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Link Breakage Prediction in AOMDV Protocol to Improve Quality of Service in MANET

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ABSTRACT: The Quality of Service (QoS) in Mobile Ad hoc Networks (MANETs) and more precisely in routing is the subject of several studies with the aim of providing better solution for new applications requiring high throughput and very low delay. The objective of this work is to enhance the AOMDV (Ad hoc On demand Multipath Distance Vector) routing strategy in maintenance phase, to improve QoS. It aims to add a mechanism able to predict the link breakage in use based on signal strength which is able to determine if the quality of link will be improved (i.e. stable) or more bad (i.e. probability of failure) in order to allow us not only to make the link management more robust but to anticipate on link braking and improve QoS. When signal quality is declining due to neighbor node remoteness, a discovery of a part of road rescue with two hops will be established and it will be used when disconnection happens. Simulations under Network Simulator (NS2) were conducted to measure traffic control, packet delivery and lost ratio in original protocol and modified version which are presented in this paper.

KEYWORDS: Mobile Ad hoc Networks (MANET), AOMDV protocol, QoS Routing, Signal Strength Connection, Network Simulator (NS2).

I. INTRODUCTION

The Mobile Ad hoc Networks (MANETs) should be able to provide a quality of service for new needs of multimedia applications and real time that require high throughput and reduced delay. So it is imperative that networks can be able to provide quality of Service (QoS) in terms of throughput, delay, jitter, reliability, etc. Taking into account limitations imposed by such networks like shared medium and dynamic topology. RFC 2386[1] characterizes QoS as series of needs to be provided by network to transport traffic from source to destination. It is defined in [2] such as the ability of network component (router, node, etc...) to provide security level for transmitting data. It is very important in Ad hoc networks because it can improve performance and enable flow of data [3].

QoS must be assured at different levels in network architecture. Ad hoc network is a wireless network, without infrastructure in which resources (bandwidth, energy, etc..) are limited. Routing in these networks is the interest heart of researchers of researchers. Several solutions have been explored and many protocols have been developed [4] including AOMDV. Nevertheless, initial versions of Ad hoc routing protocols doesn't take into account real-time constraints to support applications that require certain QoS. So they must be adapted appropriately to meet QoS requirements of these new applications.

A QoS routing protocol select roads that best meets QoS parameters like throughput, delay, jitter, etc. In this paper we propose to reinforce AOMDV routing strategy especially in the maintenance phase. For this reason, we aim to add mechanism to predict link breakage prediction in use, based on signal strength that determines if link quality improves (more stable) or decreases failure probability which allows us to not only to make link management more robust and anticipate the link failure and therefore to optimize some QoS parameters and anticipate the link failure and

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therefore to optimize some QoS parameters and to determine impact of mobility and duration interval between two consecutive rate on traffic control, reliability (packet loss), packets transit delay etc.

II. RELATED WORK

In recent years, several solutions have been proposed to support QoS at routing level for mobile ad hoc networks (MANETs). Most of them extend AODV protocol [5] and use either backup routes selected by multi paths protocols that generate a significant overhead during discovery and maintenance phases, or a link failure prediction mechanism based on residual energy or received signal value from neighbor node, or a combination of both of them (prediction & multi-path).

AODV – Reliable Delivery (AODV-RD) developed in [8] focuses on an anticipated warning mechanism to detect a link failure by Signal Stability-Based Adaptive Routing (SSA) [9], method to identify good or bad link based on weakness or greatness of signals and to proceed a repair action before the primary route breaks. This protocol increase PDR and reduce end to end delay.

Abdule and Hassan [10] propose Divert Failure Route Protocol (DFRP) for resolving link failure problem in Ad hoc network based on AODV protocol. DFRP tries to avoid a link failure in advance and monitors the link to next hop to predict link status through signal strength. Main functions of DERP are to predict signal strength, and to find a new route to divert data to the new path. This protocol reduces delay resulting from sending link failure information back to the sender.

Hwang and Varshney [11] propose an Adaptive Dispersity QoS Routing (ADQR) method to find multiple disjoint routes with long lifetime. ADQR use signal strength information obtained from lower layers to predict route failure and initiate fast route maintenance to react quickly to network changes. It improves routing performance and supports end-to-end QoS.

Modified Reverse Ad Hoc On-demand Vector (MRAODV) routing protocol cited in [16] is based on link/route stability estimation which reduces routing overhead in discovery and maintenance process and increased packet delivery ratio. When an active route fails, the source node with the awareness of routes stabilities, can select the best path in available routes set.

A proposal discussed in [17] is an intelligent protocol that performs proactive route maintenance process by using path reliability information, and analyzes its effect in path selection. When route failure occurs, packets may be rapidly switched to an alternate route, without waiting until the route to be broken to restart the route discovery process. This protocol outperforms AODV in terms of increased throughput and reduced overhead.

The most of these proposals [18 - 22] improve AODV protocol and use Failure Prediction mechanism, network lifetime and/or energy consumption. Maleki, Mortez et al [18] propose Lifetime Prediction Routing (LPR) to enhance the network lifetime by finding routing solutions that minimize the variance of the remaining energies of nodes in the MANET. They use battery lifetime prediction based on its past activity and they choose the path with maximum lifetime. LPR introduces some additional traffic but it improves the network lifetime.

Veerayya [19] develops a Stability-based QoS-capable AODV (SQ-AODV) protocol to enhance AODV based on how to best use node energy for both route discovery and maintenance process and how to adapt more quickly to networks conditions. SQ-AODV provides stable routes, increase PDR, and reduce control overhead and packet delay.

A proposal discussed in [20] called AODV_LFF routing protocol introduces the mechanism of link failure prediction into AODV routing protocol in data transmission process. This protocol can reduce network transmission delay effectively, and also can boost packet delivery rate.

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III. QUALITY OF SERVICE IN MANET

Quality of Service (QoS) refers to capacity to provide better service for different applications having ability to transmit under good conditions data stream, in terms of availability, throughput, delay, jitter, packet loss. Quality of service also involves controlling and optimizing network resources. QoS model in mobile ad hoc network defines architecture for all possible. This template must take into account all these networks constraints (mobility, energy lack, etc...).Classical models like Intserv[25] and Diffserv[26] proposed first for wired network and internet are not adapted to MANETs constraints like mobility and capacity.

Various specific models developed for MANETs like FQMM[27] (Flexible Quality of Service Model for MANET) which was the first proposed model with size not exceeding 50 nodes. it doesn't take into account all MANETs characteristics. SWAN model [28] (Service Differentiation in Stateless Wireless Ad hoc Networks) based on best-effort service and use control admission to check bandwidth availability to ensure traffic transit without congestion.

IMAQ[29] (an Integrated Mobile Ad hoc QoS Framework) is QoS model oriented for multimedia; it includes a routing layer and software service layer (middleware).

On the other hand, QoS routing in MANET is an essential element and many research try to find a solution to this. Since routing in network, can establish the shortest link in terms of hops or delay between source and destination, the purpose of QoS routing is to find the best path according to specific criteria for desired QoS (delay, loss rate, throughput...) based on reliable and stable links.

IV. AOMDV PROTOCOL

A. INTRODUCTION

The main idea in AOMDV is to compute paths during route discovery. It is designed primarily for highly dynamic Ad hoc networks where link failures and route breaks occur frequently. When single path on demand routing protocol. The main idea in AOMDV is to compute multiple paths during route discovery. It is designed primarily for highly dynamic Ad hoc networks where link failures and route breaks occur frequently. When signal path on-demand routing protocol such as AOMDV is used in such networks; a new route discovery is needed in response to every route break. This inefficiency can be avoided by having multiple redundant paths available. Now, a new route discovery is needed only when all paths to the destination break.

A noteworthy feature of the AOMDV protocol is the use of routing information already available in the underlying AODV protocol as much as possible. Thus little additional overhead is required for the computation of multiple paths. The AOMDV protocol has two main components:

1. A route update rule to establish and maintain multiple loop-free paths at each node.
2. A distributed protocol to find link-disjoint paths.

B. DISCOVERY PHASE

Every time, a node wishes to transmit, it checks its routing table for any valid path to desired destination. If isn't the case, it launches the discovery paths. This operation is initiated by broadcasting RREQ control packet specifying parameters such as sequence number to be used to indicate fresh paths, pair (ID packet and IP source address) to check if request is ready treated by node or not (problems of Duplication) and TTL (Time To Live) (number of hops) that is assigned to the initial value TTL_START. If no response is made after RREP_WAIT_TIMEOUT period, the same RREQ is rebroadcast by source node but with a TTL incremented by TTL_INCREMENT (more hops and therefore more chance to find a path) and waiting period for response has no longer time than the previous one.

When intermediate node receives a request (RREQ), it checks its routing table for availability of path to the destination and if so, a reply packet (RREP) is returned to source telling how to reach the destination. Otherwise it increments hop count and rebroadcast RRREQ packet. Before sending, node stores IPs and node from which a first copy of applications is received, then uses a reverse path to be traversed by RREP packet in uncast.

When the RREQ packet reaches the destination one, the latter constructs a RREP packet and forwards it in reverse, using previously saved IPs and each passage by node in reverse path, field "hop count" of this packet (RREP) is incremented (distance in number of hops).

C. MAINTENANCE PHASE

In order to maintain consistent paths, periodic transmission of HELLO message (which is a RREP with TTL equal to one) is performed. If three HELLO messages are not received consequently from neighboring node, the link in question is considered as failing. Paths failures are generally due to nodes mobility in Ad hoc Network. If unsuccessful, the source node tries to find another path and decrements the attempts number (RREQ_RETRIES) by one.

V. **IV LBP_AOMSV (LINK BREAKAGE PREDICTION IN AOMDV)**

A. INTRODUCTION

In this section, we start by a motivation with an illustrative example to better promote this solution. Approach principle is based on a discovery phase identical to AOMDV and maintenance phase where new algorithms are integrated to predict failure before a disconnection takes place.

B. MOTIVATIONS

In dynamic environment, a frequent disconnection cause's considerable packets data loss due to lack of alternate paths (routes) and the reconstruction of new route generate an additional volume packets (routing) control. That's why it is important to predict any disconnection (failure) probable on active route based on signal strength between neighboring nodes. The signal strength value informs us about the link quality and it depends on nodes mobility. Signal strength can determine can determine if link quality improves (more stable) or decreases (probability failure) which allow us not only to make link management more robust and anticipate on link failure and thereby improve QoS contribution. When signal strength is in fall due to neighbor's node remoteness, a discovery of path to rescue two more hops will be established that will be used in disconnection case.

To illustrate our idea, consider the following example in (Fig 1). Nodes x1, x2 and xi are close two by two and neighbour to xs on one side and xd the other. S is the source and D is the destination.

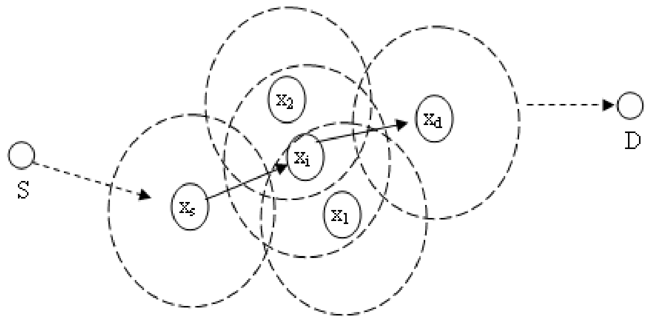

Fig.1. Vicinity nodes Graph

When node xi moves away due to mobility, its signal weakens (tends towards zero) and disconnection probability increases.

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Two cases are to be considered:

i)Xi move towards xd and leave the range of xs (break of segment [xs,xi]),then xs tries to rebuild road pieces [xs,sp,xi,xd] , where p is one of neighbour at one hop from xs.

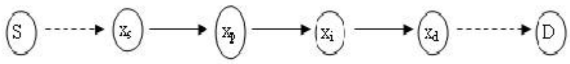

Fig 2 : Rebuilding in xs side

ii)Xi move towards xs and leave the range of xd(break of the segment[xi,xd]),then xs tries to rebuild road pieces [xs,xp,xd],where p is one of the neighbour at one hop from xs.

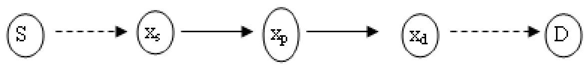

Fig. 3 : Rebuilding in xd side.

V. ALGORITHMS

A. LINK EVALUATION PROCEDURE

1. Compare "Val_SiganlStrength" to "Threshold"
2. If it is greater than threshold, everything is good so nothing to do and go to 4.
3. Otherwise launch procerdure – Handoff with H_Handoff packet
4. End

B. HANDOFF EVALUATION PROCEDURE

1. Find the best neighbor (xp) (greatest Val-SS of xi)
2. If it does not exist, a local repair as in the AOMDV will be initiated if failure occurs.
3. If it exists, Handoff (H) is handoff node, broadcasting H_Handoff packet between P and H has a path to Destination D.
4. Verify if node H has a path to D.
5. If it is the case, the segment is rebuilt and goes to
6. Otherwise re-launch the –Handoff procedure for node H (for only one execution).
7. End

VI. SIMULATION

Network Simulator (NS2) version 2.31 is used to investigate and analyze proposed idea. Simulation context consists of 20 nodes in a region 800 x 600 m2. Random Way Point (RWP) mobility is used and the transmission range is set to 250m for ideal unstructured. Nodes moves at average speed of 5m/s. Two scripts are used, the first (cbrgen.tcl) for random generating traffic for constant Bit Rate (CBR) of 512 bytes according to UDP protocol and the second (Setdest) to produce mobility scenarios. Simulation time is sets to 120 s for all tests.

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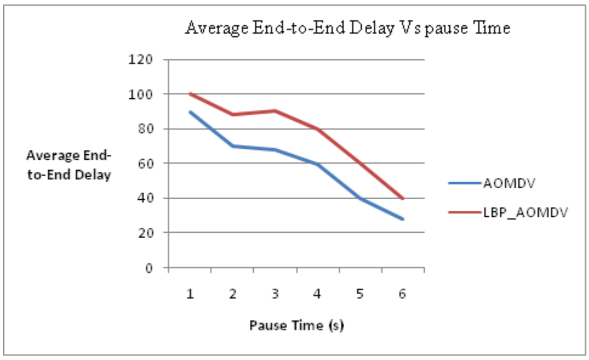

Fig 4.Average End-to-End Delay Vs Pause Time

Fig.4 Shows the graph between Average End-to-End delay vs Pause time. When compare AOMDV, LBP_AOMDV gives a better results.

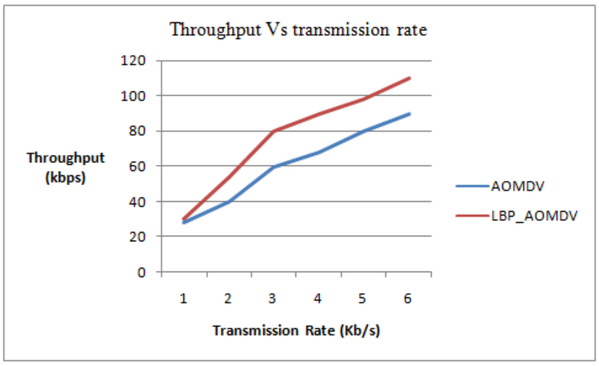

Fig.5. Throughput Vs Transmission rate

Fig.5 shows a relationship between Throughput and transmission rate of AOMDV and LBP_AOMDV. When compare AOMDV, LBP_AOMDV's transmission rate is increased. If we increase the throughput, the transmission rate also increased. The link breakage prediction scenario works in a good manner and before failure the links are identified and performance in transmission rate and throughput are increased.

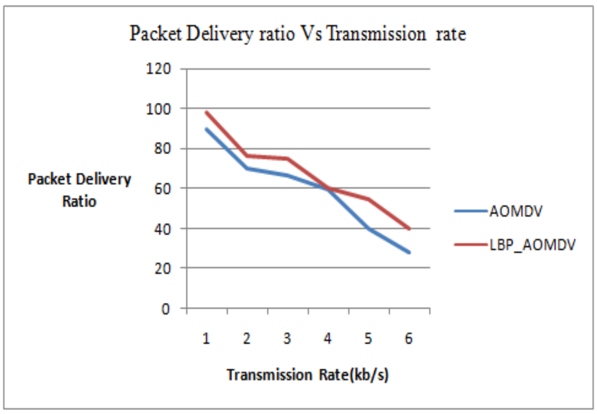

Fig.6: Packet Delivery Ratio Vs Transmission Time

Fig.6 shows a relationship between packet delivery ration and transmission rate of AOMDV and LBP_AOMDV. When compare AOMDV, LBP_AOMDV's transmission rate is increased. If we increase the transmission rate, the

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packet delivery ratio will also be increased. The link breakage prediction scenario works in a good manner and before failure the links are identified and performance in transmission rate and packet delivery ratio will also increased.

VII. CONCLUSION AND FUTURE WORK

In this paper, the proposed protocol (PF_AODV) based on AODV, has improved QoS for applications in MANETs certainly in context proposed in our simulation. Using signal strength to predict future disconnection of road in use and to provide another segment (cache link) before break occurs will be greatly minimizes control traffic generated during roads reconstruction phase as it does in the original version.

The simulation results shows that PF_AODV provides better performance in terms of throughput, loss and delay. Future extensions of AODV protocol to add control admission to handle each traffic type separately and determine what kind of traffic should be penalized to free up bandwidth to support traffic priority.
Another direction in addition to the idea developed in this paper is to regulate conflicts caused by more than one procedure launch to ensure handoff phase between neighboring nodes to minimize control load is to introduce a random delay before each node initiates handoff phase, one node initiates this phase earlier than other or to promote nodes near the destination, if not; source recovery in AODV will better do.

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