QoS in Wireless Sensor Networks – Survey

V. Vanitha[1] D. Palanivel Rajan[2]

ABSTRACT

Sensor networks are distributed networks made up of small sensing devices equipped with processors, memory, and short-range wireless communication. They differ from traditional computer networks in that they have resource constraints, unbalanced mixture traffic, data redundancy, network dynamics, and energy balance. Work within wireless sensor networks (WSNs) Quality of service (QoS) has been isolated and specific either on certain functional layers or application scenarios. However the area of sensor network quality of service (QoS) remains largely open. In this paper we examine and discuss the requirements, challenges of handling of QoS traffic and open research issues on QoS management in WSN and the various approaches for obtaining the QoS in WSN.

1. INTRODUCTION

Wireless sensor networks are a new class of distributed systems that are an integral part of the physical space they inhabit. Unlike most computers, which work primarily with data created by humans, sensor networks reason about the state of the world that embodies them. This bridge to the physical world has captured the attention and imagination of many researchers, encompassing a broad spectrum of ideas, from environmental protection to military applications. Recent advances in wireless communications and electronics have enabled the development of low cost, low-power, multifunctional sensor nodes that are small in size and communicate in short distances. These sensor nodes consist of sensing, data processing, and communicating components and sensor networks represent a significant improvement over traditional sensors. A sensor network is composed of a large number of sensor nodes that are densely deployed either inside the phenomenon or very close to it. The position of sensor nodes need not be engineered or predetermined. This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fitted with an onboard processor. Instead of sending the raw data to the nodes responsible for the fusion, they use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data. Although many protocols and algorithms have been proposed for traditional wireless ad hoc networks, they are not well suited to the unique features and application requirements of wireless sensor networks WSNs). WSNs fundamentally differ from traditional wireless networks because WSNs devices have limited

---

[1] Assistant Professor,Department of Computer Science and Engineering, Kumaraguru College of Technology ,Anna University ,Coimbatore, Tamil nadu, India. Email : vanithajayaprakash@yahoo.com

[2] Student, II M.E (CSE), Department of Computer Science and Engineering, Kumaraguru College of Technology,Anna University ,Coimbatore, Tamil nadu, India. Email : *Palanivelrajan.d@gmail.com*

capabilities, tight resource capacities, and are typically deployed in high densities with unpredictable distribution in dynamic and often harsh environments. All physical characteristics add to the complexity of determining whether certain Quality of Service (QoS) requirements can actually be met for WSNs' application. To meet application level QoS requirements in actual WSNs deployments, many research have been focused on WSNs' QoS. But in WSNs QoS has been isolated and specific either on certain functional layers or application scenarios. Although such research is beneficial to the specific cases that it investigates, it may not be considered all the elements that affect the required QoS performance. This will become even more apparent as we analysis WSN capabilities in higher levels of sophistication, and the interaction complexity among a WSN component functionalities increases.

Energy-aware network management will ensure a desired level of performance for the data transfer while extending the life of the network. Energy constraints combined with a typical deployment of large number of sensor nodes have necessitated energy-awareness at most layers of networking protocol stack including network and link layers. Current research on routing in wireless sensor networks mostly focused on protocols that are energy aware to maximize the lifetime of the network, are scalable to accommodate a large number of sensor nodes, and are tolerant to sensor damage and battery exhaustion.. Energy-aware routing can optimize the transmission energy, while collision avoidance and minimization of energy consumed by the receiver can be achieved via energy-efficient medium access control (MAC) mechanisms. Since such energy consideration has dominated most of the research in sensor networks, the concepts of latency, throughput and delay jitter were not primary concerns in most of the published work on sensor networks. However, the increasing interest in real-time applications along with the introduction of imaging and video sensors has posed additional challenges. Such performance metrics are usually referred to as quality of service (QoS) of the communication network. Energy-aware QoS routing in sensor networks will ensure guaranteed bandwidth (or delay) through the duration of a connection as well as providing the use of the most energy efficient path. In this paper, we analyze the requirements of QoS, the system architecture design issues for sensor networks, challenges of supporting QoS in traffic at the network and also about the various algorithms for obtain QoS in WSN.

2. QOS REQUIREMENTS FOR WSN

In this section we outline WSN QoS requirements for several layers which we refer to the OSI 7-Layers as in traditional networks. For each layer, we give the definition of QoS requirements.

2.1 Application Layer

The QoS requirements in the application layer are specified by users. We define the following QoS requirements for WSNs applications: System Lifetime, Response Time, Data novelty, Detection Probability Data Reliability and Data Resolution. WSNs are often required to sustain its functionalities for a certain time period. System Lifetime is defined as the time from system deployment up to the time when it cannot satisfy users' requirements. In on-demand WSNs applications, Response Time refers to the latency from the time that a user sends a query to the time that the user receives the response. Data novelty refers to the latency from the time an event is detected by a sensor to the time the data about the event arrive at storage sensors or sink points. In addition to data transmission, WSNs also needs to monitor phenomena in the real world and generate sensing data. Detection Probability refers to the probability that a real world phenomenon can be detected and reported to a user. Two requirements on data quality, Data reliability and Data Resolution refer to the degree that the reported data corresponds to real world phenomena and the sampling rate in the spatial/temporal scale, respectively. Data reliability describes the accuracy of the data and Data Resolution imposes temporal/spatial granularity on the data.

2.2 Transport Layer

The QoS requirements for the transport layer: Reliability, Bandwidth, Latency and Cost. For convenience of discussion, differentiate the concept of packets and unique packets are differentiated as defined by the "collective" concept introduced in from a sensor's point of view, unique packets refer to the packets containing data that are not correlated with the already received data. All of the QoS requirements within the transport layer use the collective concept, which means only unique packets are counted as received by the destination. Reliability refers to the percentage of unique packets successfully received from all sending sources in reference to those that were actually transmitted. Bandwidth refers to the number of unique packets received per unit time from all sending sources. Latency refers to the shortest total delay at the intermediate nodes/channels in transmitting a unique packet from all sending sources to a destination, which includes propagation delay, queuing delay, routing delay, etc. Cost is defined as the number of transmissions to retrieve a unique packet from all sending sources.

2.3 Network Layer

The following QoS requirements of the network layer: Path Latency, Routing Maintenance, Congestion Probability, Routing Robustness and Energy Efficiency. Path Latency refers to the average number of hops between all source destination pairs in the network. Routing Maintenance refers to the energy consumption rate to maintain routes between all source destination pairs. Congestion Probability is the probability that the traffic load on any path exceeds the bottleneck capacity of all the links on the path. Routing Robustness is defined as the maximal probability of packet loss that routing must sustain. Energy Efficiency measures the amount of energy consumed to transmit a data packet along a path.

2.4 Connectivity Maintenance Layer

The QoS requirements for the connectivity maintenance layer: Network Diameter, Network Capacity, Average Path Cost, Connectivity Robustness, and Connectivity Maintenance. Network Diameter is defined as the maximal transmission latency between two sensors in the formed network topology. Network Capacity is defined as the number of packets that can be transmitted concurrently in the network. Average Path Cost is defined as the average amount of energy consumed to transmit one packet between all source destination pairs. Connectivity Robustness is defined as the maximal allowed number of failed sensors/links that the network connectivity must sustain. Connectivity Maintenance measures the energy consumption rate to maintain a connected network topology.

2.5 Coverage Maintenance Layer

The QoS requirements for the coverage maintenance layer: Coverage Percentage, Coverage Reliability, Coverage Robustness and Coverage Maintenance. Coverage Percentage refers to the percentage of area monitored by at least one sensor. Coverage Reliability refers to the minimal allowed sensing probability. Coverage Robustness is defined as the minimal number of sensors monitoring the same location. Coverage Maintenance measures the number of messages exchanged to provide and maintain network coverage.

2.6 MAC Layer

The QoS requirements for the MAC layer: Communication Range, Throughput, Transmission Reliability and Energy Efficiency. Communication Range refers to the maximal distance of one-hop data transmission. Throughput refers to the maximal number of data frames that can be transmitted successfully by the MAC layer per unit time. Transmission Reliability refers to the percentage of successfully transmitted frames. Energy Efficiency measures the amount of energy consumed to successfully transmit one frame within one-hop.

2.7 Physical Layer

The physical layer describes wireless sensor capabilities, which encompass wireless unit capabilities, processor capabilities and sensing unit capabilities. Specifically, wireless unit capabilities refer to Channel Speed, Coding and RF Power. Processor capabilities are Location capabilities, Timing capabilities, Processing Speed and Computation Power. Sensing unit capabilities include Measurement Accuracy, Sensing Range and Sensing Power. A sensor's physical capabilities impose resource constraints on the QoS requirements of other layers. For wireless unit capabilities, Channel Speed impacts Throughput in the MAC layer; Coding impacts Throughput and Transmission Reliability in the MAC layer; RF Power impacts Communication Range, Transmission Reliability and Energy Efficiency in the MAC layer. For processor capabilities, Location and Timing capabilities impact Location Accuracy and Timing Accuracy respectively; Processing Speed determines Processing Latency in the data management layer; Computation Power impacts Computation Cost, Data Abstraction and Data Accuracy in the data management layer, as well as Energy Consumption in the location/time service layer. For sensing unit capabilities, Measurement Accuracy impacts Coverage Reliability and Coverage Robustness in the coverage maintenance layer; Sensing Range affects Coverage Percentage in the coverage maintenance layer; Sensing Power affects all the requirements in the coverage maintenance layer.

3. DESIGN ISSUES

Depending on the application, design goals/constraints have been considered for sensor networks. Since the performance of a routing and MAC protocols are closely related. A summary of design issues is given in Table 1.

3.1 Network Dynamics

There are three main components in a sensor network. These are the sensor nodes, sink and monitored events. Aside from the very few setups that utilize mobile sensors, most of the network architectures assume that sensor nodes are stationary. On the other hand, supporting the mobility of sinks or cluster-heads (gateways) is sometimes deemed necessary Routing messages from or to moving nodes is more challenging since route stability becomes an important optimization factor, in addition to energy, bandwidth etc. The sensed event can be either dynamic or static depending on the application. Monitoring static events allows the network to work in a reactive mode, simply generating traffic when reporting. Dynamic events in most applications require periodic reporting and consequently generate significant traffic to be routed to the sink.

3.2 Node Deployment

Another consideration is the topological deployment of nodes. This is application dependent and affects the performance of the routing protocol. The deployment is either deterministic or self-organizing. In deterministic situations, the sensors are manually placed and data is routed through pre-determined paths. In addition, collision among the transmissions of the different nodes can be minimized through the pre-scheduling of medium access. However in self-organizing systems, the sensor nodes are scattered randomly creating an infrastructure in an ad hoc manner. In that infrastructure, the position of the sink or the cluster-head is also crucial in terms of energy efficiency and performance. When the distribution of nodes is not uniform, optimal clustering becomes a pressing issue to enable energy efficient network operation.

3.3 Node Communications

During the creation of an infrastructure, the process of setting up the routes is greatly influenced by energy considerations. Since the transmission power of a wireless radio is proportional to distance squared or even higher order in the presence of obstacles, multi-hop routing will consume less energy than direct communication. However, multi-hop routing introduces significant overhead for topology management and medium access control. Direct routing would perform well enough if all the nodes were very close to the sink. Most of the time sensors are scattered randomly over an area of interest and multi-hop routing becomes unavoidable. Arbitrating medium access in this case becomes cumbersome.

3.4 Data Delivery Models

Depending on the application of the sensor network, the data delivery model to the sink can be continuous, event-driven, query-driven and hybrid. In the continuous delivery model, each sensor sends data periodically. In event-driven and query-driven models, the transmission of data is triggered when an event occurs or a query is generated by the sink. Some networks apply a hybrid model using a combination of continuous, event-driven and query-driven data delivery. The routing and MAC protocols are highly influenced by the data delivery model, especially with regard to the minimization of energy consumption and route stability. For instance, it has been concluded that for a habitat monitoring application where data is continuously transmitted to the sink, a hierarchical routing protocol is the most efficient alternative. This is due to the fact that such an application generates significant redundant data that can be aggregated on route to the sink, thus reducing traffic and saving energy. In addition, in continuous data delivery model time-based medium access can achieve significant energy saving since it will enable turning off sensors' radio receivers CSMA medium access arbitration is a good fit for event-based data delivery models since the data is generated sporadically

Table 1 : Design Issues

Design Issue	Primary Factors
Network Dynamics	mobility of node, target, and sink
Node Deployment	Deterministic or ad Hoc
Node Communications	Single-hop or multi-hop
Data Delivery Models	continuous, event-driven, query-driven, or hybrid
Node Capabilities	multi- or single function; homogeneous or heterogeneous capabilities
Data Aggregation/Fusion	in-network (partially or fully) or out-of-network

3.5 Node Capabilities

In a sensor network, different functionalities can be associated with the sensor nodes. In early work on sensor networks, all sensor nodes are assumed to be homogenous, having equal capacity in terms ofcomputation, communication and power. However, depending on the application a node can be dedicated to a particular special function such as relaying, sensing and aggregation since engaging the three functionalities at the same time on a node might quickly drain the energy of that node. Some of the hierarchical protocols proposed in the literature designate a cluster-head different from the normal sensors. While some networks have picked cluster-heads from the deployed sensors, in other applications a cluster-head is more powerful than the sensor nodes in terms of energy, bandwidth and memory. In such cases the burden of transmission to the sink and aggregations are handled by the cluster-head.

3.6 Data Aggregation/Fusion

Since sensor nodes might generate significant redundant data, in some applications similar packets from multiple nodes can be aggregated so that the number of transmissions would be reduced. Data aggregation is the combination of data from different sources by using functions such as suppression (eliminating duplicates), min, max and average. Some of these functions can be performed either partially or fully in each sensor node, by allowing sensor nodes to conduct in-network data reduction. Recognizing that computation would be less energy consuming than communication, substantial energy savings can be obtained through data aggregation. This technique has been used to achieve energy efficiency and traffic optimization in a number of routing protocols. In some network architectures, all aggregation functions are assigned to more powerful and specialized nodes. Data aggregation is also feasible through signal processing techniques. In that case, it is referred as data fusion where a node is capable of producing a more accurate signal by reducing the noise and using some techniques such as beams forming to combine the signals. Data aggregation makes medium access control complex since redundant packets will be eliminated and such elimination will require instantaneous medium access arbitration. In such case, only CSMA and CDMA-based MAC protocols are typically applicable leading to an increase in energy consumption.

4. QOS CHALLENGES IN SENSOR NETWORKS

While sensor networks inherit most of the QoS issues from the general wireless networks. The following is an outline of design considerations for handling QoS traffic in wireless sensor networks:

4.1 Bandwidth Limitation

A typical issue for general wireless networks is securing the bandwidth needed for achieving the required QoS. Bandwidth limitation is going to be a more pressing issue for wireless sensor networks. Traffic in sensor networks can be burst with a mixture of real-time and non-real-time traffic. Dedicating available bandwidth solely to QoS traffic will not be acceptable. A trade-off in image/video quality may be necessary to accommodate non-real-time traffic. In addition, simultaneously using multiple independent routes will be sometime needed to split the traffic and allow for meeting the QoS requirements. Setting up independent routes for the same flow can be very complex and challenging in sensor networks due energy constraints, limited computational resources and potential increase in collisions among the transmission of sensors.

4.2 Removal of Redundancy

The sensor networks are characterized with high redundancy in the generated data. For unconstrained traffic, elimination of redundant data messages is somewhat easy since simple aggregation functions would suffice. However, conducting data aggregation for QoS traffic is much more complex. Comparison of images and video streams is not computationally trivial and can consume significant energy resources. A combination of system and sensor level rules would be necessary to make aggregation of QoS data computationally feasible. For example, data aggregation of imaging data can be selectively performed for traffic generated by sensors pointing to same direction since the images may be very similar. Another factor of consideration is the amount of QoS traffic at a particular moment. For low traffic it may be more efficient to cease data aggregation since the overhead would become dominant. Despite the complexity of data aggregation of imaging and video data, it can be very rewarding from a network performance point-of-view given the size of the data and the frequency of the transmission.

Energy and delay trade-off: Since the transmission power of radio is proportional to the distance squared or even higher order in noisy environments or in the non-flat terrain, the use of multi-hop routing is almost a standard in wireless sensor networks. Although the increase in the number of hops dramatically reduces the energy consumed for data collection, the accumulative packet delay magnifies. Since packet queuing delay dominates its propagation delay, the increase in the number of hops can, not only slow down packet delivery but also complicate the analysis and the handling of delay-constrained traffic. Therefore, it is expected that QoS routing of sensor data would have to sacrifice energy efficiency to meet delivery requirements. In addition, redundant routing of data may be unavoidable to cope with the typical high error rate in wireless communication, further complicating the trade-off between energy consumption and delay of packet delivery.

4.3 Buffer Size Limitation

Sensor nodes are usually constrained in processing and storage capabilities. Multi-hop routing relies on intermediate relaying nodes for storing incoming packets for forwarding to the next hop. While a small buffer size can conceivably suffice, buffering of multiple packets has some advantages in wireless sensor networks. First, the transition of the radio circuitry between transmission and reception modes consumes considerable energy and thus it is advantageous to receive many packets prior to forwarding them. In addition, data aggregation and fusion involves multiple packets. Multi-hop routing of QoS data would typically require long sessions and buffering of even larger data, especially when the delay jitter is of interest. The buffer size limitation will increase the delay variation that packets incur while traveling on different routes and even on the same route. Such an issue will complicate medium access scheduling and make it difficult to meet QoS requirements

4.4 Support Of Multiple Traffic Types

Inclusion of heterogeneous set of sensors raises multiple technical issues related to data routing. For instance, some applications might require a diverse mixture of sensors for monitoring temperature, pressure and humidity of the surrounding environment, detecting motion via acoustic signatures and capturing the image or video tracking of moving objects. These special sensors are either deployed independently or the functionality can be included on the normal sensors to be used on demand. Reading generated from these sensors can be at different rates, subject to diverse quality of service constraints and following multiple data delivery models, as explained earlier. Therefore, such a heterogeneous environment makes data routing more challenging

5. SURVEY ON QOS IN WSN

Different research works have been done for QoS in wireless sensor networks:

5.1 Application-Specific Qos Control

In this paper, authors [3] define the optimal number of power-up nodes in the focused area as the QoS target. In order to make the optimal number of nodes to power up in the focused area, a modified Gur Game strategy is given. In the strategy, the base station receives the QoS feedback and gives the dynamic domination information including the area shape information and the dynamic gradient parameters. This results show that the strategy can effectively control the number of power-up nodes and meet the requirement of QoS.

5.2 Qos Reliability Of Hierarchical Clustered WSN

In this paper authors [4] discuss about the problem of reliability modeling and analysis of hierarchical clustered wireless sensor networks. They propose reliability measures that integrate the conventional connectivity-based network with the sensing coverage measure indicating the Quality of Service (QoS) of the WSN and they propose a progressive approach for evaluating such coverage-oriented QoS reliability.

5.3 A Qos-Based Adaptive Clustering Algorithm

The hierarchical routing algorithms for wireless sensor networks mainly focus on distributing energy load among all the nodes and pay little attention to Quality of Services (QoS) support in WSN. In this paper, author [7] developed a algorithm, QAC (QoS-based Adaptive Clustering algorithm), which not only concerns energy consumption but also can improve the reliability and the steadiness of wireless sensor networks by establishing a dual cluster-head model. QAC proposes a local-centralized mechanism for electing cluster-head and suggests a parameter to measure the QoS support in hierarchical applications of WSNs. This model can increase the reliability and the steadiness of wireless sensor network by distributing evenly the communication load and the load of data fusion among cluster-heads. The dual cluster-head model can also improve the survival ability of wireless sensor networks and makes the network fitting in with the fierce changes of environment.

5.4 An Efficient QoS Management in WSN

In this paper authors [6] emphasize the need for repositioning of the Consolidating and Advancing node, (CAN: Principal Node) to improve network lifetime in terms of energy and other QoS parameters such as latency and throughput. The address issues related to its repositioning such as the time and position of relocation and the control of its movement without causing negative impact on the performance of the WSN. Mobility factor is exploited to support QoS requirements. In this paper a scheme called Energy Conserving Relocation (ECR) to pursue relocation of CAN to a safe location on demand is presented. ECR performs relocation based on the minimum energy concept of sensor nodes. The concept of repositioning adds a new dimension to the existing Heterogeneous Wireless Sensor Network. It is observed through simulation that lifetime of the network, average energy consumption and QoS parameters are much better when compared to earlier algorithms.

5.5 An Energy-Aware QoS Routing Protocol for Wireless Sensor Networks

Recent advances in wireless sensor networks have led to many new routing protocols specifically designed for sensor networks. Almost all of these routing protocols considered energy efficiency as the ultimate objective in order to maximize the whole network lifetime.. In this paper, they propose an energy-aware QoS routing protocol for sensor networks which can also run efficiently with best-effort traffic. The protocol finds a least-cost, delay-constrained path for real-time data in terms of link cost that captures nodes' energy reserve, transmission energy, error rate and other communication parameters. Moreover, the throughput for non-real-time data is maximized by adjusting the service rate for both real-time and non-real-time data at the sensor nodes. Simulation results have demonstrated the effectiveness of our approach for different metrics.

6. CONCLUSION

Recent QoS studies in sensor networks focus on only QoS domain, either timeliness or reliability. They are also limited in differentiating services for traffics with different levels of timeliness and reliability requirements. Here we have analyzed the technical issues for supporting QoS constrained traffic in wireless sensor networks. In the QoS algorithm we discuss about the dual cluster-head model of QAC can improve the survival ability of WSNs. and it has the feature of load balance. This feature helps QAC to balance energy consumption in all nodes and to avoid congestion at cluster-heads by distributing evenly nodes in all clusters, which means that it can distribute evenly the communication load and the data fusion load among all cluster-heads. In a word, QAC has a balanced utilization of resources. QAC also suggests that designer can use standard deviation of number of nodes in a cluster to estimate the robustness while designing WSNs. Finally, QAC is quite simple and is suitable for heterogonous applications with large number of nodes that are densely deployed.

REFERENCE

[1] K. Akayya and M. Younis, *"An Energy-Aware QoS Routing Protocol for Wireless Sensor Networks"*, in the Proceedings of IEEE Workshop on Mobile and Wireless Networks (MWN2003), Providence, RI, May 2003.

[2] D. Chen and P. K. Varshney, *"QoS Support in Wireless Sensor Networks: A Survey"*, in the Proc. of the International Conference on Wireless Networks 2004 (ICWN'04), Las Vegas, Nevada, USA, June 21-24, 2004.

[3]. Juejia Zhou, Chundi Mu, *"A Kind of Application-Specific QoS Control in Wireless Sensor Networks"*, in the Proceedings of the International Conference on Information Acquisition 2006, Weihai, Shandong, China, August 20 - 23, 2006.

[4] Liudong Xing and Akhilesh Shrestha, *" QoS Reliability of Hierarchical Clustered Wireless Sensor Networks"*, in the proceedings of IEEE, PP. 641-646, 2006.

[5] C. S. Raghavendra, Krishna M. Sivalingam, Taieb F. Znati, *" Wireless sensor networks"*, Published by Springer ISBN 1402078838, 9781402078835.

[6] Suraiya Tarannum, Divya Prakash, Sneha Susan George, Tara B V, Ushe S, Nalini L, Venugopal K R, L M Patnaik, *"Consolidate and Advance: An Efficient QoS Management Technique in Heterogeneous Wireless Sensor Networks"*, in the Proceedings of IEEE-International Conference on Signal processing, Communication and Networking Madras Institute of Technology, Anna University, Chennai, India, Jan 4-6, 2008, PP. 80-85.

[7] Weike Chen, Wenfeng Li , Heng Shou, Bing Yuan, *"A QoS-based Adaptive Clustering Algorithm for Wireless Sensor Networks"*, in the Proceedings of International Conference on Mechatronics and Automation, June 25 - 28, PP. 1947-1952, 2006.

[8] M. Younis, K. Akkaya, M. Eltoweissy and A. Wadaa, *"On Handling QoS Traffic in Wireless Sensor Networks"*, in the Proc. of 37th Hawaii International Conference on System Sciences (HICSS'04), PP. 292-301, Hawaii, Jan. 2004.

[9] Yuanli Wang, Xianghui Liu, Jianping Yin, *"Requirements of Quality of Service in Wireless*

Sensor Network", in the Proceedings of the International Conference on Networking, International Conference on Systems and International Conference on Mobile Communications and Learning Technologies (ICNICONSMCL'06), © 2006 IEEE.

Author's Biography

V.Vanitha is working as Asst Prof at Kumaraguru College of Technology Anna University, Coimbatore, Tamil nadu, INDIA. She has received B.E, M.E, Degree in Computer Science and Engineering and currently pursuing Ph.D at Anna University. Her main research interest includes Wireless Ad-hoc Networks.

D.Palanivel Rajan worked as Lecturer at Karpagam College of Engineering Anna University, Coimbatore, Tamil nadu, INDIA. He has received B.E, Degree in Computer Science and Engineering and currently pursuing M.E M.E., at Kumaraguru College of Technology Anna University, Coimbatore, Tamil nadu, INDIA. His interest includes Networks