

A ANALYSIS & SURVEY ON QUALITY OF SERVICE IMPROVEMENT IN MANET, VANET AND WSN

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Abstract: An Ad-hoc network has a Provision of Quality of Service(QoS) to support many applications like digital and multimedia applications. However One of the challenging tasks in Ad-hoc Network(MANET &VANET) is Quality of Service (QoS) which is determined by numerous parameters such as bandwidth and delay constraints, varying channel conditions, power limitations, node mobility, dynamic topology, packet delivery ratio, end-to-end delay and connection duration. With the increasing demand for real time applications in the Wireless Sensor Network (WSN), real time critical events anticipate an efficient quality-of-service (QoS) based routing for data delivery from the network infrastructure. Designing such QoS based agent routing protocol to meet the reliability and delay guarantee of critical events while preserving the energy efficiency is a challenging task. This paper surveying about qos based agent routing algorithms in MANET, WSN and VANET.

Keywords: MANET, QOS, VANET, WSN

I. Introduction

Mobile ad hoc network (MANET) is a decentralized, self-organizing wireless network without any fixed infrastructure. Each node in a MANET behaves not only as a host, but also as a router [1]. Mobile multimedia ad hoc networks have created great demand in the services for the mobile users that require stringent Quality of Service (QoS). However, there are several problems and issues which have to be considered for QoS support in MANETs including signaling, medium access control, security, reservation, and routing. Routing is considered as one of the most important aspect of MANET due to the dynamic topology. Even-though wireless ad hoc networking researchers have addressed the routing problem since a decade; they have still not yet come up with a robust and efficient routing scheme. Thus, we have scope to develop efficient routing protocols for multimedia applications to decrease routing related overheads and find QoS routes with better packet delivery ratio, higher throughput and lower delays.

Table-driven (proactive), on-demand (reactive) and hybrid routing protocols are three main categories of routing protocols for ad hoc wireless networks. Table driven routing algorithms include Destination Sequenced Distance Vector (DSDV), Clustered Gateway Switch Routing (CGSR) and Wireless Routing Protocol (WRP). On demand routing algorithms include Dynamic Source Routing (DSR), On-Demand Distance Vector Routing (AODV), Temporally Ordered Routing Algorithm (TORA) and Zone Routing Protocol (ZRP). Hybrid routing

algorithms aim to use advantages of table driven and on demand algorithms and minimize their disadvantages. Ant colony Mobile agent based algorithms are a special category of algorithms (proactive, reactive and hybrid) that provide features such as adaptivity and robustness which essentially deal with the challenges of the MANETS.

A Vehicular Ad hoc Network (VANET) is a form of wireless ad hoc network to provide communications among vehicles and nearby roadside equipments. It is emerging as a new technology to integrate the capabilities of new generation wireless networking to vehicles. The major purpose of VANET is to provide (2) ubiquitous connectivity while on the road to mobile users, who are otherwise connected to the outside world through other networks at home or at the work place, and efficient vehicle-to-vehicle communications that enable the Intelligent past decades, it has received tremendous attention from both academia and industry all over the world. A WSN typically consists of a large number of low-cost, low-power, and multifunctional wireless sensor nodes, with sensing, wireless communications and computation capabilities [4,5]. These sensor nodes communicate over short distance via a wireless medium and collaborate to accomplish a common task, for example, environment monitoring, military surveillance, and industrial process control [6]. The basic philosophy behind WSNs is that, while the capability of each individual sensor node is limited, the aggregate power of the entire network is sufficient for the required mission.

Quality of Service (QoS) means that the network should provide some kind of guarantee or assurance about the level or grade of service provided to an application. The actual form of QoS and the QoS parameter to be considered depends upon specific requirements of an application. For example, an application that is delay sensitive may require the QoS in terms of delay guarantees. Some applications may require that the packets should flow at certain minimum bandwidth. In that case, the bandwidth will be a QoS parameter [7]. Certain application may require a guarantee that the packets are delivered from a given source to destination reliably, then, reliability will be a parameter for QoS.

In this paper, first we discussed about the MANET, VANET, WSN and QoS. The reminder of this paper is organized as follows. In section 2, we explain about the characteristics of MANET and WSN. In section 3, we discussed about the characteristics of VANET. Section 4, provides the detailed discussions of several Routing algorithms for MANET and VANET. Section 5, explains about Agent Ant colony optimization based Routing algorithms for MANET and VANET. Section 6, we discussed about Agent and Algorithms used in MANET. Section 7, we explains about Agent and Algorithms used in VANET. Section 8, we discussed about ROUTING Algorithms for WSN. Section 9, we gives the conclusion of this survey paper.

II. CHARACTERISTICS OF MANET AND WSN

Transportation Systems (ITS). ITS includes a variety of applications such as cooperative traffic monitoring, control of traffic flows, blind crossing (a crossing without light control), prevention of collisions, nearby information services, and real-time detour route computation.

Wireless sensor network (WSN) is widely considered as one of the most important technologies for the twenty-first century [3]. In the As compared to the traditional wireless communication networks such as mobile ad hoc network (MANET) and cellular systems, wireless sensor networks have the following unique characteristics and constraints:

Dense sensor node deployment: Sensor nodes are usually densely deployed and can be several orders of magnitude higher than that in a MANET.

Battery-powered sensor nodes: Sensor nodes are usually powered by battery and are deployed in a harsh environment where it is very difficult to change or recharge the batteries.

Severe energy, computation, and storage constraints: Sensor nodes are having highly limited energy, computation, and storage capabilities.

Self-configurable: Sensor nodes are usually randomly deployed and autonomously configure themselves into a communication network. **Unreliable sensor nodes:** Since sensor nodes are prone to physical damages or failures due to its deployment in harsh or hostile environment.

Data redundancy: In most sensor network application, sensor nodes are densely deployed in a region of interest and collaborate to accomplish a common sensing task. Thus, the data sensed by multiple sensor nodes typically have a certain level of correlation or redundancy.

Many-to-one traffic pattern: In most sensor network applications, the data sensed by sensor nodes flow from multiple source sensor nodes to a particular sink, exhibiting a many-to-one traffic pattern.

Frequent topology change: Network topology changes frequently due to the node failures, damage, addition, energy depletion, or channel fading.

III. CHARACTERISTICS OF VANET

In addition to the similarities to ad hoc networks, such as short radio transmission range, self-organization and self management, and low bandwidth, VANETs can be distinguished from other kinds of ad hoc networks as follows:

Highly dynamic topology: Due to high speed of movement between vehicles, the topology of VANETs is always changing.

Frequently disconnected network: Due to the same reason, the connectivity of the VANETs could also be changed frequently. Especially when the vehicle density is low, it has higher probability that the network is disconnected.

Mobility modeling and predication: Due to highly mobile node movement and dynamic topology, mobility model and predication play an important role in network protocol design for VANETs.

Geographical type of communication: Compared to other networks that use unicast or multicast where the communication end points are defined by ID or group ID, the VANETs often have a new type of communication that addresses geographical areas where packets need to be forwarded.

Various communications environments: VANETs are usually operated in two typical communications environments. In highway traffic scenarios, the environment is relatively simple and straightforward (e.g., constrained one-dimensional movement), while in city conditions it becomes much more complex.

Sufficient energy and storage: A common characteristic of nodes in VANETs is that nodes have sample energy and computing power (including both storage and processing), since nodes are cars instead of small handheld devices.

Hard delay constraints: In some VANETs applications, the network does not require high data rates but has hard delay constraints.

Interaction with on-board sensors: It is assumed that the nodes are equipped with on-board sensors to provide information that can be used to form communication links and for routing purposes.

IV. ROUTING ALGORITHMS FOR MANET AND VANET

The **Ad hoc On demand Distance Vector (AODV)** algorithm is a demand based protocol. Using distance vectors, each node stores available routes for known destinations. AODV floods a

„RouteRequest“ (RREQ) message to its neighbors to discover new routes. Each Route request RREQ message propagates through the network until it reaches the destination or a node that has a fresh route to the destination. AODV uses only the shortest path to transfer data and does not require nodes to store routes to destinations they do not communicate with.

Dynamic Source Routing (DSR) is also based and, like AODV, uses only the shortest discovered path. When a node wants to send a message, it broadcasts a route request message to its neighbors which add their own addresses and rebroadcast the message until it reaches the destination which replies using the discovered path. When a failed link is detected, a message is sent to the source and the route is discarded. DSR then rebroadcasts to discover a new route. DSR supports both bidirectional and unidirectional links.

The **Cluster Based Routing Protocol (CBRP)** is another demand based protocol that divides the MANET nodes into a set of clusters.

One host is elected as each cluster's „head“ which maintains the cluster's membership information. The need for inter cluster routing is discovered using the membership information and is performed by the cluster heads. CBRP is useful for large scale MANETs since the clustering reduces the number of routing messages needed.

Optimized Link State Routing (OLSR) [8] is a proactive protocol. Each node selects a set of neighbors as multipoint relays (MPRs) which periodically announce their existence to the network. MPRs are used to find routes in the network. Unlike CBRP, OLSR selects MPRs dynamically.

Topology Broadcast using Reverse Path Forwarding (TBRPF)

[9] is another proactive protocol that uses shortest paths. Each node maintains a „source tree“ of shortest paths to its reachable nodes and announces a part of its source tree to its neighbors using a combination of periodic and triggered updates. To decide which part of the source tree to send, a node computes its „reportable node set“

(RN). Node i puts node u in RN if it determines that some neighbor j may select node i to be the next hop on a shortest path from j to u .

The **Fisheye State Routing protocol (FSR)** [10] is also a proactive protocol. A „center“ node in the MANET stores link state information for all nodes. This node periodically sends the information for all nodes to its r -hop neighbors ($r = 1, 2, \dots$). This is done at different frequencies based on the value of r . In FSR, nodes can obtain the entire network topology and therefore compute efficient routes.

V. AGENT-ANT COLONY

OPTIMIZATION (ACO) BASED ROUTING ALGORITHMS FOR MANET AND VANET ANTNET

It is a proactive routing algorithm proposed for wired datagram network based on the principle of ant colony optimization [11]. In Ant net each node maintains a routing table and has an additional task of maintaining the node movement statistics based on the traffic distribution over the network. The routing table contains the destination node, next hop node and a measure of the goodness of using the next hop to forward data packet to the destination. The goodness measure is based on Pheromone values that are normalized to one. Ant net uses two sets of homogeneous mobile agents called forward ants and backward ants to update the routing tables. These mobile agents are small and light packets containing source IP address, destination IP address, packet ID and a dynamically growing stack consisting of Node ID and Node Traversal Time. A node which receives a forward ant for the first time creates a record in its routing table. An entry in the routing table is having triple values. They are destination address, next hop and pheromone value. During the route finding process ants deposit pheromone on the edges.

In the simplest version of the algorithm, the ants deposit a constant amount $\Delta\psi$ of pheromone, i.e. the amount of pheromone of the edge $e(i; j)$ when the ant is moving from node i to node j is changed as follows

$$\Psi_{i,j} := \Psi_{i,j} + \Delta\psi$$

The forward ant selects next node heuristically, based on pheromone value in the routing table. The forward ants are also used to collect information about traffic distribution over the network. When the forward ant reaches the destination, it generates the backward ant and then dies. The backward ant retraces the path of forward ant in the opposite direction. At each node backward ant updates the routing table and additional table containing statistics about traffic distribution over the network.

Ant Routing Algorithm (ARA)

It is a reactive protocol for mobile adhoc networks [12]. The routing table entries in ARA contain pheromone values for choosing a neighbor as the next hop for each destination, the

pheromone values in the routing table decay with time and nodes enter a sleep mode if the pheromone in the routing table has reached a lower threshold. Route discovery in ARA is performed by a set of two mobile agents forward ants and backward ants having unique sequential numbers, to prevent duplicate packet that are flooded through network by the source and destination nodes respectively. The forward ant and backward ant update the pheromone tables at the nodes along the path for source and destination respectively. Once the route discovery for a particular destination has been performed, the source node does not generate new mobile agents for the destination, instead the route maintenance is performed by the data packets.

In ARA, the selection of next hop is decided by dynamic vs probabilistic routing. In Ant the selection of the next hop for a data packet is always decided by the amount of pheromone values, i.e. a node i selects a neighbor j with probability $P(i:j)$ as follows

$P_{i,j} = 1$ if $\Psi_{i,j}$ is maximum

0 otherwise

ARA is extended to use probabilistic routing, i.e. a node i selects a neighbor j with probability. N_i is the set of one step neighbors of node i .

ARA with probabilistic routing is denoted by ARAstat. The main advantage of using probabilistic route selection is that the load is distributed over the existing paths to the destination.

AntHocNet

AntHocNet is a hybrid algorithm [13]. It is reactive in the sense that a node only starts gathering routing information for a specific destination when a local traffic sensor needs to communicate with the destination and no routing information is available. In AntHocNet, nodes do not maintain routes to all possible destinations at all the times; rather the nodes generate mobile agents only at the beginning of a data session. It is proactive because as soon as the communication starts and during the entire duration of the communication, the nodes proactively keep the routing information related to the ongoing flow up-to-date with network changes for both topology and traffic. The algorithm finds paths by minimal number of hops, low congestion and good signal quality between adjacent nodes. Different Ant based Algorithms namely Ant Based Control Routing, Ant Colony based Routing Algorithm, Probabilistic Emergent Routing Algorithm, AntHocNet, AntNet were presented in [16]. Additional algorithms like Ant-AODV, Position based Ant Colony Routing Algorithm for MANETs (POSANT), Ant colony based Multi-path QoS-aware Routing (AMQR), Ant-based distributed route algorithm (ADRA).

VI. AGENT AND ALGORITHMS USED IN MANET

Agent based QoS routing: The scheme uses a mobile agent to perform this operation. Every node in a network comprises of an agent platform. We assume that every node in a network maintains an agency for QoS routing. [14].

User Monitoring Agent (UMA): It is a static agent which is present in all nodes that monitors the request generated at the node. If demand generated, this agent triggers the DSR Agent (DSRA) and QoS Agent (QoSA) and also this agent computes the residual bandwidth, delays, jitters and packet losses for each link and updates the QoS status profile at regular intervals. All the parameters are computed within a given continuous time window this database sends to the QoSA for future computation.

Neuro-Fuzzy Agent (NFA): It is a static agent, when there is demand at the node, automatically this agent triggers and start training of data sets defined for multimedia communication till acceptable error limit.

DSR Agent (DSRA): It is a Static agent. When the request from the UMA, it starts discovery of multipath from source to destination and selects NDMR With stable paths. After finding it requests to QoS agent for QoS selection of each path.

QoS Agent (QoSA): It is also a static agent. This receives two requests, first from UMA that demands to compute requested QoS for particular application using optimized membership values and second request from DSRA to check QoS at each node according to requested QoS. After this, this provides QoS paths for communication.

Route Maintenance Agent (RMA): It is a mobile agent, which migrates along the path which is communicating. If any link failed due to node mobility or failure of node, this agent finds alternate path to destination from disconnected link.

Algorithm: QoS based DSR protocol using Neuro-Fuzzy agent Begin

step 1: Optimize the Membership functions by training of input data set vector using error back propagation algorithm.

step 2: If any demands from the user in the network, then, Start multipath route discovery
else

Update the network and go to step 2.

step 3: Get the QoS satisfied paths among stable paths using trained data set vector and fuzzy logic.

step 4: If QoS paths are present,

If only one QoS path, then, start transmission of packets through it.

Else

Select One best QoS path and start the transmission of packets through it.

else

update the network and go to step 2.

step 5: If any route failure,

then, start route discovery from disconnected node and go to step 3.

Else

Update the network and go to step 2.

step 6: If any more requests,

then, go to step

2. else

Update the network and go to step 2.

End

ACO algorithm

Algorithm : ANT Colony based Optimization

Input: An instance x of a combine optimization problem **While** termination condition not met do

Schedule activities

Ant based

solution

construction ()

Pheromone

update ()

Daemon actions ()

End scheduled activities

S_{best} best solution in the population of solutions

End while

Output: S_{best} candidate to optimal solution for x

VII. AGENT AND ALGORITHMS USED IN VANET

In Vehicular Agent (IVA): IVA is static agent resides in vehicle which communicates with the DFA to acquire/spread the relevant information. IVA collects the status (moving or stationary) and location information of vehicle from sensors equipped in a vehicle.

Observant Agent (OA): OA is a mobile agent that travels around the network by creating its clones to propagate the decisive information during the critical situations. Examples of critical situation are accident, traffic jam, bad weather conditions, tracing a vehicle involved in crime or traffic rule violation etc. It also informs IVA and updates the vehicle database. OA is sent by DFAs to the vehicles moving in the network.

Information Finding Agent (IFA): IFA travels in the network to search for the requisite information as desired by vehicle user. IFA is sent by the DFA in the network on the request issued by user or DFA itself to get traffic information. [15]

Algorithm 1: Advance Mobile Agent (AMA)

Step 1: Move RA into network

& count nodes.

Step 2: If (hop == 1) then,

Step 3: Mobile agent is deleted

(because no other node is there.)

Step 4: else

Step 5: If RA node reached to next node then,

Step 6: Create Reverse Mobile Agent with path information.

Step 7: else

Step 8: Decrease the hop of mobile agent by 1.

Step 9: Collect the network information needed for routing & submerge the mobile agents to neighbor nodes. Step 10: end if

Working of RMA is explained in Algorithm 2.

Algorithm 2: Reverse Mobile Agent (RMA)

Step 1: if RA node reached to next node then

Step 2: Convey all the collected information to RA, i.e., information regarding path followed and resources available on that path to update routing table.

Step 3: remove mobile agent. Step

4: else

Step 5: give all the information collected to node

Step 6: travel to next hop.

Step 7: end if

VIII. ROUTING ALGORITHMS FOR WSN

The underlying network structure can play significant role in the operation of the routing protocol in WSNs.

1 Flat Routing

In flat networks, each node typically plays the same role and sensor nodes collaborate together to perform the sensing task. Due to the large number of such nodes, it is not feasible to assign a global identifier to each node.

1.1 Sensor Protocols for Information via Negotiation (SPIN)

SPIN disseminates all the information at each node to every node in the network assuming that all nodes in the network are potential base-stations [17]. This enables a user to query any node

and get the required information immediately. These protocols make use of the property that nodes in close proximity have similar data, and hence there is a need to only distribute the data that other nodes do not possess. The SPIN family of protocols uses data negotiation and resource-adaptive algorithms. Nodes running SPIN assign a high-level name to completely describe their collected data (called meta-data) and perform meta-data negotiations before any data is transmitted. This assures that there is no redundant data sent throughout the network. These protocols work in a time-driven fashion and distribute the information all over the network, even when a user does not request any data.

1.2 Directed Diffusion

As a data-centric protocol, applications in sensors label the data using attribute-value pairs. A node that demands the data generates a request where an interest is specified according to the attribute-value based scheme defined by the application. The sink usually injects an interest in the network for each application task [18]. The nodes update an internal interest cache with the interest messages received. The nodes also keep a data cache where the recent data messages are stored. This structure helps in determining the data rate. On receiving this message, the nodes establish a reply link to the originator of the interest. This link is called gradient and it is characterized by the data rate, duration and expiration time. Additionally, the node activates its sensors to collect the intended data. The reception of an interest message makes the node establish multiple gradients (or first hop in a route) to the sink. In order to identify the optimum gradient, positive and negative reinforcements are used. The algorithm works with two types of gradients: exploratory and data gradients. Exploratory gradients are intended for route setup and repair whereas data gradients are used for sending real data.

1.3 Rumor routing

The Rumor Routing protocol improves a node's ability to transmit queries and event information throughout a wireless sensor network. The most expedient way to guarantee every query is successful is to flood the WSN with both query and event information [19] [20]. Each node within a WSN with Rumor Routing initializes using an active broadcast to locate neighboring nodes. These neighbors are added to a list within the node's memory, which is maintained through subsequent active broadcasts, or by passively listening to other nodes' broadcasts. Additionally, each node maintains an event table containing forwarding information for each event it has been informed of. If a node witnesses an event, it adds it to its event table and generates an agent. The agent traverses the network, "informing" other nodes of events it has witnessed. The agent uses a straightening algorithm to maintain a straight path, thereby transmitting information as far across the network as possible. The agent contains a list of witnessed events as well as the number of hops to each event. When received by a node, the agent synchronizes its list with the node's list so both of their tables contain routes to every event. In addition, since agents are broadcast in the WSN, every neighboring node within receiving distance of the agent receives the updated information and updates their event tables as well. This behavior continues until the agent's lifetime expires. To receive event

information, a node within the WSN generates a query. The query is sent in a random direction to a neighboring node. That node, if aware of a route to the event, forwards the query accordingly. Otherwise, it forwards the query in a random direction to one of its neighboring nodes. The query uses the same algorithm as the agent to determine the direction to send the query, thus avoiding the same nodes. Should a node within the network fail, however, it is possible the query could be caught in a loop. To avoid this, each query is assigned limited lifetime, as well as a random identification number. If a query arrives at a node which has already forwarded it, the node instead sends the query to a random neighbor, thus breaking the loop. This process continues until the query has reached a node that has information about the event, or until the query's lifetime expires. If the originating node of a query determines it did not reach the event, it can retransmit the query, quit the query, or flood the network with the query.

1.4 Minimum Cost Forwarding (MCF)

Minimum Cost Forwarding is an efficient protocol appropriate for simple WSN with limited resources. The aim of MCF is to establish a means of delivering messages from any sensor in a field of sensor nodes along a minimum cost path to an interested client node or base station [21]. MCF exploits the fact that the direction of routing is always known, i.e. data always flows from sensor nodes towards a base station. A sensor node need not possess a unique ID nor store a routing table. In fact, the cost of sending a message to the base station is the sole information required by a node to implement the MCF protocol. The simplicity of the MCF is an advantage for sensor nodes with limited processing capability and/or memory. MCF is uncomplicated in operation; nodes may be in one of two states, that is initialization or operational. In the initial state, initialization, the minimum cost field is established over the network. This is followed by the operational state during which nodes generate and forward messages to the base station using the minimum cost path established during initialization. After initialization, the node remains in operational mode. The minimum cost for a particular node is the optimal path to the destination node. The cost of a link may simply be the hop count, a measure of consumed wireless energy, the delay between the source and sink, a function of the received signal strength, number of retransmissions or some composite. Messages are broadcast to neighboring nodes either when information is sensed or when forwarding other messages.

1.5 Gradient-Based Routing

The key idea in GBR is to memorize the number of hops when the interest is diffused through the whole network. As such, each node can calculate a parameter called the height of the node, which is the minimum number of hops to reach the BS. The difference between a node's height and that of its neighbor is considered the gradient on that link. A packet is forwarded on a link with the largest gradient. GBR uses some auxiliary techniques such as data aggregation and traffic spreading in order to uniformly divide the traffic over the network. When multiple paths pass through a node, which acts as a relay node, that relay node may combine data

according to a certain function. In GBR, three different data dissemination techniques have been discussed (1) Stochastic Scheme, where a node picks one gradient at random when there are two or more next hops that have the same gradient, (2) Energy-based scheme, where a node increases its height when its energy drops below a certain threshold, so that other sensors are discouraged from sending data to that node, and (3) Stream-based scheme, where new streams are not routed through nodes that are currently part of the path of other streams. The main objective of these schemes is to obtain a balanced distribution of the traffic in the network, thus increasing the network lifetime.

1.6 Information-driven sensor querying (IDSQ)

The main idea of the information-driven approach is to base the decision for sensor collaboration on information constraints as well as constraints on cost and resource consumption. Using measures of information utility, the sensors in a network can exploit the information content of data already received to optimize the utility of future sensing actions, thereby efficiently managing the scarce communication and processing resources. In IDSQ, the querying node can determine which node can provide the most useful information with the additional advantage of balancing the energy cost. However, IDSQ does not specifically define how the query and the information are routed between sensors and the BS. Therefore, IDSQ can be seen as a complementary optimization procedure [22].

1.7 ACQUIRE

The operation of ACQUIRE can be described as follows. The BS node sends a query, which is then forwarded by each node receiving the query. During this, each node tries to respond to the query partially by using its pre-cached information and then forward it to another sensor node. Once the query is being resolved completely, it is sent back through either the reverse or shortest-path to the BS. Hence, ACQUIRE can deal with complex queries by allowing many nodes to send responses [23].

1.8 COUGAR

COUGAR utilizes in-network data aggregation to obtain more energy savings. The abstraction is supported through an additional query layer that lies between the network and application layers. COUGAR incorporates architecture for the sensor database system where sensor nodes select a leader node to perform aggregation and transmit the data to the BS. The BS is responsible for generating a query plan, which specifies the necessary information about the data flow and in-network computation for the incoming query and send it to the relevant nodes. The query plan also describes how to select a leader for the query. The architecture provides in-network computation ability that can provide energy efficiency in situations when the generated data is huge. COUGAR has some drawbacks. First, the addition of query layer on each sensor node may add an extra overhead in terms of energy consumption and memory storage. Second, to obtain successful in-network data computation, synchronization among nodes is required before sending the data to the leader node. Third, the leader nodes should be dynamically maintained to prevent them from being hot-spots (failure prone) [35].

2 Hierarchical Routing

Hierarchical or cluster-based routing, originally proposed in wire line networks, are well-known techniques with special advantages related to scalability and efficient communication. As such, the concept of hierarchical routing is also utilized to perform energy-efficient routing in WSNs. In a hierarchical architecture, higher energy nodes can be used to process and send the information while low energy nodes can be used to perform the sensing in the proximity of the target. This means that creation of clusters and assigning special tasks to cluster heads can greatly contribute to overall system scalability, lifetime, and energy efficiency. Hierarchical routing is an efficient way to lower energy consumption within a cluster and by performing data aggregation and fusion in order to decrease the number of transmitted messages to the BS. Hierarchical routing is mainly two-layer routing where one layer is used to select cluster heads and the other layer is used for routing.

2.1 LEACH protocol

The goal of LEACH is to find the way to low consumption of energy in the cluster and to improve the life time of the wireless sensor network. LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station. Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy. Nodes that have been cluster heads cannot become cluster heads again for P rounds, where P is the desired percentage of cluster heads. Thereafter, each node has a $1/P$ probability of becoming a cluster head in each round. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data. All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot. The operation of LEACH is separated into two phases, the setup phase and the steady state phase. In the setup phase, the clusters are organized and CHs are selected. In the steady state phase, the actual data transfer to the base station takes place. The duration of the steady state phase is longer than the duration of the setup phase in order to minimize overhead [25].

2.2 Power-Efficient Gathering in Sensor Information Systems (PEGASIS)

PEGASIS (Power-Efficient Gathering in Sensor Information Systems), which is near optimal for this data gathering application in sensor networks. The key idea in PEGASIS is to form a chain among the sensor nodes so that each node will receive from and transmit to a close neighbor. Gathered data moves from node to node, gets fused, and eventually a designated node transmits to the BS. Nodes take turns transmitting to the BS so that the average energy spent by each node per round is reduced. Building a chain to minimize the total length is similar to the travelling salesman problem, which is known to be intractable. However, with the radio

communication energy parameters, a simple chain built with a greedy approach performs quite well. PEGASIS has two main objectives. First, increase the lifetime of each node by using collaborative techniques and as a result the network lifetime will be increased. Second, allow only local coordination between nodes that are close together so that the bandwidth consumed in communication is reduced [26].

2.3 Threshold-sensitive Energy Efficient Protocols (TEEN and APTEEN)

TEEN is a energy efficient hierarchical clustering protocol which is suitable for time critical applications. The CH sends aggregated data to the next higher level CH until data reaches the sink. TEEN is designed for reactive networks, where the sensor nodes react immediately to sudden changes in the value of the sensed attribute. Sensor nodes sense the environment continuously, but data transmission is done occasionally and this helps in energy efficiency. This protocol sends data if the attribute of the sensor reaches a Hard Threshold and a small change the Soft Threshold. The drawback of this protocol is that if the threshold is not reached, the nodes may not communicate and we do not know if a node is dead [27]. APTEEN is an improvement to TEEN and aims at periodic data collection and reacting to time critical events. It is a hybrid clustering based protocol and supports different types of queries like (i) historical query, to get results on past data (ii) one-time query that gives a snapshot of the environment and (iii) persistent queries, to monitor an event for a time period. The cluster exists for an interval called the cluster period, and then the BS regroup clusters, at the cluster change time. For query responses it uses node pairs. If adjacent nodes sense similar data, only one of them responds to a query, the other one goes to sleep mode and thereby saves energy [28].

2.4 Minimum Energy Communication Network (MECN)

MECN is a location-based protocol for achieving minimum energy for randomly deployed networks, which uses mobile sensors to maintain a minimum energy network. It computes an optimal spanning tree with sink as root that contains only the minimum power paths from each sensor to the sink. This tree is called minimum power topology. It has two phases: Enclosure Graph Construction: MECN constructs sparse graph, called an enclosure graph, based on the immediate locality of the sensors. An enclosure graph is a directed graph that includes all the sensors as its vertex set and edge set is the union of all edges between the sensors and its neighbors located in their enclosure regions. Cost distribution: In this phase non-optimal links of the enclosure graphs are simply eliminated and the resulting graph is a minimum power topology. This graph has a directed path from each sensor to the sink and consumes the least total power among all graphs having directed paths from each sensor to the sink. Every sensor broadcasts its cost to its neighbors, where the cost of a node is the minimum power required for this sensor to establish a directed path to the sink [29].

2.5 Hierarchical Power-aware Routing (HPAR)

The protocol divides the network into groups of sensors. Each group of sensors in geo-graphic proximity is clustered together as a zone and each zone is treated as an entity. To perform

routing, each zone is allowed to decide how it will route a message hierarchically across the other zones such that the battery lives of the nodes in the system are maximized. Messages are routed along the path which has the maximum over all the minimum of the remaining power, called the max-min path. The motivation is that using nodes with high residual power may be expensive as compared to the path with the minimal power consumption.

3. Location based routing protocols

In this kind of routing, sensor nodes are addressed by means of their locations. The distance between neighboring nodes can be estimated on the basis of incoming signal strengths. Relative coordinates of neighboring nodes can be obtained by exchanging such information between neighbors.

3.1 Geographic and Energy Aware Routing (GEAR) The protocol, called Geographic and Energy Aware Routing (GEAR), uses energy aware and geographically informed neighbor selection heuristics to route a packet towards the destination region. The key idea is to restrict the number of interests in directed diffusion by only considering a certain region rather than sending the interests to the whole network. By doing this, GEAR can conserve more energy than directed diffusion [30]. There are two cases to consider:

- (a) When a closer neighbor to the destination exists: GEAR picks a next-hop node among all neighbors that are closer to the destination.
- (b) When all neighbors are further away: In this case, there is a hole. GEAR picks a next-hop node that minimizes some cost value of this neighbor.

3.2 The Greedy Other Adaptive Face Routing (GOAFR)

GOAFR is a combination of greedy routing and face routing in the following sense: Whenever possible, the algorithm tries to route in a greedy manner; in order to overcome local minima with respect to the distance from the destination. GOAFR Algorithm is used in both average case and Worst case environments. This Algorithm provides good enough result for routing and it performs other routing algorithm such as AFR. GOAFR does guarantee the source to destination delivery of data [31].

3.3 SPAN

SPAN is a power saving technique for multi hop ad-hoc wireless networks that reduces energy consumption without significantly diminishing the capacity or connectivity of the network. It is a distributed, randomized algorithm where nodes make local decisions on whether to sleep, or to join forwarding backbones as a coordinator. Each node bases its decisions on an estimate of how many of its neighbors will benefit from it being awake and the amount of energy available to it. To preserve capacity, a node decides to volunteer be a coordinator if it discovers that two of its neighbors cannot communicate with each other directly or through an existing coordinator. Each node delays announcing its willingness with a random delay that takes two factors into account: the amount of remaining battery energy, and the number of pairs of neighbors it can connect together. This combination ensures with high probability, a capacity preserving connected backbone at any point in time, where nodes tend to

consume energy at about the same rate. SPAN does all this using only local information consequently sending well with the number of nodes [32].

IX. CONCLUSION

QoS aware routing in MANET, VANET and WSN is a challenging task. Many research works have been carried out in this area. In this paper, comprehensive survey of QoS based Agent routing algorithm is proposed which supports real time and multimedia applications. These algorithms are more adaptive and energy efficient which takes node's remaining energy as well as drain rate (i.e. energy dissipation rate) as QoS parameter. It selects the node which has sufficient resource to satisfy the QoS constraints. In high mobility cases it is very efficient in terms of quick route maintenance. These algorithms are taken care of end to end delay, available bandwidth, and hop count as QoS parameter which increases network throughput. This paper clearly explains the characteristics of MANET, VANET and WSN and also analysis the qos based agent routing algorithms in MANET, VANET and WSN

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