SURVEY ON QUALITY OF SERVICE BASED AGENT ROUTING ALGORITHMS IN MANET, VANET AND WSN

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Abstract

An Ad-hoc network has a Provision of Quality of Service(QoS) to support multimedia applications. One of the most 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 Senor 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,

1.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 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 ofwireless ad hoc network to provide communications amongvehicles and nearby roadside equipments. It is emerging asa new technology to integrate the capabilities of newgeneration wireless networking to vehicles. The majorpurpose of VANET is to provide (2) ubiquitousconnectivity while on the road to mobile users, who areotherwise connected to the outside world through othernetworks at home or at the work place, and efficientvehicle-to-vehicle communications that enable theIntelligent

Transportation Systems (ITS).ITS includes avariety of applications such as cooperative trafficmonitoring, control of traffic flows, blind crossing (acrossing without light control), prevention of collisions,nearby information services, and real-time detour routescomputation.

Wireless sensor network (WSN) is widely considered as one of the most important technologiesfor the twenty-first century [3]. In the past decades, it hasreceived tremendous attention fromboth academia and industry all over the world. A WSN typically consists of a large number oflow-cost, low-power, and multifunctional wireless sensor nodes, with sensing, wirelesscommunications and computation capabilities [4,5]. These sensor nodes communicate over shortdistance via a wireless medium and collaborate to accomplish a common task, for example,environment monitoring, military surveillance, and industrial process control [6]. The basicphilosophy 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 networkshould provide some kind of guarantee or assuranceabout the level or grade of service provided to anapplication. The actual form of QoS and the QoSparameter to be considered depends upon specificrequirements of an application. For example, anapplication that is delay sensitive may require the QoSin terms of delay guarantees. Some applications mayrequire that the packets should flow at certain minimumbandwidth. In that case, the bandwidth will be a QoSparameter[7]. Certain application may require a guaranteethat the packets are delivered from a given source todestination reliably, then, reliability will be a parameterfor 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 basedRouting 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.

2. CHARACTERISTICS OF MANET AND WSN

As compared to the traditional wireless communication networks such as mobile ad hoc network(MANET) and cellular systems, wireless sensor networks have the following uniquecharacteristics and constraints:

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

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

Severe energy, computation, and storage constraints: Sensors nodes are having highly limitedenergy, computation, and storage capabilities.

Self-configurable: Sensor nodes are usually randomly deployed and autonomously configurethemselves into a communication network.

Unreliable sensor nodes: Since sensor nodes are prone to physical damages or failures due to itsdeployment in harsh or hostile environment.

Data redundancy: In most sensor network application, sensor nodes are densely deployed in aregion of interest and collaborate to accomplish a common sensing task. Thus, the data sensed bymultiple 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 sensornodes flow from multiple source sensor nodes to a particular sink, exhibiting a many-to-onetraffic pattern.

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

3. CHARACTERISTICS OF VANET

In addition to the similarities to ad hoc networks, such asshort radio transmission range, self-organization and selfmanagement,and low bandwidth, VANETs can bedistinguished from other kinds of ad hoc networks asfollows:

Highly dynamic topology: Due to high speed ofmovement between vehicles, the topology of VANETs isalways changing.

Frequently disconnected network: Due to the samereason, the connectivity of the VANETs could also bechanged frequently. Especially when the vehicle density islow, it has higher probability that the network isdisconnected.

Mobility modeling and predication: Due to highly mobilenode movement and dynamic topology, mobility model andpredication play an important role in network protocoldesign for VANETs.

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

Various communications environments: VANETs areusually operated in two typical communicationsenvironments. In highway traffic scenarios, theenvironment is relatively simple and straightforward (e.g.,constrained one-dimensional movement), while in cityconditions it becomes much more complex.

Sufficient energy and storage: A common characteristicof nodes in VANETs is that nodes have sample energy andcomputing 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 harddelay constraints.

Interaction with on-board sensors: It is assumed that thenodes are equipped with on-board sensors to provideinformation that can be used to form communication linksand for routing purposes.

4.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. AODVfloods a 'RouteRequest' (RREQ) message to its neighbors to discover new routes. Each Route requestRREQ message propagates through the network until it reaches the destination or a node thathas a fresh route to the destination. AODV uses only the shortest path to transfer data anddoes 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 basedprotocol thatdivides 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 clusterrouting isdiscovered 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 proactiveprotocol that uses shortest paths. Each node maintains a 'source tree' of shortest paths to itsreachable nodes and announces a part of its source tree to its neighbors using a combinationof periodic and triggered updates.To decide which part of the source tree to send, a node icomputes its 'reportable node set' (RN). Node i puts node u in RN if it determines that someneighbor 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,..). This is done at differentfrequencies based on the value of r. In FSR, nodes can obtain the entire network topology andtherefore compute efficient routes.

5.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 thepheromone 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

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$P_{i,j} = 1$ 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. *Ni* 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 basedRouting Algorithm Routing, 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).

6.AGENT AND ALGORITHMS USED IN MANET

Agent based QoSrouting: 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 staticagent, when there is demand at the node,automatically this agent triggers and startstraining of data sets defined for multimediacommunication till acceptable error limit.
DSR Agent (DSRA): It is a Static agent.When the request from the UMA, it startsdiscovery of multipath from source todestination and selects NDMR With stablepaths. After finding it requests to QoS agentfor QoS selection of each path.
QoS Agent (QoSA): It is also a static agent.This receives two requests, first from UMAthat demands to compute requested QoS forparticular application using optimizedmembership values and second request fromDSRA to check QoS at each node according torequested QoS. After this, this provides QoSpaths for communication.
Route Maintenance Agent (RMA): It is amobile agent, which migrates along the pathwhich is communicating. If any link failuredue to node mobility or failure of node, thisagent finds alternate path to destination fromdisconnected 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

7.AGENT AND ALGORITHMS USED IN VANET

In Vehicular Agent (IVA): IVA is static agent resides invehicle which communicates with the DFA to acquire/spread the relevant information. IVA collects the status(moving or stationary) and location information of vehiclefrom sensors equipped in a vehicle.
Observant Agent (OA):OA is a mobile agent that travelsaround the network by creating its clones to propagate thedecisive information during the critical situations.Examples of critical situation are accident, traffic jam, badweather conditions, tracing a vehicle involved in crime ortraffic rule violation etc. It also informs IVA and updatesthe vehicle database. OA is sent by DFAs to the vehiclesmoving in the network.
Information Finding Agent (IFA):IFA travels in thenetwork to search for the requisite information as desiredby vehicle user. IFA is sent by the DFA in the network onthe request issued by user or DFA itself to get trafficinformation. [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.

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Step 6: travel to next hop.
Step 7: end if

8.ROUTING ALGORITHMS FOR WSN

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

1 **Flat Routing**

In flat networks, each node typically plays the same roleand sensor nodes collaborate together to perform thesensing task. Due to the large number of such nodes, it isnot feasible to assign a global identifier to each node.

1.1 Sensor Protocols for Information via Negotiation(SPIN)

SPIN disseminate all the information at each node toevery node in the network assuming that all nodes in thenetwork are potential base-stations [17]. This enables a userto query any node and get the required informationimmediately. These protocols make use of the propertythat nodes in close proximity have similar data, and hencethere is a need to only distribute the data that other nodesdo not posses. The SPIN family of protocols uses datanegotiation and resource-adaptive algorithms. Nodesrunning SPIN assign a high-level name to completelydescribe their collected data (called meta-data) andperform meta-data negotiations before any data istransmitted. This assures that there is no redundant datasent throughout the network. These protocols work in atime-driven fashion and distribute the information all overthe network, even when a user does not request any data.

1.2 Directed Diffusion

As a data-centric protocol, applications in sensors labelthe data using attribute-value pairs. A node that demandsthe data generates a request where an interest is specifiedaccording to the attribute-value based scheme defined bythe application. The sink usually injects an interest in thenetwork for each application task [18]. The nodes update aninternal interest cache with the interest messages received.The nodes also keep a data cache where the recent datamessages are stored. This structure helps on determiningthe data rate. On receiving this message, the nodesestablish a reply link to the originator of the interest. Thislink is called gradient and it is characterized by the datarate, duration and expiration time. Additionally, the nodeactivates its sensors to collect the intended data. Thereception of an interest message makes the node establishmultiple gradients (or first hop in a route) to the sink. Inorder to identify the optimum gradient, positive andnegative reinforcements are used. There algorithm workswith two types of gradients: exploratory and datagradients. Exploratory gradients are intended for route setupand repair whereas data gradients are used for sendingreal data.

1.3 Rumor routing

The Rumor Routing protocol improves a nodes ability totransmit queries and event information throughout awireless sensor network. The most expedient way toguarantee every query is successful is to flood the WSNwith both query and event information [19] [20]. Each nodewithin a WSN with Rumor Routing initializes using anactive broadcast to locate neighboring nodes. Theseneighbors are added to a list within the nodes memory,which is maintained through subsequent active broadcasts,or by passively listening to other nodes' broadcasts.Additionally, each node maintains an event tablecontaining forwarding information for each event it hasbeen informed of. If a node witnesses an event, it adds itto its event table and generates an agent. The agenttraverses the network, "informing" other nodes of events ithas witnessed. The agent uses a straightening algorithm tomaintain a straight path, thereby transmitting informationas far across the network as possible. The agent contains alist of witnessed events as well as the number of hops toeach event. When received by a node, the agentsynchronizes its list with the node's list so both of theirtables contain routes to every event. In addition, sinceagents are broadcast in the WSN, every neighboring nodewithin receiving distance of the agent receives the updatedinformation and updates their event tables as well. Thisbehavior continues until the agent's lifetime expires.To receives event information, a node within the WSNgenerates a query. The query is sent in a random directionto a neighboring node. That node, if aware of a route tothe event, forwards the query accordingly. Otherwise, itforwards the query in a random direction to one of itsneighboring nodes. The query uses the same algorithm asthe agent to determine the direction to send the query, thusavoiding the same nodes. Should a node within thenetwork fail, however, it is possible the query could becaught in a loop. To avoid this, each query is assigned limited lifetime, as well as a random identificationnumber. If a query arrives at a node which has alreadyforwarded it, the node instead sends the query to a randomneighbor, thus breaking the loop. This process continuesuntil the query has reached a node that has informationabout the event, or until the query's lifetime expires. If theoriginating node of a query determines it did not reach theevent, it can retransmit the query, quit the query, or floodthe network with the query.

1.4 Minimum Cost Forwarding (MCF)

Minimum Cost Forwarding is an efficient protocolappropriate for simple WSN with limited resources. Theaim of MCF is to establish a means of deliveringmessages from any sensor in a field of sensor nodes alonga minimum cost path to an interested client node or basestation [21]. MCF exploits the fact that the direction ofrouting is always known, i.e. data always flows fromsensor nodes towards a base station. A sensor node neednot possess a unique ID nor store a routing table. In fact,the cost of sending a message to the base station is thesole information required by a node to implement theMCF protocol. The simplicity of the MCF is an advantagefor sensor nodes with limited processing capability and/ormemory. MCF is uncomplicated in operation; nodes maybe in one of two states, that is initialization or operational.In the initial state, initialization, the minimum cost field isestablished over the network. This is followed by theoperational state during which nodes generate and forwardmessages to the base station using the minimum cost pathsestablished during initialization. After initialization, thenode remains in operational mode.The minimum cost for a particular node is the optimalpath to the destination node. The cost of a link may simplybe the hop count, a measure of consumed wireless energy,the delay between the source and sink, a function of thereceived signal strength, number of retransmissions orsome composite. Messages are broadcast to neighboringnodes either when information is sensed or whenforwarding other messages.

1.5 Gradient-Based Routing

The key idea in GBR is to memorize the number of hopswhen the interest is diffused through the whole network.As such, each node can calculate a parameter called theheight of the node, which is the minimum number of hopsto reach the BS. The difference between a node's heightand that of its neighbor is considered the gradient on thatlink. A packet is forwarded on a link with the largestgradient. GBR uses some auxiliary techniques such asdata aggregation and traffic spreading in order touniformly divide the traffic over the network. Whenmultiple paths pass through a node, which acts as a relaynode, that relay node may combine data according to acertain function. In GBR, three different datadissemination techniques have been discussed (1)Stochastic Scheme, where a node picks one gradient atrandom when there are two or more next hops that havethe same gradient, (2) Energy-based scheme, where anode increases its height when its energy drops below acertain threshold, so that other sensors are discouragedfrom sending data to that node, and (3) Stream-basedscheme, where new streams are not routed through nodesthat are currently part of the path of other streams. Themain objective of these schemes is to obtain a balanceddistribution of the traffic in the network, thus increasingthe network lifetime.

1.6 Information-driven sensor querying (IDSQ)

The main idea of the information-driven approach is tobase the decision for sensor collaboration on informationconstraints as well as constraints on cost and resourceconsumption. Using measures of information utility, thesensors in a network can exploit the information contentof data already received to optimize the utility of futuresensing actions, thereby efficiently managing the scarcecommunication and processing resources. In IDSQ, thequerying node can determine which node can provide themost useful information with the additional advantage of balancing the energy cost. However, IDSQ does notspecifically define how the

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query and the information arerouted between sensors and the BS. Therefore, IDSQ canbe 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 byeach node receiving the query. During this, each node triesto respond to the query partially by using its pre-cachedinformation and then forward it to another sensor node.Once the query is being resolved completely, it is sentback through either the reverse or shortest-path to the BS.Hence, ACQUIRE can deal with complex queries byallowing many nodes to send responses [23].

1.8 COUGAR

COUGAR utilizes in-network data aggregation to obtainmore energy savings. The abstraction is supported throughan additional query layer that lies between the networkand application layers. COUGAR incorporatesarchitecture for the sensor database system where sensornodes select a leader node to perform aggregation andtransmit the data to the BS. The BS is responsible forgenerating a query plan, which specifies the necessaryinformation about the data flow and in-networkcomputation for the incoming query and send it to therelevant nodes. The query plan also describes how toselect a leader for the query. The architecture provides innetworkcomputation ability that can provide energyefficiency in situations when the generated data is huge.COUGAR has some drawbacks. First, the addition ofquery layer on each sensor node may add an extraoverhead in terms of energy consumption and memorystorage. Second, to obtain successful in-network datacomputation, synchronization among nodes is requiredbefore sending the data to the leader node. Third, theleader nodes should be dynamically maintained to preventthem from being hot-spots (failure prone) [35].

2 Hierarchical Routing

Hierarchical or cluster-based routing, originally proposedin wire line networks, are well-known techniques withspecial advantages related to scalability and efficientcommunication. As such, the concept of hierarchicalrouting is also utilized to perform energy-efficient routingin WSNs. In a hierarchical architecture, higher energynodes can be used to process and send the informationwhile low energy nodes can be used to perform thesensing in the proximity of the target. This means thatcreation of clusters and assigning special tasks to clusterheads can greatly contribute to overall system scalability,lifetime, and energy efficiency. Hierarchical routing is anefficient way to lower energy consumption within acluster and by performing data aggregation and fusion inorder to decrease the number of transmitted messages tothe BS.Hierarchical routing is mainly two-layer routingwhere one layer is used to select cluster heads and theother layer is used for routing.

2.1 LEACH protocol

The goal of LEACH is to find the way to lowconsumption of energy in the cluster and to improve thelife time of the wireless sensor network. LEACH is ahierarchical protocol in which most nodes transmit tocluster heads, and the cluster heads aggregate andcompress the data and forward it to the base station. Eachnode uses a stochastic algorithm at each round todetermine whether it will become a cluster head in thisround. LEACH assumes that each node has a radiopowerful enough to directly reach the base station or thenearest cluster head, but that using this radio at full powerall the time would waste energy. Nodes that have beencluster heads cannot become cluster heads again for Prounds, where P is the desired percentage of cluster heads.Thereafter, each node has a 1/P probability of becoming acluster head in each round. At the end of each round, eachnode that is not a cluster head selects the closest clusterhead and joins that cluster. The cluster head then creates aschedule for each node in its cluster to transmit its data.All nodes that are not cluster heads only communicatewith the cluster head in a TDMA fashion, according to theschedule created by the cluster head. They do so using theminimum energy needed to reach the cluster head, andonly need to keep their radios on during their time slot. The operation of LEACH isseparated into two phases, the setup phase and the steadystate phase. In the setup phase, the clusters are organizedand CHs are selected. In the steady state phase, the actualdata transfer to the base station takes place. The durationof the steady state phase is longer than the duration of thesetup phase in order to minimize overhead [25].

2.2 Power-Efficient Gathering in Sensor InformationSystems (PEGASIS)

PEGASIS (Power-Efficient Gathering in SensorInformation Systems), which is near optimal for this datagathering application in sensor networks. The key idea inPEGASIS is to form a chain among the sensor nodes sothat each node will receive from and transmit to a closeneighbor. Gathered data moves from node to node, getfused, and eventually a designated node transmits to theBS. Nodes take turns transmitting to the BS so that theaverage energy spent by each node per round is reduced.Building a chain to minimize the total length is similar tothe travelling salesman problem, which is known to beintractable. However, with the radio communicationenergy parameters, a simple chain built with a greedyapproach performs quite well. PEGASIS has two mainobjectives. First, increase the lifetime of each node byusing collaborative techniques and as a result the networklifetime will be increased. Second, allow only localcoordination between nodes that are close together so thatthe bandwidth consumed in communication is reduced[26].

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

TEEN is a energy efficient hierarchical clustering protocolwhich is suitable for time critical applications. The CHsends aggregated data to the next higher level CH untildata reaches the sink. TEEN is designed for reactivenetworks, where the sensor nodes react immediately tosudden changes in the value of the sensed attribute. Sensornodes sense the environment continuously, but datatransmission is done occasionally and this helps in energyefficiency. This protocol sends data if the attribute of thesensor reaches a Hard Threshold and a small change theSoft Threshold. The drawback of this protocol is that if thethreshold is not reached, the nodes may not communicateand we do not know if a node is dead [27].

APTEEN is an improvement to TEEN and aims atperiodic data collection and reacting to time criticalevents. It is a hybrid clustering based protocol andsupports different types of queries like (i) historical query,to get results on past data (ii) one-time query that gives asnapshot of the environment and (iii) persistent queries, tomonitor an event for a time period. The cluster existsforan interval called the cluster period, and then the BS regroupsclusters, at the cluster change time. For queryresponses it uses node pairs. If adjacent nodes sensesimilar data, only one of them responds to a query, theother 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, whichuses mobile sensors to maintain a minimum energynetwork. It computes an optimal spanning tree with sinkas root that contains only the minimum power paths fromeach sensor to the sink. This tree is called minimum powertopology. It has two phases:Enclosure Graph Construction: MECN constructs sparsegraph, called a enclosure graph, based on the immediatelocality of the sensors. An enclosure graph is a directedgraph that includes all the sensors as its vertex set andedge set is the union of all edges between the sensors andits neighbors located in their enclosure regions.Cost distribution: In this phase non-optimal links of theenclosure graphs are simply eliminated and the resultinggraph is a minimum power topology. This graph has adirected path from each sensor to the sink and consumesthe least total power among all graphs having directedpaths from each sensor to the sink. Every sensorbroadcasts its cost to its neighbors, where the cost of anode is the minimum power required for this sensor toestablish 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 isclustered together as a zone and each zone is treated as anentity. To perform routing, each zone is allowed to decidehow it will route a message hierarchically across the otherzones such that the battery lives of the nodes in the

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systemare maximized. Messages are routed along the path which has the maximum over all the minimum of the remainingpower, called the max-min path. The motivation is thatusing nodes with high residual power may be expensive ascompared to the path with the minimal powerconsumption .

3. Location based routing protocols

In this kind of routing, sensor nodes are addressed bymeans of their locations. The distance betweenneighboring nodes can be estimated on the basis ofincoming signal strengths. Relative coordinates ofneighboring nodes can be obtained by exchanging suchinformation between neighbors.

3.1 Geographic and Energy Aware Routing (GEAR)

The protocol, called Geographic and Energy AwareRouting (GEAR), uses energy aware and geographicallyinformedneighbor selection heuristics to route a packettowards the destination region. The key idea is to restrictthe number of interests in directed diffusion by onlyconsidering a certain region rather than sending theinterests to the whole network. By doing this, GEAR canconserve more energy than directed diffusion [30]. Thereare two cases to consider:

(a) When a closer neighbor to the destination exists:GEAR picks a next-hop node among all neighbors thatare closer to the destination.

(b) When all neighbors are further away:In this case, there is a hole. GEAR picks a next-hop nodethat minimizes some cost value of this neighbor.

3.2 The Greedy Other Adaptive Face Routing(GOAFR)

GOAFR is a combination of greedy routing and facerouting in the following sense: Whenever possible, thealgorithm tries to route in a greedy manner; in order toovercome local minima with respect to the distance fromthe destination. GOAFR Algorithm is used in bothaverage case and Worst case environments. ThisAlgorithm provides good enough result for routing and itperforms other routing algorithm such as AFR.GOAFR does guarantee the source to destination deliveryof data [31].

3.3 SPAN

SPAN is a power saving technique for multi hop ad-hocwireless networks that reduces energy consumptionwithout significantly diminishing the capacity orconnectivity of the network. It is a distributed, randomizedalgorithm where nodes make local decisions on whether tosleep, or to join forwarding backbones as a coordinator.Each node bases its decisions on an estimate of how manyof its neighbors will benefit from it being awake and theamount of energy available to it.To preserve capacity, a node decides to volunteer be acoordinator if it discovers that two of its neighbors cannotcommunicate with each other directly or through anexisting coordinators low and rotate this role amongst allnodes, each node delays announcing its willingness with arandom delay that takes two factors into account: theamount of remaining battery energy, and the number ofpairs of neighbors it can connect together. Thiscombination ensures with high probability, a capacitypreserving connected backbone at any point in time,where nodes tend to consume energy at about the samerate. SPAN does all this using only local informationconsequently sending well with the number of nodes [32].

9.CONCLUSION

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

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