be relayed through other nodes. As the predictable routine, the relay is preselected and hence fading may cause a high failure probability at the router. Geographic communication with the optimized relaying network offers a mathematical intend for the relay assortment for a time period using a geographic communication scheme. It offers the enhanced mechanism for direct transmission and routing using certain other geographic routings.

A.A. Bhorkar et al (2009) considered the dispersed adaptive opportunistic routing scheme for multi-hop wireless and ad-hoc network. The methods used a reinforcement learning framework to route the packet and it proved to be the reliable method to identify the channel allocation. The routing scheme is used to ensure the impact of learning in the context whereas the network structure is characterized by transmission accomplishment probabilities. The routing schemes achieved the best performance compared to the existing methods, but the scalability-related issues are unaddressed.

Floriano De Rango et al (2012) considered the energy-efficient and protocol management which are the critical issues to be handled during the design of the algorithm. It also maintained the node mobility where in the scalable routing plan have been considered and the rules tried to regulate certain QoS restraint and lessen the route detection procedures. Frequently, the energy saving, path duration and constancy can be two complementary efforts and assuring the two metrics can be extremely complicated. The novel routing approach is used to attempt link stability and rate energy utilization in line to provide with the correctness of the anticipated solutions by using the connection-set capability and energy alert routing protocols.

Thomas F. La Porta et al (2009) presented a method for scheming mobile system consisting of particular nodes communicating whose mobility can be forbidden by the essential network. The author designed the mechanism for heterogeneous mobile ad hoc network consisting of two breeds of mobile nodes with relatively plentiful power resources. The author suggested a narrative exploitation structure that makes use of mobility prophecy and mechanism in tandem with the underlying MANET routing protocol and defined the association between the relay nodes. The author presented two illustrations of the relay node with the resolution to accomplish dissimilar goals. First, one Min-Total was accomplished that minimized the total amount of energy in a diagonal manner during data transmission. Second one Min-Max minimized the maximum energy during the data transmission. As a result, it further indicated that when the transmit nodes comprise a small portion of the entire nodes in the network, the anticipated structure results in important power savings.

Fatme El-Moukaddem et al (2010) regarded a key confrontation for data-demanding WSNs that transmit all the data produced within an application's duration to the base location regardless of the reality that sensor nodes have limited energy supplies. The author uses the data rate level to lesson the intensiveness of data in wireless sensor network. It concentrates on three types of the algorithms. The first algorithm does not need complex movement planning of mobile nodes. As a result, it can be implemented on a number of low-cost mobile feeler platforms. The second algorithm incorporates the energy consumption with the mobility and wireless transmission into a holistic optimization framework. The first algorithm computes the most favorable routing tree assuming that the number of nodes can move and the second algorithm to improve the topology of the routing tree by the accumulation of new nodes by using the mobility of the newly added nodes. The third algorithm gets better reposition of its nodes using the routing tree by altering its topology.

Thrasyvoulos Spyropoulos et al (2008) regarded that the mobile systems which are connected erratically do not form a whole path from the sender and receiver. The predictable routing scheme is unsuccessful, since they try to establish an absolute end to end path, previous to the sending of any data. To contract with such a network, researchers have recommended using deluge-based routing schemes. While a deluge based schemes have an elevated probability of delivery, they result in a lot of power problems and further humiliate their performance. The efforts to reduce the overhead of the deluge based scheme have frequently been plagued by large delays. As a result, scatter routing not only carried out extensively smaller quantity broadcast per message, but also had worse average delivery delays than the existing schemes. It is extremely scalable and keeps hold of high-quality performance under a large variety of settings.

Sushant Sharma et al (2010) designed cooperative communications use spatial diversity via a few relay nodes. Above the communication, the option of selecting a relay node is the danger for the overall network performance. The relay node problem in the cooperative ad-hoc network surroundings is a problematic consideration, where numerous source-destinations compete for the same pool of relay nodes in the network. The main intention is to allocate the obtainable relay nodes to a different source-destination, so as to exploit the least amount of data rate among all pairs. The main intention to achieve optimality using an optimal polynomial time algorithm is called ORA.

2.3 Fault Tolerance Relay Nodes in Wireless Sensor Network

Zhi Ang Eu et al (2009) considered energy utilization as a significant problem in wireless sensor networks, which naturally rely on nonrenewable power sources like batteries for power. The author introduced the optimized network performance by identifying the most favorable routing method and relay node assignment scheme for wireless sensor network motorized through ambient power saving. There are three different geographic routing methods and two relay node assignment schemes. As a result, the optimal amalgamation of routing algorithm and relay node assignment schemes offer imminent routing algorithms and relay node assignment schemes on wireless sensor networks that rely exclusively on energy saving in.

Ashima Gupta et al (2010) regarded high-speed wireless broadband access for real time application more relevant to manage and forecast flows in a service distinguished manner. The mathematical form intended for prioritized admission control and forecast in orthogonal occurrence separation numerous access (OOSNA) technologies enables multiple users to communicate using a time-frequency grid.

Dejun Yang et al (2012) considered the wireless sensor networks and relay node assignment to improve the energy effectiveness. The author used two tired constrained relay node assignment problem where the relay node can be located only at some pre individual candidates location. To accumulate the connectivity prerequisite, the connected single-cover trouble is enclosed by a base location or a relay node and the relay nodes form a connected network with the base locations. The two associated dual wrap troubles are enclosed by the two base stations or the relay node. The relay nodes form a two-connected network with the base location. The author used the assumption S that $S \geq 2a > 0$ where S represents the communication range of the relay node and sensor nodes. As a result, the number of transmitting nodes using the formula is no more than twice of that used in a most select solution.

Xiaohua et al (2009) considered an efficient approach to determine the most favorable hop used for multi-hop ad hoc wireless network. This approach was based on the assumption that the nodes use consecutive interfering abandonment (CIA), and the maximal fraction mingles (MFM) to deal with the communal interfering and utilize all the received signal power. The signal-to interference-plus-noise ratio (SINR) of a node resolute solitary by the nodes is earlier than it, not the nodes after it, along a packet forwarding lane. The iterative process chooses the communicating node and evaluates the path method in addition to the capability of a random multi hop packet forwarding path.

Gianni A. Di Caro et al (2011) considered the relay node assignment problem in the wireless sensor network, to locate a limited number of available communicating nodes that can act as a supplementary relay to promote the sensor data toward one or more base positions. The relay node denotes the location in order to enhance the network recital in terms of deliverance ratio and end-to-end delay, and/or to provide connectivity in moderately disengaged areas. These scenarios include the repair of the network in a phase breakdown otherwise the case of networks used in lively environments, such as the network individuality need to be animatedly tailored to the altering conditions. The number

of constraint and consequence components expected modeling the exact individuality of the wireless situation. As a result, the scheme alongside provided betterment with the state-of-the-art dynamic routing protocol, assess the excellence of the routes, and a relay node assignment heuristic to evaluate the positioning of the relay nodes.

Yibin Li et al (2013) stated that the renewable energy such as radiation, can be used to expand the lifetime of a wireless sensor network node. Such systems basically alter the problem related to power scheduling. As a substitute of maximizing system lifetime with a predetermined amount of energy that is used in battery-powered systems, the purpose of scheduling results in the avoidance of energy depletion at any given time. The partial dynamic reconfiguration is established as a well-organized method for intensive applications, such as video and encryption processing. The software-based accomplishment reconfigurable hardware (HW) has the need of time and energy for reconfiguration ahead of enabling the application, which reasons a transaction between the SW and the reconfigurable HW. The novel methodology is obtainable for the scheduling of dynamic reconfiguration for a WSN node under energy-savings conditions based on algebraic information on tasks and accessible energy.

Zongqing Lu et al (2013) provided a solution to eradicate data redundancy and minimize data transmission, which are critical to saving energy in wireless sensor networks (WSNs). The operator contributing towards network processing is recorded with nodes using a sensor network. They receive data from downward stream operators, progress them and route the output to either the awake stream operators or the sink node. The main purpose of operator tree assignment is to minimize the total energy consumption while performing the networking process. There are two mechanisms for using an assignment algorithm. First, one centralized algorithm is that it does not level to large wireless sensor networks, since both sensor nodes are necessary to know the entire topology of the network. The heuristic algorithms are used to place a tree prearranged operator graph, and present a dispersed implementation to optimize in the network processing cost and diminish the communication transparency.

Karakus, C et al (2013) considered improving the lifetime of wireless sensor networks, which is straightly related to the energy effectiveness of computation and communications operation in the sensor nodes. The sensing hypothesis suggests a new way of sending the signal with a much lower number of linear measurements when compared to the conventional case provided that the underlying signal is sparse. Energy debauchery models for both CS and conventional approach are constructed and used to assemble a varied numeral programming framework that jointly provided the energy costs of computation and communication for both CS and conservative approaches. Statistical psychoanalysis is performed by analytically sampling the parameter space. As a result, CS extended the network lifetime for sparse signals and is more beneficial for WSNs with a slighter coverage area.

3. Integrated Network Topological Control and Key Management

The Incorporated Network Topological control and Key management (INTK) scheme of the relay network provides effective routing and security solutions. INTK Scheme encompasses the incorporation of security and routing, active security, robust re-keying, low complexity and the multiple intensites of encrypt features in relay networks. Security scheme is designed with the consideration of multi cluster based topology control through a multiple intensity keying.

D. Satishkumar and N. Nagarajan (2013) found out an improved network topology acquisition process for IEEE 802.16j non transparent mode relay networks. National Chiao Tung University implemented the algorithm process of setting channel identification in mobile stations, which accepted that a new mobile station is mainly focused. The mobile stations which are in the exposure area of the base station are given first preference, and those outside the coverage area are assigned channel ID through relay stations. There are two IDs that are set for both mobile stations. Mobile stations are primarily accepted base stations, to allocate bandwidth.

3.1 Integrated Network Topological Control in WSN

Chi Lin et al (2012) found out energy constrained wireless sensor networks and energy-effectiveness which are considered to be critical for extending the networks lifetime. The data aggregation ant colony algorithm is used to develop the energy-efficiency system. The data aggregation ant colony algorithm contains three stages such as initialization, packet transmission and operations on pheromones. During the transmission stage, each node approximates the residual energy and the amount of pheromones of neighbor nodes to compute the probability of dynamically selecting the

next hop. Subsequent to convinced encircling of transmissions, the pheromones' alteration is carried out, which takes the advantage of both global and local merits for evaporating or depositing pheromones. As a result, data aggregation ant colony algorithm is supposed to be of higher superiority on an average degree of nodes, energy effectiveness, extends the network lifetime, computation intricacy and a sensation ratio of one hop broadcast.

Seok-Chul Kwon et al (2011) regarded multichannel multi boundary for ad hoc wireless networks which gets considerable ability of upgradation by extenuating co-channel interference. Though equipped with an incomplete number of channels and interfaces, this approach cannot keep away from a traffic load as the network traffic increases. The author introduced the narrative scheme of network coding which is dependent on the mixture of a concept of code overhearing and coding conscious channel assignment. The method to recover the radio coverage limitation using conservative network coding scheme improved suppleness in terms of throughput when there is an inadequate number of interfaces. As a result, the methods for improvement in the throughput are compared to the non network coding scheme.

Djamel Djenouri and Ilangko Balasingham (2011) considered the quality of service routing protocol intended for wireless sensor network. The main target of the wireless applications contains the variety of data traffics. It is depended on the QoS necessities according to the type of data category, which enables to give more than a few and modified QoS metrics for both traffic types. It uses a multi sink single path method to add to consistency. The protocol makes use of the diversity in data traffic as considering latency, reliability, residual energy in sensor nodes, and broadcast power flanked by nodes to cast QoS metrics with a multi objective trouble. As a result, the protocol activates with any MAC Protocol for providing the acknowledgement mechanism.

Wei-Chieh Ke et al (2011) considered wireless sensor by joining sensors which have the capability to collect the process, and store the surrounding information in addition to communicate with each other through the inter sensor wireless communication. These traits allow wireless sensor networks to be used in a broad range of applications. These methods provide an incentive for using the minimum sensor network to build a connected wireless sensor network that covers critical quadrangle grids by using critical square grid coverage. As a result, the algorithm improves the critical path coverage.

Samira Mesmoudi and Mohammed Feham (2011) regarded wireless sensor network as a developing technology ensuing from the progress of different fields. The wireless sensor network allows various necessary signals for information related to medical data that needs higher security. This presentation comprises of the wireless body sensor network as the limitation in resource's energy and data-processing. The author used symmetric cryptographic key establishment based on the biometric physiology.

Yao Liang and Rui Liu (2013) considered an important problem of wireless sensor network topology interfering and tomography from the direct dimension analyzed at the data sink. The wireless sensor network topologies are constrained to constant routing tree inference, which is insensible time varying routing that remains unchanged to wireless channel changes. The approach in wireless sensor routing topology capacity is necessary for improving the routing method, topology control and anomaly detection and balances the loads to allow efficient network management and the operations are further used to optimize.

Suat Ozdemir and Yang Xiao (2009) considered a huge number of low-cost sensor nodes that have severe imperfect sensing, computation, and communication capacities. The resource restricted nodes are important to minimize the amount of data broadcasting so that the average sensor lifetime, and the whole bandwidth uses are improved. Data aggregation comprises of mixing sensor node's data with the sink node in order to lessen the amount of data broadcast on the network. The author identified the relation between security and data aggregation procedure in the wireless sensor network. As a result, the methods offer the secure level data aggregation.

Xue Wang et al (2009) considered energy restraint as a main impact on the wireless sensor network. The author used the dispersed power optimization methods for target tracking applications. All the sensor nodes are clustered by grouping together the maximum entropy. For each cluster, the coverage and energy measured by using Dijkstra's and grid barring algorithm, correspondingly is considered. A combination of sensor nodes which are situated in the neighborhood of the target are waked up and have the chance to report their data. As a result, energy effectiveness of wireless

sensor network is improved by similar atom swarm optimization, dynamic approach, and sensor node selection.

Gaurav S. Kasbekar et al (2011) considered huge number of sensors to carry out the dispersed sensing of an objective field where a sensor wrap is taken as a subset of the set of all sensors that wrap the target field. The lifetime of the network is the time from the point the network starts operation awaiting the set of all sensors with the non-zero residual energy not comprising a sensor cover any more. The author provides the polynomial time based allocation mechanism to increase the lifetime of given networks. The mechanism does not need information about the position of nodes or directional information, which is complex to obtain in sensor networks. All the sensor nodes know the distance between the neighbor nodes in the broadcast range. As a result, the mechanism allocates the weight to all the nodes in the exponential form based on the fraction of its initial energy that has been used up so far.

Cunqing Hua et al (2008) considered optimal routing mechanism and the data aggregation for wireless sensor network. The author used to maximize the network lifetime by using the most select routing in data aggregation. The essential and adequate circumstances for attaining the optimality are addressed and a distributed incline algorithm is designed accordingly. The methods can considerably diminish the data traffic and network lifetime is improved. As a result, with the help of the dispersed algorithm, the most favorable values professionally below all network configurations are arrived.

Srikanth Hariharan et al (2011) regarded a particular situation when the opponent tries to induce nodes that it is a legal neighbor, which it can do easily and without the use of cryptographic primitives. The author developed the protected neighbor detection protocol for stable multi-hop wireless network. The author proved that certain constraints like, nonappearance of packet losses, devoid of using any federalized trusted node or particular hardware, protected neighbor detection protocol avoids any node, legal or malicious, from being incorrectly added to the neighbor list of another legitimate node that is not within its transmission range. As a result, to provide the effectiveness of protected neighbor, the detection of protocol to consider the packet losses during those situations were considered accordingly.

3.2 Topological control and key management in WSN

Wei Wang et al (2009) considered combined routing and scheduling in a wireless mesh network as it is considered as an important performance upgrading. As well, the joint routing and scheduling regularly need a centralized organizer to compute the optimal routing and scheduling and distributes such strategy to all the nodes. The routing scheme used to attain vigorous presentation under traffic information indecision. It attains the worst-case optimal value below different traffic conditions with the exclusive feature of authentication using the centralized routing and scheduling in wireless mesh networks.cAs a result, the scheme provides better performance in multipath routing, spatial reprocess and balancing the loads.

Musab Ahmad et al (2013) provided mechanisms to improve the security by using a multi-path routing algorithm. The multi-path routing is difficult to be secured routing and with the help of Trusted Route of Spatial Disjoint Multipath Routing protocol tried to provide security. This protocol, compared to all other routing protocols, raises the throughput and minimizes the amount of every finding overheads, end to end delay and also improve the security of the multipath routing protocol.

Lei Ying et al (2011) considered the backpressure algorithm that not only assures network constancy when the network is a overloaded, beneath light or modest loads, packets may be sent over without extended routes, but the algorithm could be very incompetent in terms of end-to-end delay and routing meeting times. These algorithms adaptively choose a set of optimal routes dependent on shortest-path information in order to minimize average path lengths between every source and destination pair. As a result, the traffic load is achieved in a way such that the extended path is used only when essential, thus resulting in a great deal fewer end-to-end packet delays compared to the traditional back-pressure algorithm.

Kanika pasrija et al (2013) provided mechanisms for data to be transmitted from one node to another node by using links called path. A routing protocol is accountable for discovering the path to be followed by the packets from source to destination. With the help of MANET, there are many protocols obtainable and as per need can be used. Each protocol has its own decisive factor to identify the path from source to destination. The author used to analyze

the scalability over mobile ad-hoc network using the shortest path routing algorithm.

Stella Kafetzoglou and Symeon Papavassiliou (2011) considered data collection and transmission model in wireless sensor networks, where the main purpose is energy efficiency. At the same time, it is adaptive to support various quality of service (QoS) application constraints. They use two energy-saving methods. The first application uses one layer, named as data aggregation and another one uses media access control layer by properly adopting sleeping mechanisms. A cross-layer approach collects the local information about the status of each sensor, including its sleep and schedules, feeds to the subsequent data aggregation phase. It gathers correlated data and aggregates it to a single packet on its way to the sink by applying a fully localized, distributed, probabilistic method.

Sai Ji et al (2013) considered the development of wireless sensor network technology, which has been accepted in a wide diversity of applications such as the health care system and so on. The safety measure's verification and random key distribution were initialized in the network deployment phase. During the network deployment phase, to make sure the real-time update security for the network topology, this scheme planned a dynamic updated key based on the AVL tree. As a result, it ensures the wireless sensor active security in addition to attaining the energy efficiency level.

3.3 Key Distribution Scheme in WSN

Ganesh and Amutha (2013) facilitated tiny and low-cost sensors with the capacity of sensing various types of physical and environmental conditions, data processing, and wireless communication. The sensor nodes have limited broadcast range and their dispensation and storage capacity at the same time limit their energy utilizations. The author introduced a competent and protected routing protocol for wireless sensor networks using the CPR-based dynamic clustering (CPRPSDC) mechanisms. The CPRPSDC partitions the nodes into clusters and select the cluster head based on certain factors. The factors included during the selection of a cluster head consists of the nodes based on the energy, and non CH nodes join with a specific CH based on the CPR values. Error revival has been implemented during the inter-cluster routing in order to keep away from end-to-end error revival. As a result, the protocol provides lower energy aware adaptive clustering hierarchy and power efficient gathering in sensor information systems.

Khan, E et al (2012) used a symmetric key production and pre-distribution scheme, using a symmetric matrix and a generator matrix of utmost rank distance (URD) codes. Sensor nodes are separated into groups, and some information is stored at each node to enable it to generate link keys. This node division significantly improves the reminiscence necessary to each node, which is approximately equal to the group size. These schemes also minimize the communication overhead to set up a link key. It necessitates only two messages to set up a connection key between any two nodes.

Dhananandhini et al (2013) considered a node in a wireless sensor network which is competent in performing certain procedure and collect sensor information from communicating with other connected nodes in the network. The nodes performing the action of broadcast are not successful. This is because of the fact that certain problem may arise such as stipulation node failure will occur at any stage, security issues arise due to the involvement of the number of nodes, and increasing broadcast time due to the higher number of nodes to be active at a particular time to complete a particular task. To solve this problem, the author has introduced two types of algorithms including, the node sensing and node failure for activity detection. The algorithm discovers routes and provides security using neighboring keys and which node involves performing the action with the current node to be active at a stipulated time while the other nodes to be in the sleep mode using the node scheduling scheme.

Jelicic, V et al (2013) considered a wireless sensor network for observing indoor air quality, which is critical for people's comfort, health, and security because they use a large percentage of time in indoor environments. They mainly focus on energy efficiency because gas sensors are powerless, and the sensor node should operate unattended for several years on a battery's energy supply. The author used to provide the context aware adaptive sampling methods in wireless sensor network and get better performance of the security and energy level.

Lee, J.-W et al (2012) worked with batteries as their energy source as it is regularly infeasible to recharge or replace batteries when they discharge in most wireless sensor networks (WSNs). The author provided ant colony based

scheduling algorithm to solve the effective energy reporting problem in WSN. As a result, the work verified the efficiency of the ant colony based scheduling algorithm for solving the effective energy reporting problem in comparison with the other algorithms.

Bharath and mayilsamy et al (2013) regarded mobility management as the significant factor which influences the performance and lifetime of the mobile sensor networks. The multi-target tracking method used ant colony optimization to guarantee these obligations. The method consisted of interacting with the mobile node in an optimal method to cover multi-target. The most favorable path is being chosen by Ant Colony Optimization technique. As a result, the method contrasts to single target tracking methods.

Adamu Murtala Zungeru et al (2012) considered high well-organized routing as an important factor for wireless sensor network protocols to meet the harsh hardware and source constraints. The routing protocols are classified depending on their computational complication, network construction, energy competence and path organization. The author provided the swarm base intelligent method to enhance the routing protocols. The author used routing modeling application simulation environment. As a result better performance was achieved compared to the existing system.

4. Cluster Based Energy Efficient and Fault Tolerant n-Coverage Network

D. Satish Kumar and N. Nagarajan (2013) considered two types of relay form described in wireless sensor networks. The first is the transparent mode, and second one is the non transparent mode. The non transparent mode is used to increase the coverage area of base location, where the low-cost relay station of equal capability as that of base location is located at the proper position. At the non transparent mode, the time engaged is familiar with the mobile stations with bandwidth allocation to be considered as one of the most critical problems. The non transparent relay station enlarges the surrounding of the base locations, and also evaluate the throughput involving the mobile station by considering the exterior coverage area of base location.

Fatme El-Moukaddem et al (2010) considered using low-cost non reusable mobile relays to lessen the energy utilization of data-demanding in a wireless sensor network. The author provides three phases. The first phase computes a more favorable direction-finding tree presumptuous with no movement between nodes. The second phase gets better topology using the direction-finding tree by avariciously adding together fresh nodes which developed mobility using the recently added nodes. The third phase gets better direction-finding tree by change placing its nodes devoid of altering its topology. This iterative phase converges on the optimal location of each node that the direction-finding tree topology does not modify. As a result, better performance was achieved using that system.

4.1 Cluster Based n-Coverage in WSN

Yujin Lim et al (2010) considered a situation with multiple varied wireless sensor networks through a solitary point of sensed data gathering or a gateway, relay points perhaps needed for the energy competent delivery of sensed data from stagnant node to the gateway. The most favorable placement of relay points to be converted into an even more trickier problem is that the stagnant sinks are energetically added failing which the path of mobile sinks cannot be identified. This problem is well addressed using the mechanism to deploy relay point in a grid prototype and to use the tree dependent relaying network for minimizing the cost of the relay point and by minimizing the overhead acquired by the direction setup from the sinks to the gateway. As a result, the tree dependent relaying network mechanism performs based on ad-hoc on demand distance vector routing protocol in terms of the data delivery time; the network serviced time and the control overhead.

Amit Kumar Bindal et al (2012) considered the wireless sensor which is dispersed of elegant sensor nodes interrelated by a wireless communication network. The Wireless Sensor Networks authorize the right to use data from an unsafe and antagonistic surroundings which would not be probable. As a result of gateways and cluster heads it offers increased network lifetime, fault tolerance, attain better network hold and increased uninterrupted operations.

Hazarath Munaga et al (2008) designed a mechanism in such a way that in wireless sensor networks, the sensor nodes neighboring to the base station are required to relay additional packets than the nodes away from the base station. The node lifetime of the sensor network depends on these neighboring nodes. Clustering methods are used to maximize the

lifetime of a wireless sensor network. There are two ways of clustering techniques used such as deciding on cluster heads through additional remaining energy, and involving cluster heads occasionally to distribute the energy utilization between nodes in each cluster and get increasing network lifetime. The fault-tolerant route clustering scheme decides the cluster heads in the wireless sensor network. Trajectory dependent clustering method is further used for choosing the cluster heads and to fault the burning spot problem by extending the network lifetime.

Xian Chen et al (2012) considered the monitoring of sensor network to rapidly sense faults, which is vital for maintaining the fitness of the network. The author concentrated on fault-tolerant out of the group observing for wireless sensor networks. The main objective is to put a minimum number of monitors in a sensor network so that all sensor nodes are observed by k dissimilar monitors, and every monitor provides no more than one wireless sensor nodes. The author used the numeral Linear Programming problem and gained the optimal resolution for the large-scale network. As a result, the Maximum stream dependent approximation algorithm and Maximum degree dependent heuristic algorithm are used to solve the problems.

Lokesh Sharma et al (2013) regard supervision and target monitoring, increasing the degree of coverage and connectivity as the most acquired basic considerations in the design of wireless sensor networks. The author considers the crisis of energy competent coverage and connectivity for haphazard placement of nodes such that vigorous sensor nodes are reduced. The associated dominating set also provided the associated dominating set and used as an effective spine for network connectivity. A number of nodes are sophisticated from separation to the spine network, whereas others are connected under the tributaries of spine network. All the nodes are activated at the same time. The redundancy level is monitored at a regular stage and wastage of resources in the network was considered. As a result, coverage is attained such that overlapping area is reduced, as a connectivity of the network is upheld via spine network and its stream.

4.2 Cluster Based Energy Efficiency in WSN

Andreas Konstantinidis et al (2010) used K-Connected and Power allocation problem in Wireless sensor networks that selects both the sensor locations and transmit power levels, to make the best use of the network coverage and lifetime purposes under K-connectivity constraints, in a single run. The authors have used DRAP and MOEABD to provide the best result in an already used system.

Nasim Khazan et al (2012) considered the problem of placing the sensor nodes in the sensors. They used suitable node placement with better parameters of networks such as coverage, communication, energy utilization and durability and optimize structure presentation according to their specified plan. The method also optimized the number of sensors, low power utilization and concluded node placement to hold a distributed sensor network with asymmetric area. As many areas, in these common methods, do not need sensor placements have also been covered, the number of sensors in the preferred area is being augmented, and subsequently, it has lead to an increase in energy utilization.

Parminder Kaur, Mrs. Mamta Katiyar (2012) regarded wireless sensor network that consisted of a great number of sensors and at least one base station. The leading disparity between the wireless sensor network and the conventional wireless networks is that sensors are tremendously sensitive to energy utilization. Energy saving is the critical matter in designing the wireless sensor networks. In order to make the best use of the lifetime of sensor nodes, it is preferable to deal out the energy degenerated throughout the wireless sensor network. So it is necessary to design effective and energy aware protocols in order to improve the network lifetime. As a result, the problem of energy utilization and network lifetime is solved to an extent.

Samia A et al (2011) considered huge number of sensor nodes that are controlled by battery frequently in a crucial environment. The first problem of energy utilization and other problems like data delivery time by sensor nodes to the sink node were considered. The cluster dependent routing protocol LEACH for energy conservation and PEGASIS chain based protocol select a near optimal chain-based node. Chain cluster dependent routing protocol used to choose the chain support to select the node which is attained in cooperation with minimum energy consumption and minimum delay.

Neeraj Kumar et al (2013) regarded the data diffusion as a main problem of wireless sensor network. The author

used to provide secure and energy effectiveness based data diffusion protocol. A routing mechanism was described to obtain the best route from the accessible routes which guides those routes to be chosen that consume less energy. In Secure data dissemination, a session key is established between dissimilar parties to be communicated. This session key is then used for protecting communication between nodes during data dissemination. As a result, the data diffusion protocol achieved better results in terms of control overhead, network lifetime and throughput.

Lin Shen and Xiangquan SHI (2008) considered wireless communication and microelectronics, which have facilitated an expansion of wireless sensor networks with low cost, low energy utilization and high utilization. A lot of clusters dependent wireless sensor network routing protocols were used to get the best results. Most of them get smaller considerations on communication defense, which is significant to make certain of network security. The insubstantial key organization scheme provides for analysis to effective clarification to the key management of hierarchical clustered wireless sensor networks.

Rahmaan K and Narendran M (2012) considered that with the increase in the number of sensor nodes, the usage of the wireless sensor network also increases rapidly. A large class of Wireless Sensor Networks relevance involves a set of separated metropolitan areas enclosed by sensor nodes scrutinizing environmental parameters. The mobile sink increased upon a metropolitan automobile through fixed paths supply the perfect infrastructure to efficiently recover sensory data from such as inaccessible wireless sensor network. The main aim concentrates towards minimizing the overall network overhead and energy spending connected in the multi-hop data repossession process and also making a certain balanced energy expenditure between sink node and extended network lifetime. This is realized throughout the construction stage where the cluster structures consisted of associate nodes that route their calculated data to their allotted cluster head. As a result, the effectiveness gets against as well as its performance gain over methods.

Shifin.K.H Suresh.S (2013) considered the energy depletion in the wireless sensor network due to the data gathering through the multi-hop transmission techniques. The author introduced Mobicluster protocol applied, which is based on the rendezvous based approach. Mobicluster protocol is not appropriate in the circumstances where connected and disconnected network is considered. It was not able to offer the data collection rate at different environments. The Mobicluster protocol enhanced on top of the by accumulation with some extra features that increase the feasibility of the system. The inter clustering and intra clustering technique was further assumed to unravel the problems related to the connected and disconnected network. To collect the data on-the-fly and to address data gathering at different environmental areas, the energy was considered as an important issue throughout and the inactive time has been appraised using the awaken-scheduling and multi-parent representation.

Stanislava Soro et al (2009) evaluated the problem of coverage conservation with respect to QoS obligations of wireless sensor networks. So far, the problem of coverage conservation has not been adequately discovered in the circumstance of cluster-dependent sensor networks. Particularly, it is not known how to choose the best node for the cluster in applications that need whole coverage of the organized area in excess of lengthy phases of time. The author concentrated heavily on the exclusive nature of applications, which included the continuation of full network coverage as the major requirement. The cluster-based network association is based on a set of coverage-aware cost metrics that is organized in impenetrable inhabited network areas that improve the cluster head nodes, lively sensor nodes and routers.

Giuseppe Anastasi et al (2009) considered wireless sensor network as sensor nodes are normally battery controlled devices. They are considered to be hazardous and it is further discussed about how to minimize the energy utilization of nodes, so that the network lifetime can be enlarged to realistic times. The author follows the energy consumption as the constituents of an archetypal sensor node, and provides with the major directions to energy conservation in the wireless sensor network. The work concentrates on explanations, which have not so far gained a wide attention such as procedures for energy competent data attainment. As a result the author has obtained better results in energy conservation using the wireless sensor network.

4.3 Energy Efficient with Fault Tolerant in WSN

Peyman Neamatollahi et al (2011) discussed systematized sensor networks into clustered structural designs, which is considered as a valuable approach for load balancing and extending the network lifetime. The author used to provide the distributed power competent method to cluster Wireless Sensor Networks. This protocol realizes energy compe-

tence using two methods, namely stipulate clustering and a multi measure cluster formation. Whenever a cluster head puts away a pre-specified part of its energy, it notifies other nodes to grasp cluster head selections for the imminent round. In distributed power, the competent scheme to cluster a node using the large amount of residual energy is regarded as the more appropriate node for selection as a cluster head. In addition, every node calculates a multi measure cost, and a regular node chooses the cluster head by the majority cost to connect to. As a result, the protocol outperforms the distributed power competent scheme to cluster Wireless Sensor Networks in terms of network lifetime and energy consumptions.

Thao P. Nghiem et al (2009) discussed the concern of identifying proper cluster-heads in advance in wireless sensor networks. Subsequently, cluster heads are usually selected in an accidental manner or mainly based on node's residual energy. Consequently, there is no assurance that network coverage is well protected as this QoS is imperative in target tracking and scrutiny applications. In order to improve coverage conservations and energy competence, a coverage-based and energy-efficient cluster-head selection algorithm is designed, which completely considers three significant issues: the node's energy, location and especially coverage cost metric. As a result, it demonstrates the algorithm demonstrated that it not only extends the network lifetime but also significantly expand network coverage, from the central phase of the network lifetime.

Suat Ozdemir et al (2013) designed multiple conflicting optimization algorithms in wireless sensor networks due to their innumerable applications in various fields including, military surveillance, facility monitoring, target detection and health care applications. Many wireless sensor networks intended problems to provide tradeoffs between multiple conflicting optimization purposes such as coverage conservation and energy conservation. The author provides multi intention optimization algorithms the so-called multi intention evolutionary algorithm based on decomposition to resolve the problem and at the same time the coverage conservation and energy conservation design problems in cluster-based WSNs is also addressed. As a result, with the help of different network topologies it is revealed that a multi intention optimization algorithm is a reasonable approach for expanding the network lifetime as conservation and it also addresses the issues related to additional coverage.

Hongbin Chen et al (2009) discussed a multi-cluster sensor network which is functional for source mining in a sensing field. Both the performance of source mining and the total energy expenditure in the sensor network which considers the utilities of the number of clusters are evaluated. A particle swarm optimization algorithm is applied which works to form the cluster which facilitates every cluster to perform source mining. As a result, performance is greatly improved by adopting the multi cluster structure of the sensor network.

Mingdong Xu et al (2009) discussed the cross-layer optimization of wireless sensor networks which were below the constraints of total energy expenditure and transmission delay. The author used to optimize the transmission energy allocation strategy and the delay of every node is taken into consideration in order to reduce the mean distortion of the measured information. As a result, the adaptive approach is used to provide an efficient sensing in terms of presentation and energy expenditure.

Chih-Yung Chang et al (2011) presented the hurdle box mechanism which is considered as a low-cost localization method for wireless sensor networks. The authors have provided a distinguished qualified location (DQL) mechanism, which uses a mobile node that fastens the broadcast tones and bonfire aiming at an individual relative locations of any two neighboring nodes. As a result, the mechanism effectively differentiates relative locations of any two neighboring nodes and thus considerably get better performance of location aware routing in wireless sensor networks compared to the stat-of-the-art techniques.

Brenk, D et al (2011) discussed the analog-to-digital converter (ADC) which is obtainable, whose mechanism makes use of effective ultra low-power method to allow wireless sensing with inactive and semi inactive sensor nodes. In addition, it is a digital circuit fraction that reduces most of the available energy. So the digital near-threshold operation was provided to minimize their utilization.

Choudhury, P et al (2012) presented optical technologies to provide energy competence of network infrastructures. The mathematical models designed proceeded in the direction of designing energy- and cost efficient mixed line rate

optical networks. As a result, the relationship between energy is reduced, and the cost is reduced in mixed line rate network design.

5. Conclusion

The general concepts of wireless sensor network like energy-alert and fault tolerance in wireless sensor network is discussed in this paper. Coverage conservation and extending the network lifetime are the primary issues in wireless sensor networks. The Current technology and research focuses on the security and coverage of wireless sensor network. We have briefly described the attacks that occur in sensor network particularly in the relay nodes and sensor nodes. Energy is one of the important resource requirements in wireless sensor networks. The Incorporated Network Topological control and Key management (INTK) scheme of the relay network provides effective routing and security solutions are also discussed in this paper.

References

[1] Satish kumar, D., Nagarajan, N. (2013). Relay technologies and technical issues in IEEE802.16j MobileMulti-hop Relay (MMR) networks, *Journal of Network and Computer Applications*., Elsevier Journal., 2013.

[2] Iyer., Srikanth, K. Manjunath, D., Sundaresan, Rajesh. (2011). In-Network Computation in Random Wireless Networks: A PAC Approach to Constant Refresh Rates with Lower Energy Costs, *IEEE Transactions on Mobile Computing*, 10 (1) January 2011.

[3] Lin, Zhichu., Schaar, Mihaela van d. (2011). Autonomic and Distributed Joint Routing and Power Control for Delay-Sensitive Applications in Multi-Hop Wireless Networks, *IEEE Transactions on Wireless Communications*, 10 (1) January 2011.

[4] Xu, Yi., Wang, Wenye. (2011). The Limit of Information Propagation Speed in Large-Scale Multihop Wireless Networks, *IEEE/ACM Transactions on Networking*, 19 (1) February 2011.

[5] Wang, Di., Wang, Xin., Cai, Xiaodong. (2011). Optimal Power Control for Multi-User Relay Networks over Fading Channels, *IEEE Transactions on Wireless Communications*, 10 (1) January.

[6] Park, Pangun., Fischione, Carlo, Bonivento, Alvise., Johansson, Karl Henrik., Sangiovanni-Vincentelli, Alberto L.(2011). Breath: An Adaptive Protocol for Industrial Control Applications Using Wireless Sensor Networks, *IEEE Transactions on Mobile Computing*, 10 (6) June 2011.

[7] Wang, Cheng, Li, Xiang-Yang., Jiang, Changjun, Shaojie., Tang., and Liu, Yunhao. (2011). Multicast Throughput for Hybrid Wireless Networks under Gaussian Channel Model, *IEEE Transactions on Mobile Computing*,10 (6), June 2011.

[8] Jiang, Canming., Shi, Yi., Y. Hou, Thomas., Kompella, Sastry. (2011). On the Asymptotic Capacity of Multi-Hop MIMO Ad Hoc Networks, *IEEE Transactions on Wireless Communications*, 10 (4) April 2011.

[9] Tan, Huseyin Ozgur., Korpeoglu, Ibrahim., tojmenovi, Ivan. (2010). Computing Localized Power Efficient Data Aggregation Trees for Sensor Networks, *IEEE Transactions on Parallel and Distributed Systems*, 2010.

[10] Jeong, Jaehoon (Paul)., Guo, Shuo., Gu, Yu (Jason). He, Tian, Du, David H.C (2012). Trajectory-Based Statistical Forwarding for Multihop Infrastructure-to-Vehicle Data Delivery, *IEEE Transactions on Mobile Computing*, 11 (10) October 2012.

[11] Byonghyok Choi., Tan F. Wong., and John M. Shea. (2012). Geographic Transmission with Optimized Relaying (GATOR) for the Uplink in Mesh Networks, *IEEE Transactions on Wireless Communications*, 11 (6), June 2012.

[12] Bhorkar, A.A., Naghshvar, M., Javidi, T., Rao, B.D. (2009). An Adaptive Opportunistic Routing Scheme for Wireless Ad-hoc Networks, *IEEE Transaction on Wireless Communication*.

[13] Rango, Floriano De., Guerriero, Francesca., Fazio, Peppino. (2012). Link-Stability and Energy Aware Routing Protocol in Distributed Wireless Networks, *IEEE Transactions on Parallel and Distributed Systems*, 23 (4) April 2012.

[14] Venkateswaran, Aravindhan., Sarangan, Venkatesh., La Porta, Thomas F., Acharya, Raj. (2009). A Mobility-

Prediction-Based Relay Deployment Framework for Conserving Power in MANETs, *IEEE Transactions on Mobile Computing*, 8 (6) June 2009.

[15] Fatme El-Moukaddem, Eric Torng, Guoliang Xing. (2010). Mobile Relay Configuration in Data-intensive Wireless Sensor Networks, *IEEE Transactions on Mobile Computing*., 2010.

[16] Thrasyvoulos Spyropoulos, Konstantinos Psounis., Cauligi S. Raghavendra. (2008). Efficient Routing in Intermittently Connected Mobile Networks: The Multiple-Copy Case. *IEEE/ACM Transactions on Networking*, 16 (1) February 2008.

[17] Sushant Sharma., Yi Shi., Y. Thomas Hou., Sastry Kompella. (2010). An Optimal Algorithm for Relay Node Assignment in Cooperative Ad Hoc Networks, *IEEE/ACM Transactions on Networking*, 2010.

[18] Eu, Zhi Ang., Tan, Hwee-Pink.. Seah, Winston K. G. (2009). Routing and Relay Node Placement in Wireless Sensor Networks Powered by Ambient Energy Harvesting, *In: IEEE Wireless Communications and Networking Conference*, 2009.

[19] Gupta, Ashima, Ghosh, Debalina., Mohapatra, Prasant. (2010). Scheduling Prioritized Services in Multihop OFDMA Networks, *IEEE/ACM Transactions on Networking*.

[20] Yang, Dejun., Misra, Satyajayant., Fang, Xi. Xue, Guoliang., Zhang, Junshan. (2012). Two-Tiered Constrained Relay Node Placement in Wireless Sensor Networks: Computational Complexity and Efficient Approximations, *IEEE Transactions on Mobile Computing* 11 (8).

[21] Xiaohua (Edward) Li. (2009). Hop Optimization and Relay Node Selection in Multi-Hop Wireless Ad-Hoc Networks journal of Springer 2009.

[22] Gianni A. Di Caro and Eduardo Feo Flushing. (2011). Optimal relay node placement for throughput Enhancement in wireless sensor networks IEEE Transaction conference paper, 2011.

[23] Yibin Li, Zhiping Jia, Shuai Xie, Fucai Liu. (2013). Dynamically Reconfigurable Hardware With a Novel Scheduling Strategy in Energy-Harvesting Sensor Networks, *IEEE Transaction on sensor journal*, 13 (5) May 2013.

[24] Zongqing Lu, Yonggang Wen, Rui Fan, Su-Lim Tan more authors. (2013). Toward Efficient Distributed Algorithms for In-Network Binary Operator Tree Placement in Wireless Sensor Networks, *IEEE Transaction on Selected Areas in Communications*, 31 (4) April 2013.

[25] Karakus, C., Gurbuz, A.C., Tavli, B. (2013). Analysis of Energy Efficiency of Compressive Sensing in Wireless Sensor Networks, *IEEE Transaction on Sensors Journal*, 13 (5) May 2013.

[26] Satish Kumar, D., Nagarajan, N. (2013). Improved Network Topology Acquisition processes in IEEE 802.16j nontransparent mode relay networks, *Journal of Discrete Mathematical Sciences and Cryptography*, 2013.

[27] Chi Lin, Guowei Wu, Feng Xia, Mingchu Li, Lin Yao, Zhongyi Pei. (2012). Energy efficient ant colony algorithms for data aggregation in wireless sensor networks, *Journal of Computer and System Sciences*., Elsevier Journal., 2012.

[28] Seok-Chul Kwon, Faramarz Hendessi, Faramarz Fekri, Gordon Stuber, L. (2011). A Novel Collaboration Scheme for Multi-Channel/Interface Network Coding, *IEEE Transactions on Wireless Communications*, 10 (1) January 2011.

[29] Djamel Djenouri, Ilangko Balasingham. (2011). Traffic-Differentiation-Based Modular QoS Localized Routing for Wireless Sensor Networks, *IEEE Transactions on Mobile Computing*, 10 (6) June 2011.

[30] Wei-Chieh Ke, Bing-Hong Liu, Ming-Jer Tsai. (2011). Efficient Algorithm for Constructing Minimum Size Wireless Sensor Networks to Fully Cover Critical Square Grids, *IEEE Transactions on Wireless Communications*, 10 (4) April 2011.

[31] Samira Mesmoudi, Mohammed Feham. (2011). BSK-WBSN: BIOMETRIC SYMMETRIC KEYS TO SECURE WIRELESS BODY SENSORS NETWORKS, *International Journal of Network Security* & Its Applications (IJNSA), 3 (5), DOI: 10.5121/ijnsa.2011.3512 155, 2011.

[32] Yao Liang, Rui Liu. (2013). Routing Topology Inference for Wireless Sensor Networks, ACM SIGCOMM Computer Communication Review 22 43 (2) April 2013.

[33] Suat Ozdemir, Yang Xiao. (2009). Secure data aggregation in wireless sensor networks: A comprehensive overview,

Computer Networks Elsevier Journal., 2009.

[34] Xue Wang, Junjie Ma, Sheng Wang, Daowei Bi. (2009). Distributed Energy Optimization for Target Tracking in Wireless Sensor Networks, *IEEE Transactions on Mobile Computing*, 9 (1) January 2009.

[35] Gaurav, Kasbekar, S., Yigal Bejerano, Saswati Sarkar. (2011). Lifetime and Coverage Guarantees through Distributed Coordinate-Free Sensor Activation, *IEEE/ACM Transactions on Networking*, 19 (2) April 2011.

[36] Cunqing Hua, Tak-Shing Peter Yum. (2008). Optimal Routing and Data Aggregation for Maximizing Lifetime of Wireless Sensor Networks, *IEEE/ACM Transactions on Networking*, 16 (4) August 2008.

[37] Srikanth Hariharan, Ness, Shroff, B., Saurabh Bagchi. (2011). Secure neighbor discovery through overhearing in static multihop wireless networks, Computer Networks., Elsevier journal.

[38] Wei Wang, Xin Liu, Dilip Krishnaswamy. (2009). IRobust Routing and Scheduling in Wireless Mesh Networks under Dynamic Traffic Conditions, *IEEE Transaction on Mobile Computing*, 8 (12) December 2009.

[39] Musab Ahmad AL-Tarawni Dr. Mohd. Yusoff Jamaluddin. (2013). Trusted Route of Spatial Disjoint Multipath Routing Over MANET, *International Journal of Applied Science and Technology* 3 (4) April 2013.

[40] Lei Ying, Sanjay Shakkottai, Aneesh Reddy. (2011). On Combining Shortest-Path and Back-Pressure Routing Over Multihop Wireless Networks, *IEEE/ACM Transactions on Networking*, 19 (3) June 2011.

[41] Pasrija, Kanika., Seema Rani, Ashok. (2013). Shortest Path Routing Over Scalable Mobile Ad Hoc Networks, *International Journal of Advanced Research in Computer Science and Software Engineering*, 3 (9) September.

[42] Kafetzoglou, Stella., Papavassiliou, Symeon. (2011). Energy-efficient framework for data gathering in wireless sensor networks via the combination of sleeping MAC and data aggregation strategies,*International Journal of Sensor Networks*, 10 (1/2), p.3-13.

[43] Ji, Sai., Huang, Liping., Wang, Jin. (2013). A Novel Key Management Scheme Supporting Network Dynamic Update in Wireless Sensor Network *International Journal of Grid and Distributed Computing*, 6 (1) February.

[44] Ganesh, S., Amutha, R. (2013). Efficient and Secure Routing Protocol for Wireless Sensor Networks through SNR based Dynamic Clustering Mechanisms, *IEEE transaction on Communications and Networks* 15 (4) August.

[45] Khan, E., Gabidulin, E., Honary, B., Ahmed, H. (2012). Matrix-based memory efficient symmetric key generation and pre-distribution scheme for wireless sensor networks, *IEEE Transaction on Wireless Sensor Systems*, 2 (2) June.

[46] Dhananandhini, J., Niranjana, C.M., Rajeshwari, K., Karthick, H. R. (2013). Detecting Sensor Node Failure and Node Scheduling Scheme for WSN *International Journal of Engineering Research and Development*, 9 (2) November 53-56.

[47] Jelicic, V., Magno, M., Brunelli, D., Paci, G. (2013). Context-Adaptive Multimodal Wireless Sensor Network for Energy-Efficient Gas Monitoring, *IEEE Transaction journal on sensor* 13 (1) January.

[48] Lee, J.-W., Daejeon, Korea, Lee, Ju-Jang. (2012). Ant-Colony-Based Scheduling Algorithm for Energy-Efficient Coverage of WSN, *IEEE Transaction on sensor journal*, 13 (1) October.

[49] Bharath Kumar, S., Mayilsamy, C. (2013). Ant-Colony-based Algorithm for Multi-Target Tracking in Mobile Sensor Networks *International Journal of Computer Applications* (0975 - 8887) 64 (2) February 2013.

[50] Zungeru, Adamu Murtala., Ang, Li-Minn., Seng, Kah Phooi. (2012). Classical and swarm intelligence based routing protocols for wireless sensor networks: A survey and comparison, *Journal of Network and Computer Applications*.

[51] Satish Kumar, D., Nagarajan, N. (2013). Analysis of Transparent and non- Transparent relay modes in IEEE 802.16j Mobile Multi-Hop relay networks, *Journal of Discrete Mathematical Sciences and Cryptography*.

[52] El-Moukaddem., Fatme Torng., Eric Xing, Guoliang. (2010). Mobile Relay Configuration in Data-intensive Wireless Sensor Networks, *IEEE Transactions on Mobile Computing*.

[53] Lim, Yujin., Park, Jaesung., Ahn, Sanghyun. (2010). Designing the tree-based relaying network in wireless sensor Networks, *International Journal of Energy, Information and Communications* 1 (1) November.

[54] Bindal, Amit Kumar., Jain, Anuj Prasad., Devendra., Patel, R. B. (2012). Hierarchical Fault Tolerant Adaptive

and Scalable Protocol for Data Dissemination in Wireless Sensor Network: HiFAS, *International Journal of Applied Engineering Research*, 7 (11).

[55] Hazarath Munaga, Murthy, J. V. R., Venkateswarlu, N. B. (2008). A Fault Tolerant Trajectory Clustering (FTTC) for selecting cluster heads inWireless Sensor Networks, *International Journal of Computational Intelligence Research*.

[56] Xian Chen., Yoo-Ah Kim., Bing Wanga., Wei Wei., Zhijie Jerry Shi., Yuan Song. (2012). Fault-tolerant monitor placement for out-of-band wireless sensor network monitoring, Ad Hoc Networks., Elsevier Journal.

[57] Sharma., Lokesh., Agnihotri, Swati. (2013). A Connectivity and Coverage Preserving Schemes for Surveillance Applications in WSN, *IJCSNS International Journal of Computer Science and Network Security*, 13 (6) June.

[58] Konstantinidis, Andreas., Yang, Kun. (2010). Multi-objective K-connected Deployment and Power Assignment in WSNs using a problem-specific constrained evolutionary algorithm based on decomposition, *Computer Communications*.

[59] Khazan, Nasim., Nima, Ali Broumandnia., Motlagh, Ghazanfari. (2012). Placement and Coverage in Asymmetrical Area, *International Journal of Advanced Research in Computer Science and Software Engineering*.

[60] Parminder Kaur, Mamta Katiyar. (2010). The Energy-Efficient Hierarchical Routing Protocols for WSN: A Review, *International Journal of Advanced Research in Computer Science and Software Engineering*, 2 (11) November.

[61] 61. Ali, Samia A., Refaay, Shreen K. (2011). Chain-Chain Based Routing Protocol, *International Journal of Computer Science*, 8 (3) No. 2, May.

[62] Kumar, Neeraj., Kumar, Manoj., Patel, R. B. (2013). A Secure and Energy Efficient Data Dissemination Protocol for Wireless Sensor Networks, *International Journal of Network Security*, 15 (6) 490-500, November.

[63] 63. SHEN, Lin., SHI, Xiangquan. (2008). A Dynamic Cluster-based Key Management Protocol in Wireless Sensor Networks, *International Journal of Intelligent Control and Systems*, 13 (2) June. 146-151.

[64] Rahmaan K., Narendran, M. (2012). Enabling Energy Efficient Sensory Data Collection with Mobile Sink, *International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)* 1 (2) July - August.

[65] Shifin, K.H., Suresh, S. (2013). Rendezvous Based Data Dissemination in Wireless Sensor Network, *International Journal of Computer Science and Management Research*, 2 (2) February.

[66] Soro, Stanislava., Heinemann, Wendi B. (2012). Cluster head election techniques for coverage preservation in wireless sensor networks, *Ad Hoc Networks*, 2009.

[67] Anastasi, Giuseppe., Conti, Marco., Francesco, Mario Di., Passarella, Andrea. (2009). Energy conservation in wireless sensor networks: A survey, *Ad Hoc Networks*.

[68] Peyman., Neamatollahi., Hoda, Taher.i, Naghibzadeh, Mohammad. (2011). Distributed Energy Efficient Scheme to Cluster, *Wireless Sensor Networks*.

[69] Nghiem, Thao P., Hyun, Kim., Jong, Lee., Sun, Ho., Cho, Tae Ho. (2013). A Coverage and Energy Aware Cluster-Head Selection Algorithm in Wireless Sensor Networks, *Journal of Springer*.

[70] Ozdemir, Suat., Attea, Bara'a A., Khalil, Onder A. (2013). Multi-Objective Evolutionary Algorithm Based on Decomposition for Energy Efficient Coverage in Wireless Sensor Networks, *Journal of Springer*.

[71] Chen, Hongbin., Guangzhou, Tse, C.K., Feng, Jiuchao. (2009). Minimizing effective energy consumption in multi-cluster sensor networks for source extraction, *IEEE Transactions on Wireless Communications*, 8 (3) March.

[72] Xu, Mingdong., Leung, H. (2011). A Joint Fusion, Power Allocation and Delay Optimization Approach for Wireless Sensor Networks, *IEEE Transaction on Sensors Journal*, 11 (3) March.

[73] Chang, Chih-Yung., Lin, Chih-Yu., Cha, Chao-Tsun. (2012). Tone-Based Localization for Distinguishing Relative Locations in Wireless Sensor Networks, *IEEE Transaction Sensors Journal*, 12 (5) May.

[74] Brenk, D., Essel, J., Heidrich, J., Agethen, R. (2011). Energy-Efficient Wireless Sensing Using a Generic ADC Sensor Interface Within a Passive Multi-Standard RFID Transponder, *IEEE Transaction on Sensors Journal* 11 (11) November.

[75] Choudhury, P., Tornatore, M., Nag, A., Ip, E. (2012). On the Design of Energy-Efficient Mixed-Line-Rate (MLR)

Optical Networks, *IEEE Transaction on Light wave Technology, Journal of* 30 (1) January.

Author's biography

D. Satish Kumar received his B.E., degree in Electrical and Electronics Engineering from Bharathiar University and M.E. degree in Computer Science and Engineering from Manonmaniam Sundharnar University respectively. He is currently working towards the PhD degree in Computer Science and Engineering in Anna University, Chennai, Tamil Nadu INDIA. His research interests accumulate in the area of wireless sensor Networks, IEEE 802.16j Multi hop Mobile networks, Routing, WIMAX networks, Network management in wired Networks and Wireless Networks.

Dr. S.Karthik, is presently a Professor & Dean, Department of Computer Science & Engineering, SNS College of Technology, affiliated to Anna University- Chennai, Tamilnadu, India. He received his M.E and Ph.D Degree from Anna University Chennai. His research interests include network security, web services and wireless systems. Dr.S. Karthik published many papers in international journal and conference papers and has been involved many international conferences as Technical Chair and tutorial presenter. He is a active member of IEEE, ISTE and Indian Computer Society