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RESEARCH ARTICLE

Quality of Service Routing Protocol for Mobile Ad hoc Network

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Abstract— The wireless Ad-Hoc network is infrastructure less with nodes in the network area are randomly moving and communicating between nodes while roaming. In this paper we propose the TDMA Based Energy Efficient Quality of Service Routing Protocol (EEQOSRP). The network scenario is established by considering 1000 X 1000 m^2 area and deploying randomly moving nodes using Tool Command Language (TCL). The resource reservation is used to decompose the total simulation time of network into smaller time slots depending upon number of nodes in the network using TDMA technique. The route is established between Source and Destination node using AODV with QOS and Multi hop routing technique. The data packets are scheduled at Source node by assigning priority and the path is established between nodes using shortest path and implemented using C++. It is observed that the values of Energy Consumption, Packet Delivery Ratio, End to End Delay and Throughput are improved Compared to Existing algorithm.

Key Terms: - Time Division Multiple Access (TDMA), high load traffic, Ad-Hoc Ondemand Distance Vector (AODV) Quality of Service Technique (QoS), Wireless Ad-hoc Networks (WANs).

I. INTRODUCTION

Ad-Hoc wireless network is a part of wireless communication network. This network does not require any infrastructure. It is a distributed Routing network, and it supports for reusing of frequency dynamically. As Ad-Hoc network has different features, so it has to solve different issues as energy constraint, shared bandwidth and mobility, hence, required to design protocols which support both MAC and Network layer. Sensor network is another part of Ad-Hoc network used to sense the environmental conditions which may be periodic conditions or non-periodic conditions. Sensor node can be used for monitoring heat, temperature, humidity, intrusion detection etc. Major challenge for Sensor network is to manage the energy constraint of nodes that form the network. For multimedia traffic delay and energy parameters are sensitive in Ad-Hoc and sensor network. Hence an Ad-Hoc network algorithm is designed to establish effective path between source and destination with negligible end to end delay. Hence Quality of Service support can be achieved for an efficient routing and MAC. The TDMA is based on time slots and are used for reservation of channel. The Time slots are reserved for time and energy sensitive traffic. The scheduling mechanism considers traffic load available at the nodes and amount of delay by the packets.

Contribution: In this paper TDMA Based Energy Efficient Quality of Service Routing Protocol is proposed the network scenario is developed by TCL. The TDMA is used to decompose the simulation time into smaller times for Multi hop routing Technique. The route is established using Multi hop technique with AODV protocol. In scheduling the data packets are assigned priority and the path between nodes are identified using shortest path.

Organization: The paper is organized as follows: survey of related work is mentioned in section II. The proposed model EEQOSRP is explained in section III. Algorithm is described in section IV, simulation results and performance analysis in section V and finally conclusion of the paper.

II. LITERATURE SURVEY

Heping Wang et al., [1] proposed a hybrid medium access control (HMAC) protocol with an embedded cross-layer optimization solution to provide routing-layer coarse-grained end to end Quality-of-Service (QOS) support for latency-sensitive traffic flows. Jong-Woon Yoo and Kyu Ho Park [2] proposed Cooperative Networking Protocol (CONET), which dynamically reforms clusters according to each node's bandwidth requirement, energy use, and application type.

Hetal Jasani [3] proposed the QoS performance of MANETs by comparing the results of using AODV and DSR routing protocols. Using OPNET Modeler, they have conducted an extensive set of performance experiments for those protocols with a wide variety of settings. Sheriff M. ElRakabawy and Christoph Lindemann [4] proposed a feasible end-to-end congestion control algorithm for overcoming the severe deficiencies of TCP in IEEE 802.11 multihop wireless networks. Arjun P. Athreya and Patrick Tague [5] proposed a routing mechanism that uses crosslayer strategies. The cross-layer strategy involves incorporating feedback and information from layers below the network layer to make decisions at the network layer. They proposed a path evaluation mechanism for the paths returned by multi-path routing mechanism. Chhagan Lal, et al., [6] proposed a comparative analysis of mobile ad-hoc routing protocols over real time video streaming. The analysis exploits the built-in support for real time multimedia streaming in MANETs. Rathnakar Acharya et al., [7] proposed to improve the QoS, IEEE Medium Access Control (MAC) protocol is enhanced to IEEE 802.11e standard by introducing new coordination functions, which has both contention based and contention free medium access methods. Siva ram murthy, Rathna R and Sivasubramanian [8] proposed clustering and routing protocol for wireless sensor network in environmental applications. Sensor dta in this application may be light intensity, temperature, pressure, humidity and their variations.

III. PROPOSED MODEL

In this section the proposed EEQOSRP model and definitions include Energy consumption, Average energy consumption, Packet delivery ratio, Throughput, End to end delay, Packet arrival interval and path length are discussed in detail.

A. Definitions:

(i) Energy Consumption (EC): The amount of Energy spent by each node to transmit number of data packets, is given in Equation 1

EC = Initial Energy assigned to node - The energy used to send data packet……(1)

(ii) Average Energy Consumption (AEC): It is an average energy consumed by each node to transmit data packets from source to destination by Multi hop Routing is given in equation 2

$$AEC = \frac{\text{EC by nodes in multi hop}}{\text{Total number of nodes in Multi hop}} \quad \text{……..……(2)}$$

(iii) Packet Delivery Ratio (PDR): The ratio of total numbers of data packets successfully delivered to the total number of data packets sent and calculated using the Equation 3.

$$PDR = \frac{\text{Data packets successfully delivered}}{\text{Total number of packets sent}} * 100\ \% \quad \text{.....(3)}$$

(iv) Throughput (T): The ratio of number of Packets delivered to the destination to the time required to travel from Source to Destination and is normally represented by Bits Per seconds (bps) and is given in equation 4.

$$T = \frac{\text{Packets delivered*size of Packet*8}}{\text{time to deliver packet}} \quad \text{.....(4)}$$

(v) End to End delay (EED**):** It is the delay between Sources to Destination nodes. It is measured by summation of delay in number of hops involved between sources and destination using equation 5

EED = $\sum_{i=1}^{n} di$……..……..…..(5)

Where d - hop delay and n- number of nodes

(vi) Packet arrival interval (PAI): Source generates constant bit rate that varies from 1 to 100 seconds, called as packet arrival interval.

(vii) Path length (PL): The varied path length between each pair of source and destination nodes is called path length. The path length is measured in hops.

B. Proposed EEQOSRP model

The efficient Routing protocol with QOS is developed in the proposed EEQOSRP model and block diagram is given in Figure 1.

(i) Network Scenario: The mobile nodes of 50 nodes are deployed randomly in the network area of 1000 X 1000^{m^2}, with each node assumed to have one Omni directional antenna and uses two ray ground reflection radio propagation models. The mobility of 2 m/sec is assigned to each node and with energy of 10 joules. The simulation time 200 seconds is assigned to the total network area. The network scenario also called Network animated file in NS-2 [9] and shows how the packets are transmitted from source to destination based on single hop as well as multi hop routing. The Tool Command Language (TCL) is used to create network animated file i.e. network scenario.

(*ii) Resource Reservation Technique:* The Quality of Service in wireless network can be improved by reserving resources like Bandwidth and time slots. The Bandwidth i.e., the maximum data transfer rate of the network which measures how much data can be sent over a specific connection in a given amount of time and is normally represented by Mbps. The bandwidth is reserved, and nodes are allowed for exclusive access to the reserved Bandwidth. The whole network area simulation time is decomposed into number of time slots to assign time to each node in the network area using TDMA technique. The TDMA technique allots 4 seconds of time to each node by decomposing total simulation time of 200 sec and is shown in Figure 2. The regular unicast and multicast data exchange between nodes can be performed. In unicast, each node turns on its radio during its own slots and sleeps during all other slots, but in this proposed work every slot turns on because of multi hop while transmitting packet from source to destination. It depends on some intermediate nodes.

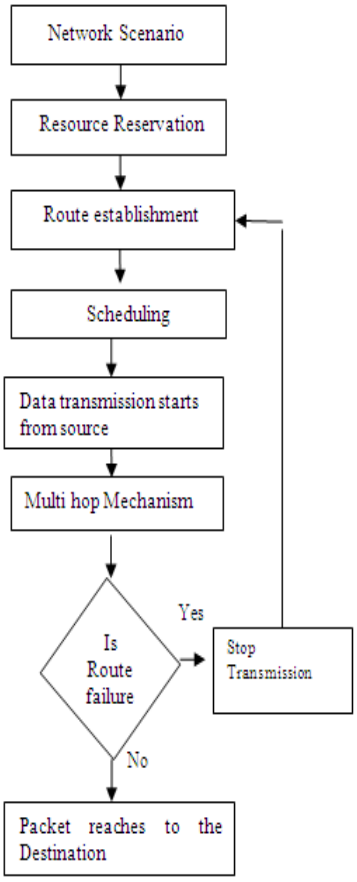

Fig.1. Proposed EEQOSRP model

(iii) Route Establishment Techniques: The number of packets to be sent from source to destination require path to be established using various route establishment techniques.

The routing may be

(a) single hop routing i.e., packets are sent from source to destination directly without any nodes between source to destination, and

(b) Multi hop routing i.e., packets are sent from source to destination using intermediate nodes. The readily available ad-Hoc on OnDemand Distance Vector (AODV) routing protocol is used as base protocol in the proposed model. The advantage of AODV protocol is that route is established between nodes only if requested by source node i.e., On demand and hence extra traffic communication is minimized. In the proposed model, the Quality Of Service Technique (QOST) is used in addition to base AODV protocol. The QOST also checks the Route failure between source and destination. The QOST is used to improve performances by established route check, if route failure is observed then the technique inform source node to establish the alternate route.

The source node first sends Request To Send (RTS) control packets to request slot reservation to the intended destination. The destination node on receiving RTS packet, it responds by sending Clear To Send (CTS) packet on the same slot. Sender node on receiving the CTS packet successfully gets the reservation for the current slot, and then transmits the data information to the destination.

The whole operation of TDMA, RTS and CTS are implemented using C++.

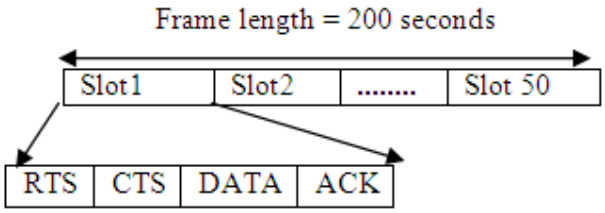

Fig.2. Resource Reservation technique

(iv) Scheduling Mechanism:

The Scheduling is network bandwidth management by packet scheduling at nodes and transmission scheduling between nodes. The scheduling decisions are based on energy available at nodes, and the small time available at nodes after transmission of its own data Packets, is used to transmit data packets stored in the buffer over a specific path. The number of data packets delivered to the destination increases with scheduling which intern throughput increases.

(v) Multi hop Mechanism: The excess delay occurred at upstream nodes is compensated by the downstream nodes that increases the priority of the packet so that they can reduce end to end delay. Hence, multi hop technique is used to carry time sensitive traffic on Ad-Hoc wireless network.

IV. ALGORITHM

The effective wireless Communication in Ad-Hoc networks using TDMA and QOST along with base protocol AODV is developed.

Assumption:

(i) The nodes are randomly distributed over a given area, and each node has a unique identifier

(ii) Each node uses a short-range radio to communicate with neighbours to save energy.

TABLE 1:

ALGORITHM OF PROPOSED PROTOCOL

(i)	The 50 mobile nodes are deployed randomly in the network area of 1000*1000 m^2 with each node is assumed to have one Omni directional antenna.
(ii)	The mobility of 2 m/sec is assigned to each node with an energy of 10 joules per node, i.e., the total energy of 50 mobile nodes is 500 joules
(iii)	The simulation time 200 seconds is assigned to the total network area
(iv)	The TDMA scheme is used in the network area.
(v)	A source node starts its packet transmission by first sending RTS control packets to request slot reservation request for intended destination. The receiver on receiving the RTS packet, it responds by sending CTS packets on the same slot. Sender node on receiving the CTS packet successfully gets the reservation for the current slot, and then transmits the data information to the destination.
(vi)	The routing protocol AODV is used as a base protocol in the proposed model.
(vii)	In The proposed model, the QOST is used in addition to base AODV protocol. The QOST also checks the route failure between source and destination
(viii)	If route failure is observed then the technique inform source node to re-establish the route.
(ix)	The shortest path between source and destination is computed using Dijkstra's algorithm.
(x)	The number of packets to be sent from Source to destination is established using multi hop routing.
(xi)	The Scheduling is network bandwidth management by packet scheduling at nodes and transmission scheduling between nodes. The scheduling decisions are based on energy available at nodes, and the small time available at nodes after transmission of its own data Packets, to transmit data packets stored in the buffer to transmit over the specific path.
(xii)	The multi hop technique is used to transmit data packets.

V. PERFORMANCE ANALYSIS

The Objectives of the algorithm are:

(i) To reduce End to End delay for High traffic

(ii) To increases throughput

The Proposed EEQOSRP for Wireless Ad-Hoc network has been implemented using Ns-2**.**

The parameters Energy Consumption**,** packet delivery Ratio, throughput and End to End delay have been compared with AODV. The network parameters such as Network area, Initial energy, Data rate values are tabulated in Table 2.

TABLE 2
NETWORK PARAMETERS

Parameter	Symbol	Value
Network area	A	1000X1000m^2
Num of Nodes	N	50-200
Packet length	L	50 Kbytes
Initial energy	E	500 joules
Datarate	B	20kbps
Simulation time	T	200s
PAI	T	1-100 sec

The EC valves between Existing and proposed EEQOSRP with r respect to PAI shown in Table 3

TABLE 3
THE VARIATION OF EC WITH PAI FOR EXISTING AND PROPOSED MODEL

PAI (seconds)	**EC (joules)**	
	AODV	**Proposed EEQOSRP**
10	6.98	6.24
20	6.98	6.24
30	6.98	6.22
40	6.97	5.75
50	6.97	5.75
60	6.97	5.74
70	6.97	5.73
80	6.96	5.73

.

The EC for existing AODV model and proposed model EEQOSRP decreases as the values of PAI increases. Source generates constant bit rate that varies from 1 to 80 seconds with 10-s steps. It is observed that the values of EC are less in the case of proposed model as compared to existing model. Since it is based on scheduling mechanism, the nodes in the proposed model consume less energy.

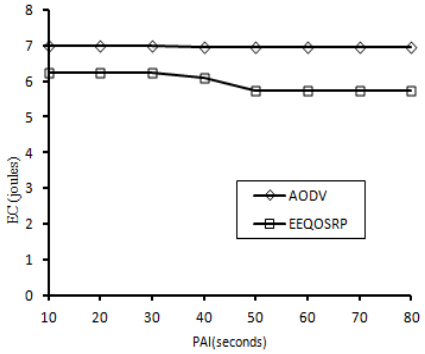

Fig3. shows EC with PAI for Existing and Proposed Model

The variation of EC with PAI is shown in figure 3. The values of EC for existing model are almost constant for variation in PAI. The values of EC decrease with increases in PAI in proposed model. The values of EC are lower in the case of proposed model compared to existing model since it is based on scheduling mechanism, the nodes in the proposed model
Consumes less energy.

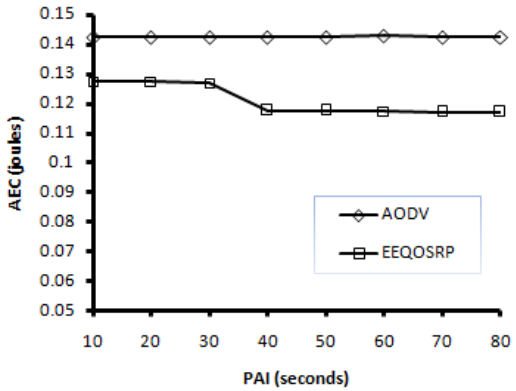

Fig.4. AEC with PAI for Existing and Proposed Model

The Variation of AEC with PAI is shown in figure 4. The values EC for existing model are almost constant for variation of PAI. The values of AEC decrease with increases in PAI in proposed model. The values of AEC are lower in the case of proposed model compared to existing model.

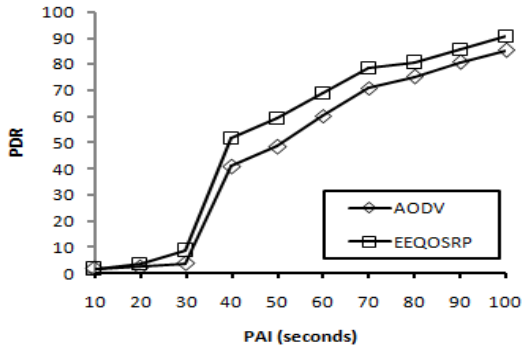

Fig5. PDR with PAI for Existing and Proposed Model

The variation of the PDR with PAI is shown in Figure 5. The value of PDR for existing and proposed model increases for variation in PAI. The values of PDR are higher in the case of proposed model compared to existing model.

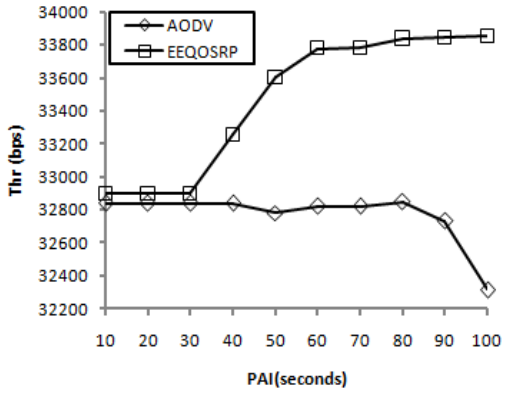

Fig6. Throughput with PAI for Existing and Proposed model

The AEC for Existing model is almost constant and proposed model decreases as the values of PAI increases. It is observed that the values of AEC is less in the case of proposed model as compared to existing model since the proposed model is based on scheduling mechanism.

The variation of the T with PAI is shown in Figure 6 the value of T for existing model almost decreases for variation in PAI. The values of T increases with increases in PAI in proposed model. The values of T are higher in the case of proposed model compared to existing model. The number of data packets delivered increases with scheduling which in turn increases throughput.

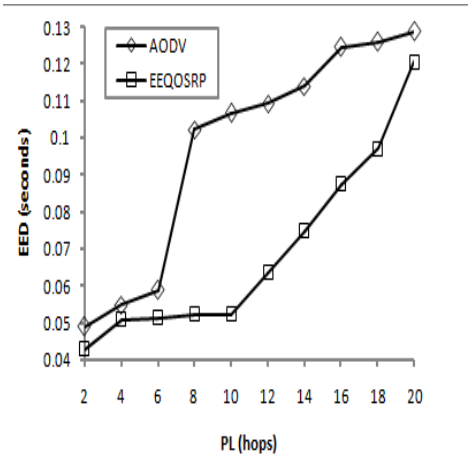

Fig.7. The variation of EED with PL for Existing and Proposed Model

The variation of the EED with PL is shown in Figure 7. The values of EED for existing model and proposed model are increases with respect to the PL. The values of EED are lower in the case of proposed model compared to existing model.

The EED for existing model and proposed model is increase as the values of PL increases. It is observed that the value of EED is less in the case of proposed model compared to existing model due to the reservation mechanism.

VI. CONCLUSION

The Ad-hoc network has wireless communication between randomly moving nodes without fixed infrastructure. In this paper TDMA based Energy Efficient Quality of Service Routing Protocol is proposed. The network scenario is established by considering area, number of nodes, and mobility to nodes using TCL. The multi hop routing technique is used based on TDMA. The AODV protocol is used between two nodes with QOST to establish route with shortest distance between Sources to Destination nodes. The packets are assigned priority at the source nodes and path between sources to destination is identified shortest path based on Scheduling. The performance values of Energy consumption, packet delivery ratio, End to End delay, and Throughput are of proposed algorithm is compared with existing algorithm. It is observed that the proposed algorithm has better performance parameters compared to existing algorithm. In future the proposed algorithm can be tested with DSR protocol to improve performance parameters.

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