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Energy Aware and Bandwidth Optimized AODV Routing for Efficient Traffic Control in Mobile AD HOC Networks

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Abstract: A Mobile Ad hoc Networks are founded a set of mobile nodes that dynamically forms networks temporarily without any fixed infrastructure. The major technical problem for mobile ad-hoc networks is to launch the route among source and destination because of the dynamic topology of the network. Routing based on energy related parameters is one of the main solutions to increase the lifetime of the network. In the recent years, energy efficient routing in Ad hoc network has addressed with several research studies. The high energy efficient routing protocols for MANET help to decrease energy utilization by minimum-hop metric. The existing work presented a Balanced Battery Usage (BBU) Routing Protocol were developed to improve the energy efficiency of ad hoc network routing. BBU protocol selects a route path to desired destination by avoid routing of packets through nodes to reduce residual energy and balance total energy consumption with all network nodes. This protocol uses the residual energy, hop count and energy threshold as cost metric. In addition to improve network life time and distribute energy consumption of Mobile Ad hoc Network (MANET). But, Traffic variance is improved bandwidth consumption of routing on ad hoc networks and increase routing overhead. Quality of MANET routing was not positive to the benchmark standards. To overcome these drawbacks, the proposed method of Energy Aware and Bandwidth Optimized AODV Routing for Efficient Traffic Control in Mobile Ad hoc Networks is used to reduce routing overhead on highly traffic route requests. Introduced a Particle Swarm Optimization technique is applied to find bandwidth optimization. The performance measures of proposed technique are done with following metrics such as, Number of Mobile Nodes, optimal Bandwidth and Node Energy Rate.

Key words: AODV · BBU-AODV · MANET · NS-2.34 · Network Lifetime · Energy Consumption · Residual energy · Geographical routing · Bandwidth Optimization · Traffic Control

INTRODUCTION

Mobile Ad hoc Network (MANET) is a significant type of wireless network in which a group of mobile entities form a temporary network except facilitate of any founded infrastructure or centralized administration. So, dynamic topology, unbalanced connections, limited energy facility and absence of fixed infrastructure are important features for MANET.

The mobile nodes in the Ad Hoc network dynamically set up routing to form individual network. The node in ad hoc network is a routing abilities and forward traffic for other communicating parties with lacking of each other's transmission range that represents lower computing and energy resources. MANET routing protocols organized into three main types of protocol such as proactive, reactive and hybrid. Proactive protocols continuously study the topology of the network through exchange topological information connecting the network nodes. Along with reactive protocols, AODV is provided the most energy efficient routing protocol. Therefore, several research learned have focused on making AODV routing protocol more energy efficiency. It is also called on demand routing.

Fig. 1: Mobile Ad-hoc Networks

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Literature Survey: This paper [1] provides two energy-aware routing algorithms namely energy aware ad hoc on-demand distance vector (e-AODV) and an energy-aware dynamic source routing (e-DSR). Glomosim is created to analysis performance of four routing algorithms such as AODV, DSR, e- AODV and e-DSR. The experimental factors are used in proposed methods such as average energy consumption, average end-to-end delay and average drop packets.

A new energy aware routing (EAR) scheme [2] was developed to use variable transmission range. The protocols were incorporated by the route discovery procedure of AODV. The protocols are created using NS-2 and compared to performance of energy consumption, network lifetime and number of a live nodes for different network scenarios.

An energy efficient multipath routing protocol is introduced [3] for selecting energy efficient path. The energy efficient protocol also includes transmission power of nodes and residual energy that exploit the network lifetime and to reduce energy utilization of mobile nodes. The energy efficient is adopted to determine an optimal route based on energy metrics by selecting a route to transfer data packets.

This paper [4] provides energy efficient routing protocols for Mobile Ad-Hoc Network (MANET). The routing and power management is one of the challenging issues because the mobile nodes in MANET. In order to, improve the network lifetime. An Ad-hoc routing protocol perform each challenges to provide average performance in all case. A medium Access Control (MAC) protocol is important effect on the function and performance of networks to use same transmission power.

In this paper [5] proposes a Particle Swarm Optimization (PSO) is a biologically motivated computational search. A number of basic differences were developed to increase speed of convergence and quality of solution establish by the PSO. The PSO is more fitting to procedure static, small optimization problem. Modification PSO is developed to work out the basic PSO problem. In [6] the proposed method presents basic concepts of PSO and its variants. In addition, it gives comprehensive analysis on the power system applications to perform powerful nature of PSO of optimization method.

This work [7] provides implementation of AODV routing protocol using possibilities and possible opportunities for finding AODV events. The socket based mechanism is performed at the time AODV routing daemon communicates alter the IP route table.

This work [8] evaluates the QoS factors such as Throughput, Delay and Packet Delivery ratio of R-AODV used TCP New Reno of traffic resource. A new method of secure ad hoc on-demand distance vector (AODV) routing protocol is proposed [9] to improve the security rate for routing packets and effectively remove the attacks. For example, black hole, modifying routing information and impersonation are removed. The AODV method utilizes hashed message authentication code (HMAC) function for quick message verification and sender to verify the intermediate nodes. In addition to, this method to reduce the time delay and computation network routing weight. The route discovery process performed the verification of security fields and performs improved than the original AODV protocol.

In [10] the event triggers is illustrated that need to AODV operation. Subsequently, performs the possibilities and decisions of Ad hoc On-demand Distance Vector (AODV) routing protocol implementation.

In this article [11], proposes a grade based two level node selection methods with Particle Swarm Optimization (PSO) technique. The node selection is an efficient and present knowledge base about environment in the local memory. There are two levels for approaching the efficient route selection process. Initially, the grade based selection is considered and then, optimum path is investigated using PSO.

In [12] a swarm intelligence technique is also called Particle swarm Optimization introduced for obtaining a routing problem to provide optimal path from graph. Now, discrete mathematics is applied to encode particle in PSO which split search space in small search space and perform this discrete optimization.

In this thesis [13], identifies problems of multipath routing in MANETs. Multipath routing permits the creation of multiple paths by connecting single source and single destination node. It is provide reliability of data diffusion (i.e., fault tolerance) or improve load balancing. Load balancing is individual significance in MANETs resulting limited bandwidth among the nodes.

In [14] the hybrid method is evaluated with Next-Hop prediction, GA and AHP based route optimization methods. The proposed method illustrates minimum real route and false route break over traditional approaches with lowest routing overhead and bandwidth usage.

In [15] a mobile ad hoc network (MANET) is a wireless network used multi-hop peer to-peer routing as alternative of static network infrastructure to give network connectivity. The network topology in a MANET frequently adjusts the time because new challenges

supporting routing protocols in MANETs, whereas traditional routing protocols cannot appropriate for MANETs.

Energy Aware and Bandwidth Optimized Aodv Routing: This work proposes a Bandwidth Optimized and Energy Aware AODV Routing technique in highly dense MANET traffic that minimized routing overhead. The Particle Swarm Optimization technique (PSO) is applied to maximize bandwidth optimization. Particle swarm optimization (PSO) is a stochastic optimization approach based on social behavior of bird flocks along with population-based search procedure particles are grouped into a swarm. Each particle in the swarm identifies a path on AODV routing to evaluate the most optimal path for needed source-destination pairs. Each particle is flown through multidimensional search space to all available paths by adjusting the position in search space according to current node's experience on bandwidth consumption and also neighbor nodes on bandwidth consumption. In addition, route request traffic is generated by source nodes to obtain path for sending data through route reply packets.

The particle makes use of the best bandwidth optimized path encountered by its neighbor's nodes and neighbors nodes to evaluate the best optimal bandwidth path for the S-D pair. A particle travels into optimum path while searching a wide area around the network for current best paths in order to reduce routing over head. The performance of each particle is measured according to a predefined fitness Function related to bandwidth optimized path. PSO integrated with BBU provides energy aware AODV protocol to modify route request (RREQ) packet for route discovery. Modified fields in the RREQ packet are adding minimum residual energy (MRE) and sum of residual energy (SRE) maintains the minimum remaining energy and sum of remaining energy along the path respectively. The main advantage of proposed work is to provide traffic controlled bandwidth optimized routing ad hoc networks to reduce routing overhead. Energy and bandwidth aware routing is to improve the quality of MANET routing.

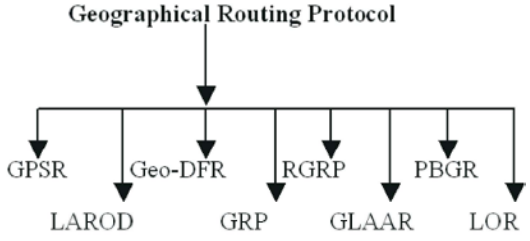

Fig.2: Some Geographic Routing Protocol

The proposed technique is divided into three phases are:

- AODV Routing in MANET
- Traffic Control
- Route Optimization with PSO

AODV Routing in MANET: AODV Protocol is applied into energy efficient traffic control to provide better routing decision in MANET Ad hoc Networks. AODV is a reactive routing protocol that maintains the routes currently used to reduce network overhead and create route discovery process when data packets need to be routed expect periodic routing packet needed. Additionally, AODV minimizes number of route broadcasts by creating routes on-demand. By using route request is forward through source to neighbors continuously, until destination or intermediate node with fresh route located to the destination. AODV packets contain destination address to deal with symmetric links that more suitable for small to medium size networks with moderate mobility.

Mobile Ad hoc Network consists of mobile platforms to move randomly at nodes. The nodes are self-organizing and adaptive that allows spontaneous formation and deformation of mobile networks (ad hoc scenario). MANET an autonomous collection of mobile users to communicate relatively bandwidth constrained wireless links as nodes are mobile network topology changed rapidly.

Mobile Ad hoc Network is a decentralized that includes all network activity such as discovering the topology and delivering messages must be executed by the nodes themselves (i.e., routing functionality incorporated into mobile node) In addition to, optimal path identification become more critical between source and destination nodes to maintain energy and efficiency bandwidth.

Traffic Control: The traffic control is to restrict the delay and buffer overflow due to network congestion and offer better performance of the network. To maintain and assign network resources effectively and quite among a set of users is a major issue. The resources distributed on MANET routing are bandwidth of the links and the queues on the routers or switches. Packets are queued in queues awaiting transmission. While several packets are competing for same link, queue overflows and packets are to be dropped. When packet drops is common events network to be congested. In Ad-hoc networks, since there is no fixed infrastructure and split

the network elements called routers. Therefore a mobile node performs the routers they are dependable for routing the packets.

Traffic control methods are router centric or host/node centric. In traffic control methods source is informed about congestion in network and it measured the packet transmission rate or find an alternate route not essentially to be an optimal route. Bandwidth Optimized AODV reduces routing overhead on high traffic route requests. Route request traffics are carried out by source nodes to obtain path for sending data through route reply packets.

Route Optimization with PSO: Particle swarm optimization (PSO) is a stochastic optimization approach derived from social behavior of bird flocks and population-based search procedure individuals clustered into a swarm. Each particle in the swarm recognizes a path on AODV routing to assess the most optimal path for involving source-destination pairs. Each particle are flown through multidimensional search space of all available paths by adjusting the position in search space along with current node's and neighbor nodes experience on bandwidth consumption. Particle Swarm Optimization technique is implemented to achieve bandwidth optimization.

The particle builds use of the best bandwidth optimized path find by itself and its neighbor's nodes to estimate the best optimal bandwidth path for the S-D pair. A particle moves on optimum path at the same time as searching a wide area network for current best paths to reduce routing overhead.

Performance Evaluation: In this section evaluate the performance of Bandwidth Optimized and Energy Aware AODV Routing technique in MANET. One of the main contributions of the work is to reduce routing overhead on highly traffic route requests. Particle Swarm Optimization technique (PSO) is implemented to achieve bandwidth optimization. Each particle in the swarm identifies an optimal path for required source-destination pairs. This particle makes use of best bandwidth optimized path for evaluating the best optimal bandwidth path. The performance metrics of the parameters is Number of Mobile Nodes, Optimal route paths, Optimal Bandwidth and Node Energy Rate. The performance metrics are

a) Number of Mobile Nodes
b) Optimal route paths
c) Optimal Bandwidth
d) Node Energy Rate.

Optimal Route Paths: Optimal Route path provides host and handles communications routing function that can route nodes and sessions based on multiple factor. Optimal routing is the process of selecting best paths in a network. Optimal Route path is performed into multipath routing that specified all possible routes from the source node and the destination node. It is one of the most important functions in the MANET

Table 1: Number of Mobile Nodes Vs optimal route paths

	Optimal route paths	
No. of Mobile Nodes	BBU(Existing)	EABO(Proposed)
10	13	15
20	16	19
30	21	23
40	23	29
50	26	33

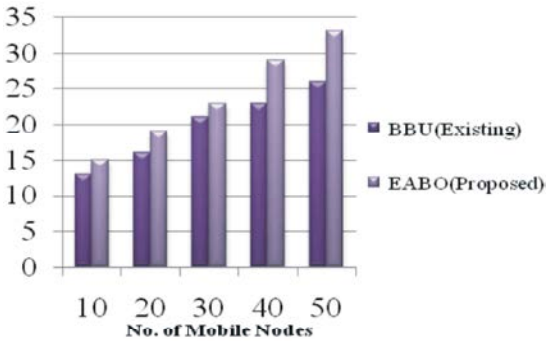

Fig. 1: Number of Mobile Nodes Vs optimal route paths

Figure 1 Demonstrate the Optimal route paths. X axis represents No. of Mobile Nodes whereas Y axis denotes the optimal route paths using both Balanced Battery Usage (BBU) and our proposed Energy Aware and Bandwidth Optimized (EABO). When the No. of Mobile Nodes increased, the optimal route path is also increased accordingly. The Optimal route path is demonstrated using the existing BBU and proposed EABO method. Figure 1 shows better performance of Proposed EABO provides mobile nodes compared to existing BBU method. The Energy Aware and Bandwidth Optimized Routing achieve 15% high performance of optimal route path when compared with existing system.

Optimal Bandwidth: The Optimal bandwidth refers to the routing capacity through or physical communication path in a communication system that measures the maximum throughput of a network. Higher the bandwidth, more efficient the method is said to be and is measured in terms of bits per second (bps).

Table 2: No. of Mobile Nodes Vs Optimal Bandwidth

	Optimal Bandwidth (bps)	
No. of Mobile Nodes	BBU(Existing)	EABO(Proposed)
10	79	85
20	82	90
30	85	93
40	89	96
50	91	99

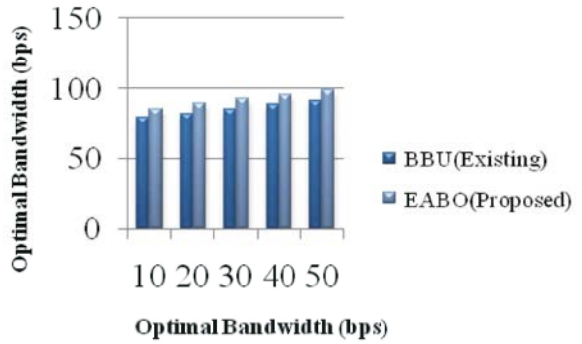

Fig. 2: No. of Mobile Nodes Vs Optimal Bandwidth

Figure 2 Show the Optimal Bandwidth. X axis represents No. of Mobile Nodes whereas Y axis indicates the Optimal Bandwidth using both Balanced Battery Usage (BBU) and our proposed Energy Aware and Bandwidth Optimized (EABO). When the No. of Mobile Nodes increased, the Optimal Bandwidth gets also increased consequently. The Optimal Bandwidth is displayed using the existing BBU and proposed EABO method. Figure 2 shows better performance of Proposed EABO provides mobile nodes compared to existing BBU method. The Energy Aware and Bandwidth Optimized routing scheme achieves 8% of Optimal Bandwidth when compared with existing system.

Node Energy Rate: The Node Energy Rate is defined as the total amount of energy required to transmit a packet from source node to destination node. The Node Energy Rate is measured using proposed BABO and it measured in terms of joules.

Table 3: Number of Mobile Nodes Vs Node Energy Rate

	Node Energy Rate (J)	
No. of Mobile Nodes	BBU(Existing)	EABO
10	45	40
20	49	45
30	53	49
40	58	53
50	65	59

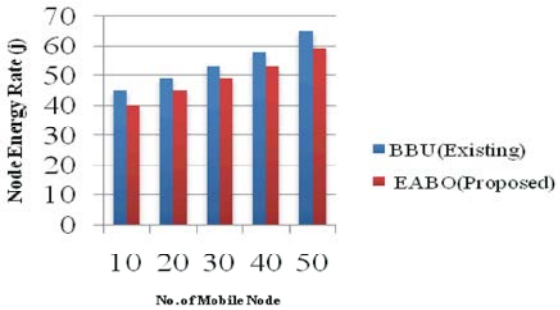

Fig. 3: No.of Mobile Nodes Vs Node Energy Rate

Figure 3 Show the rate of Node Energy. X axis represents No. of Mobile Nodes whereas Y axis indicates the node energy rate using both Balanced Battery Usage (BBU) and our proposed Energy Aware and Bandwidth Optimized (EABO). When the No. of Mobile Nodes increased, the rate of Node Energy gets decreased consequently. The rate of Node Energy is demonstrated using the existing BBU and proposed EABO method. Figure 3 shows better performance of Proposed EABO provides mobile nodes compared to existing BBU method. The Energy Aware and Bandwidth Optimized routing scheme achieves 9 % of Node Energy rate when compared with existing system.

CONCLUSION

This paper proposes Bandwidth Optimized and Energy Aware AODV Routing technique were developed used to reduce the overhead on highly traffic route requests. Particle Swarm Optimization technique is applied to achieve bandwidth optimization. PSO technique integrated with BBU provides energy aware AODV to modify route request (RREQ) packet for route discovery. The bandwidth optimized provided traffic control that used for routing ad hoc networks to reduce routing overhead. In addition, energy and bandwidth aware routing is improved the quality of MANET routing. The performance of proposed Bandwidth Optimized and Energy Aware routing are done with following metrics through the NS-2 simulator.

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