QoS Enhancement using Efficient Routing Protocol for Video over Wireless Adhoc Networks

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ABSTRACT
A mobile ad hoc network (MANET) is an autonomous system of mobile nodes connected by wireless links. Power failure of a mobile node not only affects the node itself but also its ability to forward packets on behalf of others and hence affects the overall network lifetime especially while multicasting the real time video file in multiple paths over a large number of nodes . Due to network mobility, the power level of nodes gets drained. Therefore it is very difficult to find and maintain an optimal power aware route.The proposed work aims at discovering an efficient power aware routing scheme in MANETs. In this work, a scheme has been proposed to maximize the network lifetime and minimizes the power consumption during the source to destination route establishment. In this paper the routing is performed based on the available power level of nodes. That is, the multiple paths are formed based on average power level of intermediate nodes between source and destination. The path having maximum average power level is selected for routing of packets. Thus the proposed work is aimed to provide efficient power aware routing considering real and non real time data transfer.

Keywords: Energy efficiency; PAR; QoS; load balancing.

1. INTRODUCTION
Mobile ad hoc networks (MANETs) consist of a collection of wireless mobile nodes which dynamically exchange data among themselves. MANET nodes are typically distinguished by their limited power, processing, and memory resources as well as high degree of mobility. The proposed project examines the issues of multipath routing in MANETs. Multipath routing allows the establishment of multiple paths between a single source and single destination node. It is typically proposed in order to increase the reliability of data transmission or to provide load balancing.

Many of the real time applications require certain rate guarantees, and demand that the network be utilized more efficiently than with current approaches to satisfy the rate requirements. Traffic mapping (load balancing) is one particular method to carry out traffic engineering, which deals with the problem of assigning the traffic load onto pre-established paths to meet certain requirements. Scrutinizing the effects of load balancing the multicast traffic in an intradomain network is also focused. There is a limited amount of existing work on multipath multicast routing. For many applications, reliable, and secure multicast is a basic requirement. Providing end-to-end reliability requires detection of packet loss, along with error recovery.

Power failure of a mobile node not only affects the node itself but also its ability to forward packets on behalf of others and hence affects the overall network lifetime. Much research efforts have been devoted to develop energy aware routing protocols. An efficient algorithm, which maximizes the network lifetime by minimizing the power consumption during the source to destination route establishment is proposed.

2. ROUTING
Routing is the act of moving information from a source to a destination in an internetwork. During this process, at least one intermediate node within the internetwork is encountered. The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an internetwork. Routing protocols use several metrics to calculate the best path for routing the packets to its destination.
Routing is mainly classified into two types namely
Static routing and Dynamic routing.

1.1 ROUTING PROTOCOLS:
Routing protocols that find a path to be followed by data packets from a source node to a destination node used in traditional wired networks cannot be directly applied in ad-hoc wireless networks due to their highly dynamic topology, absence of established infrastructure for centralized administration, bandwidth-constrained wireless links and resource-constrained nodes.

1.1.1 Ad hoc On-demand Distance Vector Routing
AODV is a reactive protocol: the routes are created only when they are needed. It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops. An important feature of AODV is the maintenance of time-based states in each node,a routing entry not recently used is expired. To find a route to a particular destination node, the source node broadcasts a RREQ to its immediate neighbors as shown in figure 2.2a. If one of these neighbors has a route to the destination, then it replies back with a RREP. Otherwise the neighbors in turn rebroadcast the request. This continues until the RREQ hits the final destination or a node with a route to the destination. At that point a chain of RREP

messages is sent back and the original source node finally has

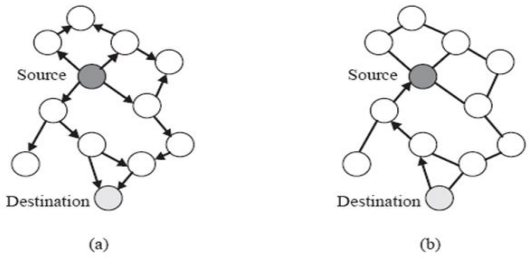

Figure: 1.1 Route discovery in AODV

The AODV protocol never produces routing loops by proving that a combination of sequence numbers and hop counts is monotonic along a route.

When a node forwards a route request packet to its neighbours, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet. AODV uses only symmetric links because the route reply packet follows the reverse path of route request packet. As the route reply packet traverses back to the source, in case if the source moves then it can reinitiate route discovery to the destination. If one of the intermediate nodes move then the moved nodes neighbour realizes the link failure and sends a link failure notification to its upstream neighbours and so on till it reaches the source upon which the source can reinitiate route discovery if needed.

Protocol Implemented

The performance of the routing protocols in wireless ad-hoc networks is investigated. From the comparison AODV protocol is chosen because of following characteristics

It will find routes only as needed.

It uses sequence numbers to track accuracy of information.

It keeps track of next hop for a route instead of the entire route.

It uses periodic HELLO messages to track Neighbors.

3. VIDEO TRANSMISSION IN MULTICAST NETWORKS

In a multicast environment , the video server needs to transmit a single video stream for each multicast group, regardless of the number of clients that will view it. The video stream is then replicated as required by the network's multicast routers and switches to allow an arbitrary number of clients to subscribe to the multicast address and receive the broadcast. In the router network, replication occurs only at branches of the distribution tree, so essentially all of the replication occurs at the last switch hop. In the multicast scenario, only 1.5 Mbps of server-to-network bandwidth is utilized leaving the remainder free for other uses or additional channels of video content. Within the network, the multicast transmission offers similar efficiency, consuming only 1/nth of the bandwidth of the multi-unicast solution.

Obviously, where there are large numbers of recipient of a replicated transmission, multicast technology makes a tremendous difference in both server load and network load, even in a simple network with a small number of router and switch hops. Additional features of multicast are beneficial in specific applications such as financial services. Multicast transmissions are delivered nearly simultaneously to all members of the recipient group. The variability in delivery time is limited to differences in end-to-end network delay among the range of server-to-client paths. In a unicast scenario, the server sequences through transmission of multiple copies of the data, so variability in delivery time is large, especially for large transmissions or large distribution lists. Another unique feature of multicast is that the server does not know the unicast network address of any particular recipient of the transmission, all recipients share the same multicast network address and therefore can join a multicast group while maintaining anonymity.

Multicasting is a more efficient method of supporting group communication than unicasting or broadcasting, as it allows transmission and routing of packets to multiple destinations using fewer network resources. The shortest path is to be determined by implementing the Ad hoc on Demand Distance Vector routing protocol in the wireless simulation environment for AODV in wireless environment [9]

Algorithm:

Source broadcast the RREQ packet to all the nodes in the network in order to discover the paths for data transmission.

Once the source receives the RREP packet, wait for a certain amount of time, then from received paths choose those ones that have the least active neighbors and starts load balancing data transfer on these paths.

The video packets are splitted into multiple parts and are transmitted via different paths.

Multicasting method is employed to transmit the video packets.

MULTIPATH MULTICASTING USING POWER ALGORITHM

Since a MANET may consist of nodes which are not able to be re-charged in an expected time period, energy conservation is crucial to maintaining the life-time of such a node. In networks consisting of these nodes, where it is impossible to replenish the nodes' power, techniques for energy-efficient routing as well as efficient data dissemination between nodes is crucial.

As shown in figure 3.1 an energy-efficient mechanism [6] for unipath routing in sensor networks called directed diffusion has been proposed. Directed diffusion is an on-demand routing approach. In directed diffusion, a (sensing) node which has data to send periodically broadcasts it. When nodes receive data, they send a reinforcement message to a pre-selected neighbor which indicates that it desires to receive more data from this selected neighbor. As these reinforcement messages are propagated back to the source, an implicit data path is set up; each intermediate node sets up state that forwards similar data towards the previous hop.

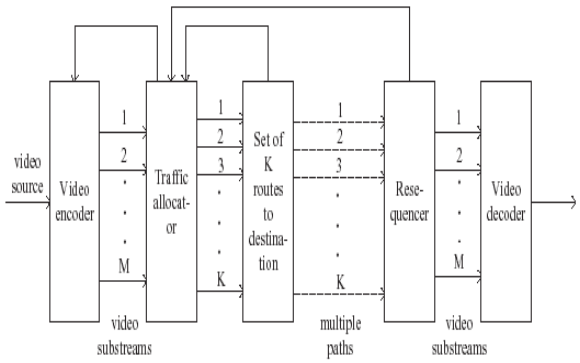

Figure: 3.1 Multipath multicast power Routing

By simulation it is observed that proposed algorithm's performance is better as compare to AODV in terms of packet delivery ratio and network lifetime for different network scenarios. Energy efficiency is one of the main problems in a mobile ad hoc network, especially designing a routing protocol. The proposed work aims at discovering an efficient power aware routing scheme in MANETs and analyzing the derived algorithm with the help of NS-2. Simulation result shows that the proposed scheme PAR is delivering more packets in different network scenarios as well as network life time of the PAR is better even in high mobility scenarios. Although this scheme can somewhat enhance the latency of the data transfer but it results in a significant power saving and long lasting routes. This scheme is one of its types in adhoc networks which can provide different routes for different type of data transfer and ultimately increases the network lifetime.

The modified proposed algorithm

Threshold = 50%; success = 0; cutoff = 10%

A := S;

Repeat

If g(A) >= threshold then

B := A;

Let A be neighbor of B that minimizes

pc(B,A) = power-cost(B,A) + v(s)f`(A);

Send message to A;

success = 1;

Until A = D (* Destination reached *)

or if success <> 1 then

if threshold > cutoff then

threshold = threshold /2;

or A = B (* Delivery failed *);

4. COMPARISION (EXISTING Vs PROPOSED)

In localized proposed algorithms, the nodes in the network make routing decisions based solely on the location of itself, the location of the destination and the location of its neighbors. Localized algorithms are distributed algorithms where simple local node behavior achieves a desired global objective. Non-localized algorithms are those in which the nodes require the complete knowledge of all the nodes in the network along with the corresponding edges. In ad hoc mobile networks, nodes are moving at all times and there may be several nodes exiting and entering the network at any given point of time. To keep a track of all these nodes and their corresponding edges is cumbersome and requires a huge overhead. To avoid this overhead, routing decisions are made on demand using the dynamic source routing technique.Intuitively, want to minimize the total power required in transmission, the shortest path would be the optimal solution. This is not always true. It will get depleted the fastest and thus lead to a breakdown of the network. To avoid this condition, the remaining battery power of each node needs to be taken into consideration. This is known as cost-aware routing. Presented some of the existing power aware metrics and routing algorithms.

4.1 Existing Power Aware Metrics And Routing Algorithms

There are number of power and cost aware metrics present. The two basic ones are Power aware routing. In this case, the transmission power depends on the distance between the source and the destination. Cost aware routing: In this case, the routing decisions are made based on the remaining life-time of nodes between the source and the destination.

4.2 Proposed Power Aware Algorithm

The proposed algorithm and the parameters considered for conducting this experiment extend the power-cost efficient algorithm to implement timing constraints. The results of the power-cost aware algorithm show that it performs better when the network/graph is dense. In a large network, a node will have a large number of neighbors. The computation time for calculating the minimum power-cost among the nodes' neighbors is quadratic or exponential (depending on the algorithm used, power+cost or power*cost). In order to reduce this computational time we introduce a threshold value for the remaining battery power of the nodes. While selecting a route, nodes with battery power greater than the threshold will only be considered. It would then go on to compute the minimum power-cost route. However, if none of the nodes meet the threshold, the threshold is reduced by half. This will continue until a node meeting the threshold is found or the threshold reduces to a minimum specified value. This would imply that the network is broken and the packet cannot be delivered. An appropriate error message is then given.

5. RESULTS & DISCUSSIONS

For the proposed algorithm simulated an ad-hoc network with varying densities and transmission ranges. Each node had a random location in a 1000 x 1000 area. They also had a random amount of initial power within a range of 700k to 1500K. The thresholds were varied from 700k to 1000K.

In this proposed method the video can be split into five parts and transmitted in multipath based on the availability of the nodes. The source and the destination for the transmission are visible. The five paths taken are shown below.

Path 1: 29-23-38-36-47

Path 2: 29-26-44-43-42-47

Path 3: 29-21-37-48-47

Path 4: 29-20-9-8-87-92

Path 5:16-28-99-89-92

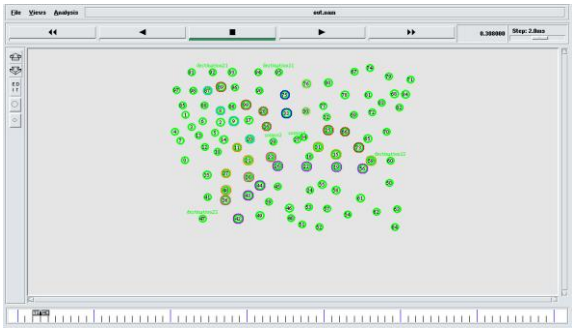

Fig 5.1 : Logical clusters based on battery status

Simulation result shows that video quality of multiple path multicast video communication is significantly higher than that of single path multicast video communication, with similar routing overhead and forwarding efficiency. The video multicasting technique applied in this paper is much superior to the existing technique. By the extensive use of AODV protocol the QoS parameters, viz, Delay and Throughput have significantly improved. From the simulation results the delay has been reduced by 0.5 s and the throughput has been increased by 5%.Wireless multicast is required for a range of emerging wireless applications employing group communication among mobile users.

NODE DEFINITIONS:

Channel	Wireless	Channel
Propagation	Two Ray	Ground
Queue	Drop Tail/PriQueue	
layer	LL	
Antenna	Omni	Antenna
Area	1000m*1000m	
Queue length	50	
Number of nodes	100	
Initial energy	5.0 Joules	
Video size	2000 bytes	
Data rate	64kbps (video phone quality)	

5.1 Performance Evaluation

Throughput

Throughput is the amount of digital data per time unit that is delivered over a physical or logical link, or that is passing through a certain network node.

$$\text{Delivery ratio} = \frac{\text{numberofpacketsreceived}}{\text{numberofpacketssent}}$$

Delay
Delay is defined as the average time taken by the packet to reach the server node from the client node.
Pause-time
Pause-time is the time for which a packet stops in when it reached a destination after a travel from the place of origination. The unit of pause-time is seconds.
Mobility
It is the velocity with which a node moves from the source to destination. It is usually specified in m/s.
Dropped packets
It is number of packets dropped due to the effect of link breaks. The dropped packets may be a control packets or data packets.
Simulation time
It is the time duration between start and end of the simulation.
Exhausted nodes
Nodes which looses their energy at the end of the simulation is called exhausted nodes

5.2 SIMULATION RESULTS

Number of nodes Vs Delivery ratio

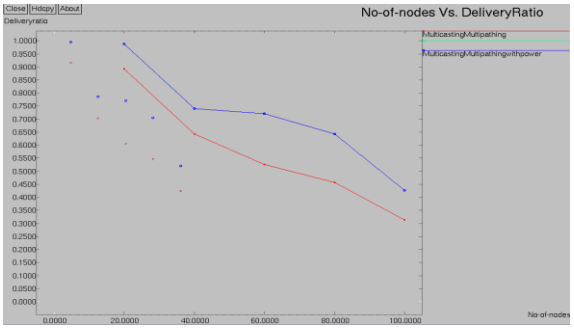

Figure :5.2 No of nodes Vs delivery ratio

Inference
The delivery ratio is obtained for different number of nodes. .As the number of nodes increases, the delivery ratio decreases in both the methods. The increase in the bandwidth utilization and network traffic leads to increase in the number of packets dropped. So the delivery ratio is decreased when the number of nodes increases. The proposed method delivery ratio is comparatively high. It is increased up to 10.6%.

Mobility Vs Delivery ratio

Inference

Figure 5.3 as the mobility tends to increase the delay decreases initially and increases and further decreases, because higher mobility introduces more instability of the network. As the mobility of nodes changes with time the delivery ratio gets affected. In our method of multicasting in multiple paths the delivery of packets gets increased even nodes changes its position. Delivery ratio increased upto 26% in the proposed method

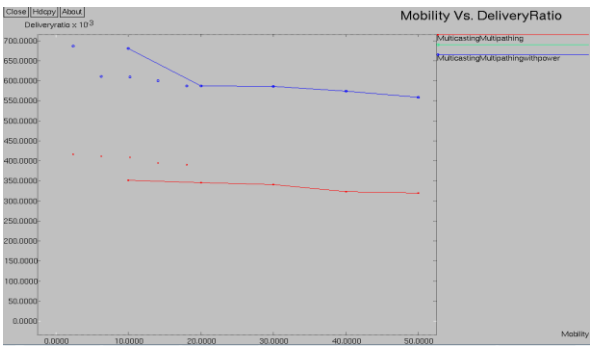

Figure: 5.3 Mobility Vs delivery ratio

Simulation time Vs No of nodes

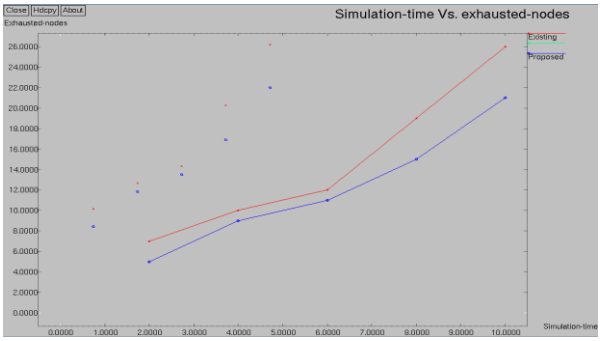

Figure: 5.4 simulation time Vs exhausted nodes

Inference

In general after the simulation of a single data transmission, the power of the nodes gets exhausted and thereby the throughput gets decreased. In proposed method we separated the nodes which do not participate in transmission will be kept as sleep state. Then data are transmitted based on node power level. From Figure 5.4 the number of exhausted nodes after transmission gets increased when compared to the existing method. No of exhausted nodes reduced upto 10.8%.

Energy Vs throughput

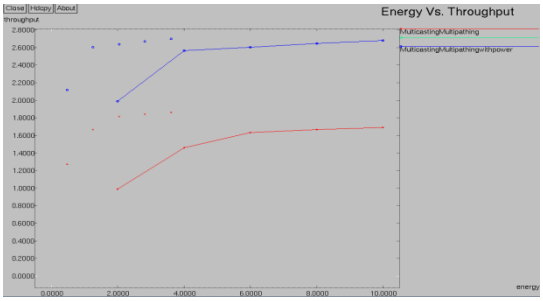

Figure: 5.5 Energy Vs throughput.

Along with the clustering technique a blend of Multipath multicast routing has also been incorporated to increase the lifetime of network by load balancing of energy consumption. As a result this proposed algorithm makes an effort to reduce the number of route discovery and contribute on improving the network performances such as Network Lifetime, Packet Delivery Ratio and Routing Overhead.

The future work includes the enhancement of QoS multipath multicasting of video and thereby avoiding vulnerable attacks and also measuring the energy drain for variable packet size.

In existing method especially in multicasting the power factor is not taken into account so that data transmission lasts for the battery status of nodes. In our method we concentrate on this power factor by classifying nodes into active, passive and sleep nodes based on their power level. Thereby the proposed method gives better throughput by selecting paths having higher power level. However low power nodes are not considered while selecting paths for multipath multicasting .From figure 9.4 and table 9.4 thus throughput gets increased considerably when compared to existing methods.

6. CONCLUSION AND FUTURE WORK

In this project, the problem of real-time video multipath multicasting communication over wireless ad hoc networks has been analyzed. Proposed method divides the ad hoc network into logical clusters. The designed algorithm exploits this logical cluster information to reduce the routing overhead.

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