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Rebirth Approach of Multiple Path System in Wireless MANET'S

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Abstract: A Mobile Ad-Hoc Network (MANET) is a self-configuring network of mobile nodes connected by wireless links to form an arbitrary topology without the use of existing infrastructure. In wireless mobile ad hoc networks (MANETs), packet transmission is impaired by radio link fluctuations. In this paper we have studied a novel channel adaptive routing protocol which extends the Ad hoc On-Demand Multipath Distance Vector (AOMDV) routing protocol to accommodate channel fading. Specifically, Channel-Aware AOMDV (CA-AOMDV) uses the channel average non-fading duration as a routing metric to select stable links for path discovery, and applies a preemptive handoff strategy to maintain reliable connections by exploiting channel state information. Using the same information, paths can be reused when they become available again, rather than being discarded. We propose new way of reusability for the downtime and lifetime of a multiple path system, as well as future scope of these recursive mechanism for common network performance measures, providing useful insights into the differences in performance between CA-AOMDV and AOMDV. Simulation and theoretical results show that CA-AOMDV has greatly improved network performance over AOMDV.

Keywords: CA-AOMDV, Concoction, Downtime, Novel Channel, Radio link,

1. INTRODUCTION

Wireless mobile ad hoc networks (MANETs) are self configuring, dynamic networks in which nodes are free to move. A major performance constraint comes from path loss and multipath fading [1]. Many MANET routing protocols exploit multihop paths to route packets. The probability of successful packet transmission on a path is dependent on the reliability of the wireless channel on each hop. Rapid node movements also affect link stability, introducing a large Doppler spread, resulting in rapid channel variations [2]. Routing protocols can make use of prediction of channel state information (CSI) based on a priori knowledge of channel characteristics, to monitor instantaneous link conditions. With knowledge of channel behavior, the best links can be chosen to build a new path, or switch from a failing connection to one with more favorable channel conditions. Several channel adaptive schemes that have been developed for MANETs to maintain connection stability can be found in the literature. In [3], [4] channel adaptive schemes are implemented in medium access control (MAC) protocols; [5] considers link stability largely in terms of longevity of a given link, termed "associativity"; a similar idea, with respect to node mobility, is considered in [6] while [7] considers node mobility to improve path reliability, utilizing only the naive transmission range channel model, not taking into account the fading characteristics of the wireless channel; [8] utilizes node-to-node routing, based on the "best" node which received a given transmission. While throughput improvements of 35 percent over traditional routing techniques are achieved, it is not clear how much delay or overhead is expended through node negotiation with each transmission.

Signal strength as a path selection criterion, is used in [9]; [10] introduces outage probability into both the routing and MAC protocols; [11], [12], [13] utilize the bit transmission rate in the network layer; and [14] employs SNR to support channel adaptive routing.

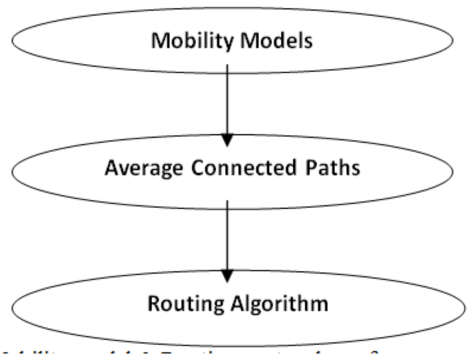


Figure 1: Association of Nodes Mobility model & Routing protocols performance

Description of Routing Protocol

A. Destination-Sequenced Distance-Vector (DSDV)

Destination-Sequenced Distance-Vector Routing protocol is a proactive table driven algorithm based on classic Bellman-Ford routing. In proactive protocols, all nodes learn the network topology before a forward request comes in. In DSDV protocol each node maintains routing information for all known destinations. The nodes periodically send this table to all neighbors to maintain the topology, which adds to the network overhead. Each entry in the routing table is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops [9].

B. Dynamic Source Routing (DSR)

Dynamic Source Routing protocol is a reactive protocol i.e. it determines the proper route only when a packet needs to be forwarded. The node floods the network with a route-request and builds the required route from the responses it receives. DSR allows the network to be completely self-configuring without the need for any existing network infrastructure or administration. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network. All aspects of protocol operate entirely on-demand allowing routing packet overhead of DSR to scale up automatically.

Route Discovery: When a source node *S* wishes to send a packet to the destination node *D*, it obtains a route to *D*. This is called Route Discovery. Route Discovery is used only when *S* attempts to send a packet to *D* and has no information on a route to *D*.

Route Maintenance: When there is a change in the network topology, the existing routes can no longer be used. In such a scenario, the source S can use an alternative route to the destination *D*, if it knows one, or invoke Route Discovery. This is called Route Maintenance [10] [11].

Mobility Models

Different mobility models can be differentiated according to their spatial and temporal dependencies.

Spatial dependency*:* It is a measure of how two nodes are dependent in their motion. If two nodes are moving in same direction then they have high spatial dependency.

Temporal dependency: It is a measure of how current velocity (magnitude and direction) are related to previous velocity. Nodes having same velocity have high temporal dependency.

Given below are the descriptions of four mobility models with detailed explanation for how they emulate real world scenario. Each description is accompanied by a Network Animator (NAM) Screenshot to give a visual representation of node movement in the model. NAM is a graphical simulation display tool. It has a GUI similar to that of a CD player (play, fast forward, rewind, pause and so on), and also has a display speed controller. All the simulations are performed on Network Simulator Version 2.27 which generates an output NAM file.

A. Random Waypoint

The Random Waypoint model is the most commonly used mobility model in research community. At every instant, a node randomly chooses a destination and moves towards it with a velocity chosen randomly from a uniform distribution [0,V_max], where V_max is the maximum allowable velocity for every mobile node. After reaching the destination, the node stops for a duration defined by the 'pause time' parameter. After this duration, it again chooses a random destination and repeats the whole process until the simulation ends. Figures 2,3,4 & 5 illustrate examples of a topography showing the movement of nodes for Random Mobility Model.

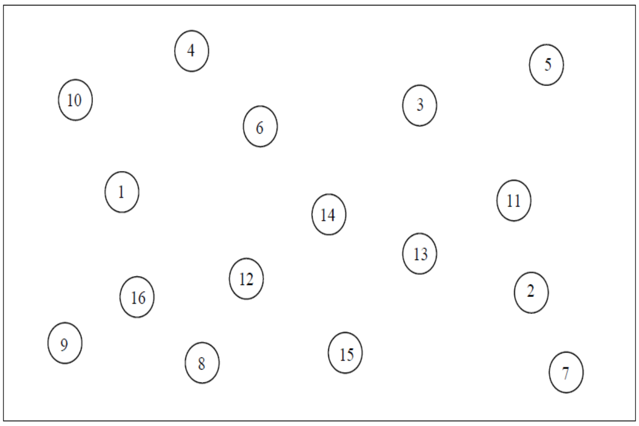


Figure 2: Topography showing the movement of nodes for Random mobility model.

B. Random Point Group Mobility (RPGM)

Random point group mobility can be used in military battlefield communication. Here each group has a logical entre (group leader) that determines the group's motion behavior. Initially each member of the group is uniformly distributed in the neighborhood of the group leader. Subsequently, at each instant, every node has speed and direction that is derived by randomly deviating from that of the group leader. Given below is example topography showing the movement of nodes for Random Point Group Mobility Model. The scenario contains sixteen nodes with Node 1 and Node 9 as group leaders.

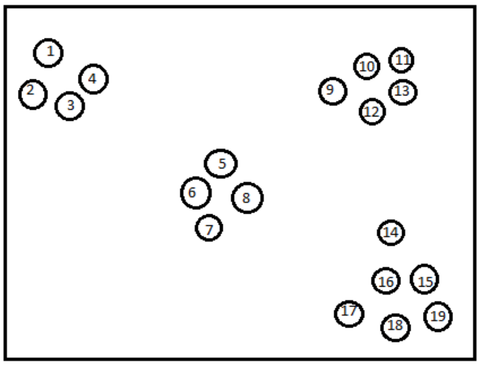


Figure 3: Topography showing the movement of nodes Random point group mobility

Important Characteristics*:* Each node deviates from its velocity (both speed and direction) randomly from that of the leader. The movement in group mobility can be characterized as follows:

$| V_{member} (t) | = | V_{leader} (t) | + \text{random}() * SDR * max\_speed$ ……………….(1)

$| \Theta_{member} (t) | = | \Theta_{leader} (t) | + \text{random}() * ADR * max\_angle$ ………………(2)

where 0 <<ADR, SDR<< 1. SDR is the Speed Deviation Ratio and ADR is the Angle Deviation Ratio. SDR and ADR are used to control the deviation of the velocity (magnitude and direction) of group members from that of the leader. Since the group leader mainly decides the mobility of group members, group mobility pattern is expected to have high spatial dependence for small values of SDR and ADR [12].

C. Freeway Mobility Model

This model emulates the motion behavior of mobile nodes on a freeway. It can be used in exchanging traffic status or tracking a vehicle on a freeway. Each mobile node is restricted to its lane on the freeway. The velocity of mobile node is temporally dependent on its previous velocity.

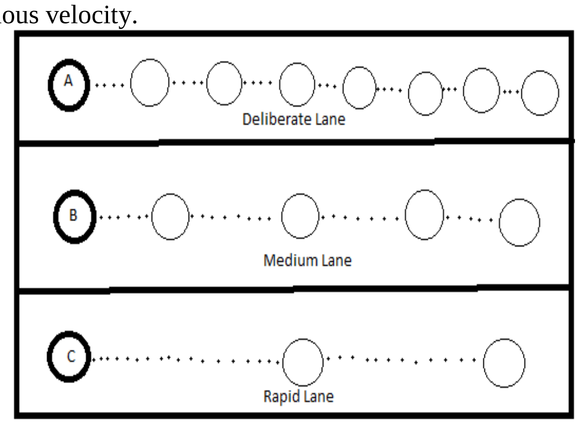


Figure 4: Topography showing various movement of nodes for Freeway mobility model.

Important Characteristics*:* In this model we use maps. There are several freeways on the map and each freeway has lanes in both directions. The differences between Random Waypoint and Freeway are the following:

(a) Each mobile node is restricted to its lane on the freeway.

(b) The velocity of mobile node is temporally dependent on its previous velocity. Formally,

$$|V_i(t+1)| = | V_i(t) | + \text{random}() * | a_i(t) | \ldots\ldots\ldots\ldots(3)$$

(c) If two mobile nodes on the same freeway lane are within the Safety Distance (SD), the velocity of the following node cannot exceed the velocity of preceding node. Formally,

$\forall i, \forall j, \forall t, D_{ij}(t) < SD \Rightarrow |V_i(t)| < |V_j(t)|$ …………(4)

if *j* is ahead of *i* in its lane.

Due to the above relationships, the Freeway mobility pattern is expected to have high spatial dependence and high temporal dependence. It also imposes strict geographic restrictions on the node movement by not allowing a node to change its lane.

D. Concoction Mobility Model cocktail

We introduce the Concoction model to emulate the movement pattern of mobile nodes on streets. It can be useful in modeling movement in an urban area .The scenario is composed of a number of horizontal and vertical streets. Given below is example topography showing the movement of nodes for Concoction Mobility Model with seventeen nodes. The map defines the roads along the nodes can move.

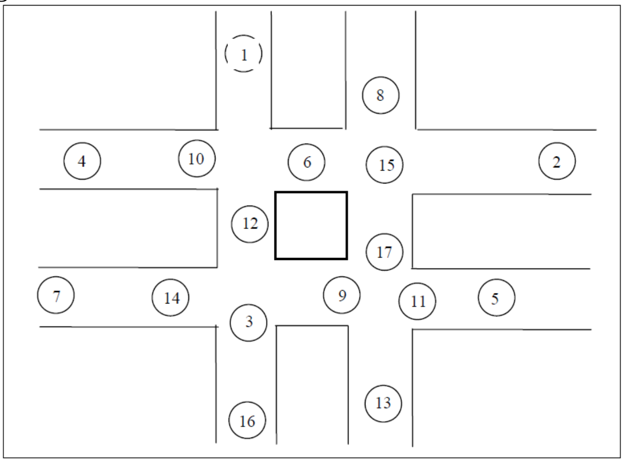


Figure 5: Topography showing the movement of nodes for Concoction mobility model

Important Characteristics*:* Maps are used in this model too. However, the map is composed of a number of horizontal and vertical streets. The mobile node is allowed to move along the grid of horizontal and vertical streets on the map. At an intersection of a horizontal and a vertical street, the mobile node can turn left, right or go straight with certain probability. Except the above difference, the inter-node and intra-node relationships involved in the Manhattan model are the same as in the Freeway model. It too imposes geographic restrictions on node mobility. [13]

2. LITERATURE SURVEY ON AODV & AOMDV

Wireless connections can result in large packet losses. Thus, it makes sense to consider routing protocols which adapt to channel variations. A channel-aware routing protocol which extends the Ad hoc On-Demand Multipath Distance Vector (AOMDV) routing protocol. We call it CA-AOMDV. AOMDV is, itself, an extension of the Ad hoc On-Demand Distance Vector (AODV) routing protocol [16]. In this section, we review the details of these two predecessor protocols.

2.1 AODV

AODV is a single-path, on-demand routing protocol. When a source node, ns, generates a packet for a particular destination node, nd, it broadcasts a route request (RREQ) packet. The RREQ contains the following fields:

<source IP address, source sequence number, broadcast ID, destination IP address, destination sequence number, hop-count>,

where the source and destination IP addresses remain constant for the lifetime of the network, source sequence number is a monotonically increasing indicator of packet “freshness,” destination sequence number is the last known sequence number for nd at ns and hop-count is initialized to zero and incremented at each intermediate node which processes the RREQ. A RREQ is uniquely identified by the combination of source sequence number and broadcast ID. An intermediate node only processes a RREQ if it has not received a previous copy of it. If an intermediate node has a route to nd with destination sequence number at least that in the RREQ, it returns a route reply (RREP) packet, updated with the information that it has. If not, it records the following information: source IP address, source sequence number, broadcast ID, destination IP address and expiration time for reverse path route entry, and forwards the RREQ to its neighbors.

Like the RREQ, a RREP is only processed on first sighting and is discarded unless it has a greater destination sequence number than the previous RREP or the same destination sequence number but a smaller hop-count. The RREP packet contains the following fields:
<source IP address, destination IP address, destination sequence number, hop-count, route expiration time>.

The route expiration time is the time after which the route is considered to have expired and a new route discovery process must be undertaken. ns sends packets via the first path it hears about. If it receives a later RREP which has either fresher information or a shorter hop-count, it swaps to that, discarding the original route information. When an active route link breaks, a route error (RERR) packet, with sequence number incremented from the corresponding RREP and hop-count of 1, is sent by the upstream node of the broken link to ns. Upon receipt of a RERR, ηs initiates a new route discovery process if it still has packets to send to nd. Nodes also periodically send “hello” messages to neighboring nodes to maintain knowledge of local connectivity.

2.2 AOMDV

The key distinguishing feature of AOMDV over AODV is that it provides multiple paths to nd. These paths are loopfree and mutually link-disjoint. AOMDV uses the notion of advertized hop-count to maintain multiple paths with the same destination sequence number. In both AODV and AOMDV, receipt of a RREQ initiates a node route table entry in preparation for receipt of a returning RREP. In AODV, the routing table entry contains the fields:

<destination IP address, destination sequence number, next-hop IP address, hop-count, entry expiration time>,

where entry expiration time gives the time after which, if a corresponding RREP has not been received, the entry is discarded. In AOMDV, the routing table entry is slightly modified to allow for maintenance of multiple entries and multiple loop-free paths. First, advertized hop-count replaces hop-count and advertized hop-count is the maximum over all paths from the current node to nd, so only one value is advertized from that node for a given destination sequence number. Second, next-hop IP address is replaced by a list of all next-hop nodes and corresponding hop-counts of the saved paths to nd from that node, as follows:

<destination IP address, destination sequence number, advertized hop-count, route list: {(next hop IP 1, hop-count 1), (next hop IP 2, hop-count 2), . . . }, entry expiration time>.

To obtain link-disjoint paths in AOMDV, nd can reply to multiple copies of a given RREQ, as long as they arrive via different neighbors.

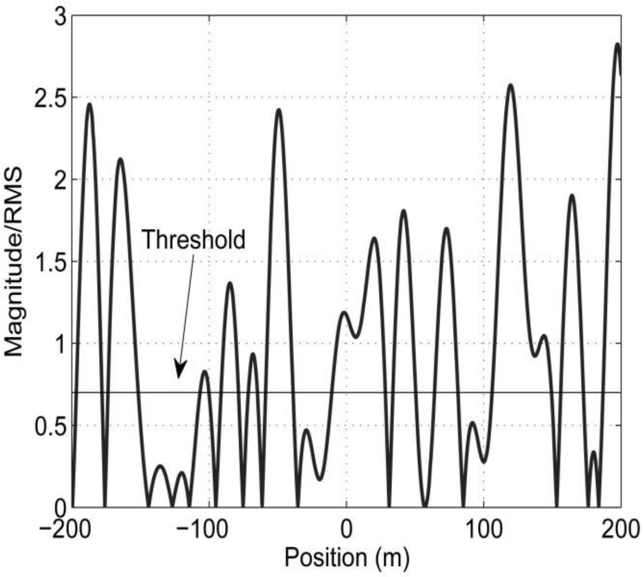


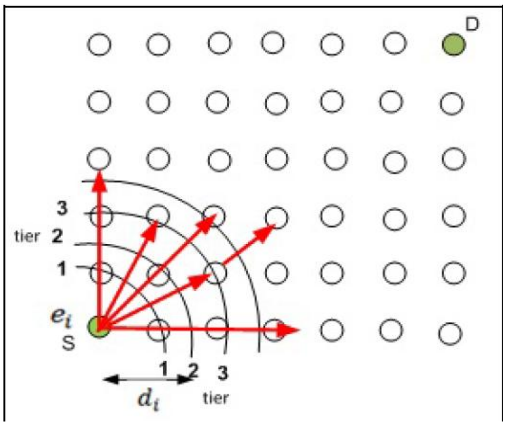
Figure 6: A typical fading waveform with threshold indicated.

3. CHARACTERISTICS OF NODES WITH CONSTRAINED ENERGY

Each node in a MANET serves as a host and/or router generating, consuming or forwarding information [7]. These nodes are fitted with and powered by batteries. The depletion of participating nodes' battery power in a routing path will shorten the network lifetime. As charging or replacing batteries on site is a difficult operation, it is necessary to use the available energy efficiently to extend the lifetime of the nodes [8-9]. Developing an energy efficient routing scheme is one way of achieving optimized performance of nodes. Nodes consume energy while transmitting beacon signals to neighboring nodes for the purpose of detecting their existence or transmitting data to another node [4].When an intermediate node has been selected as a router, it consumes more energy than an idle node as it is actively involved in communication [10]. Thus, the nodes' residual energy is important in determining the path to successfully completing data transfer without interruption. Hence a routing protocol that considers the nodes' residual energy will perform better than the protocols that do not. We have to compare protocols in low mobility environment, where routes do not break to too often. Proactive protocols may give better performance for near stable environment. Performance of other routing protocol can be evaluated over various mobility models taking in to consideration number of average connected paths to gain greater insights into the relationship between them.

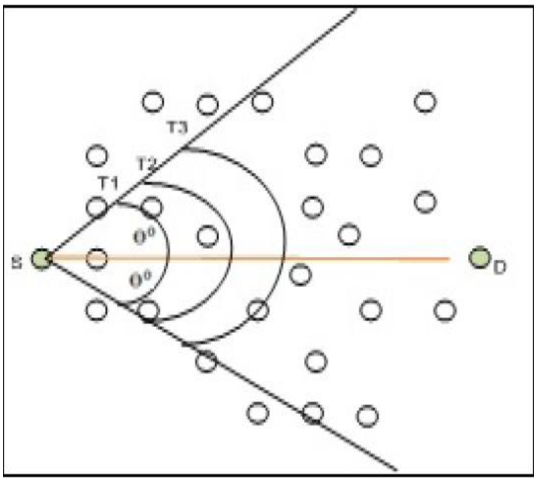
4. PROBABILITY BASED ON NODE SELECTION CRITERIA

The proposed probability based node selection method considers a new parameter known as the energy distance factor. This factor helps to select the best next hop node for optimizing the energy efficiency of the network. The scheme also considers the residual energy of the nodes as a fraction rather than the absolute energy levels. Based on this scheme of selecting nodes with sufficient residual energy, an energy aware routing protocol for MANETs is proposed in this paper. The aim of this scheme is to improve the performance of the path lifetime by selecting the best nodes along the path from the source to destination.



It is common for each node in a network to have a different energy level. Hence it is important to select the best intermediate node in terms of residual energy. Route discovery is costly in terms of both transmission delay and energy consumption. During the route discovery, multiple nodes will have to be contacted for the purpose of identifying and establishing the route again. This would consume more energy than that required for transmitting data.

The nodes between the source and destination are divided into tiers as shown in Figure 2. The tier arrangement is as follows; every node that can be reached directly or by one hop from the source is considered a Tier 1 node, Tier 2 nodes can be reached with only two hops. Similarly, Tier 3 nodes need three hops from the source and so on. Figure 3 shows the distribution of nodes between the source and destination. Depending on the availability of nodes, node distribution can be symmetrical by the straight line connecting the source and destination nodes. The straight line path between the source and destination is the most preferable as it would create the shortest possible path consuming the lowest energy.



Farthest Distance Deviation Discovery of Nodes

5. EXPERIMENTAL RESULTS & DISCUSSION

Implementation is the stage in the project where the theoretical design is turned into a working system and is giving confidence on the new system for the users, which it will work efficiently and effectively. It involves careful planning, investigation of the current System and its constraints on implementation, design of methods to achieve the change over, an evaluation, of change over methods. Apart from planning major task of preparing the implementation are education and training of users. The more complex system being implemented, the more involved will be the system analysis and the design effort required just for implementation.

Variation in UDP throughput

	(< 5 Hops)	(> 5 Hops &< 9)
DSR (Bytes /Unit Time)	167.66	110.12
DSDV (Bytes / Unit Time)	123.84	63.23

In this section we present the results from our evaluations of Secured CA-AOMDV [16]. The routing protocols have been evaluated in the network simulator NS-2[17] using both the pheromone reconnaissance mobility model and the random waypoint mobility model (for comparative purposes). The two main evaluation metrics used are delivery ratio and effort required for each generated data packet (overhead). The delivery ratio is the most important evaluation criteria since it determines the quality of service as perceived by the user or application. The effort used to transfer a packet is also important since lean protocols will allow either a higher throughput or lower power consumption by the nodes. This will be measured as the number of transmissions performed per generated data packet. In both dense and sparse areas we compared the delivery ratio and overhead with the existing basic CA-AOMDV [16] protocol.

The simulator was originally developed by the University of California at Berkeley and VINT project the simulator was recently extended to provide simulation support for ad hoc network by Carnegie Mellon University (CMU Monarch Project homepage, 1999). The NS-2[17] simulator has several features that make it suitable for our simulations.

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- A network environment for ad-hoc networks
- Wireless channel modules (e.g.802.11)
- Routing along multiple paths,
- Mobile hosts for wireless cellular networks.

Simulation Parameters

For simulation, we used network simulator NS-2[17].34, implementing the mobile-to-mobile channel with Doppler frequency. This model has considered an area of 750m X 750m with a set of mobile nodes placed randomly and broadcast range is 150m.The simulation was carried out for different number of nodes using Network simulator (NS2).

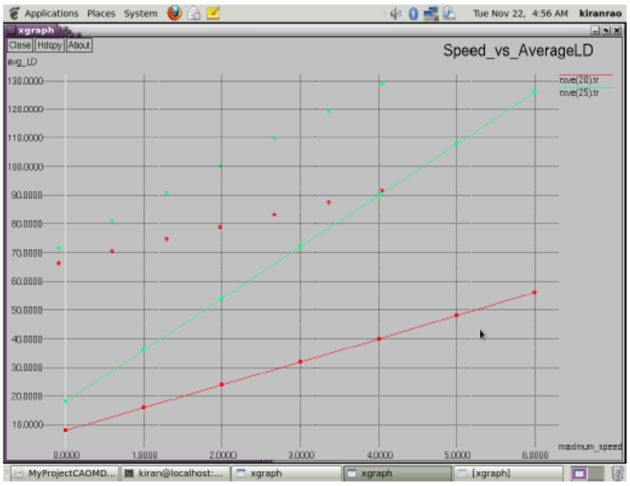
Here, we consider 25 mobile nodes with Channel Aware [16][18] routing protocol with the simulation parameters as described in table 5.1.

Simulator Requirements

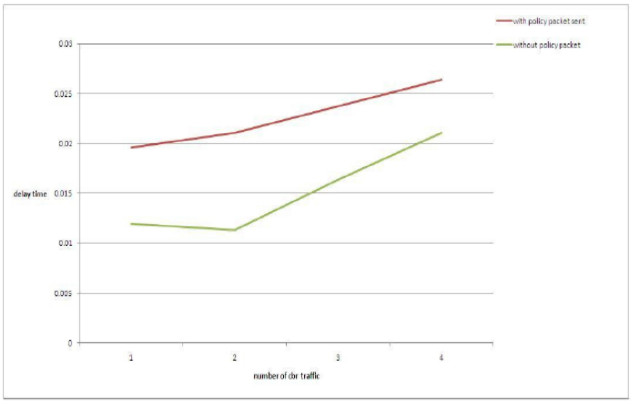
Table 5.1 Simulator parameters

Routing Protocol	**CA-AOMDV**
No. of nodes	20
Traffic type	CBR
Channel capacity	2 Mbps
Simulator	NS2
CBR packet size	512 bytes

Graph Generated

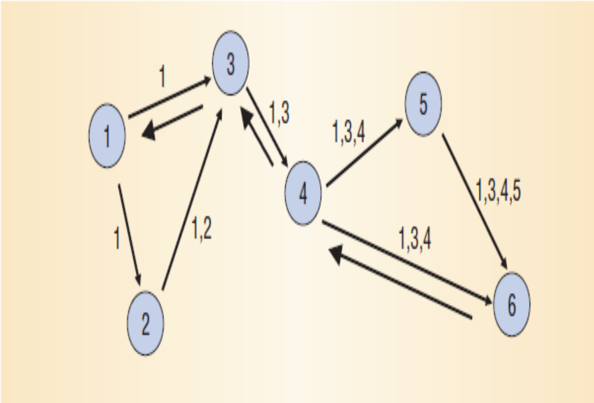


The analysis and simulation results show that Secured CA-AOMDV is a efficient protocol compared with the existing Channel aware routing protocol. Compared to CA-AOMDV the Secured CA-AOMDV is efficient in secured data transmission.



6. FUTURE SCOPE

There are still many problems such as tunnelling attacks, selectively drop packets; etc are still persist in these ad-hoc networks. So it is also possible to implement the other routing schemes with the reduction of attacks. In our future work, we will investigate how to reduce the overhead on transforming a key between mobile nodes. Another interesting research direction is the formulation of accurate metrics and mechanisms to predict path security, both confidentiality and availability, based on historical information. And also we can construct a virtual small world network by adding virtual long links to reduce the chance of a protocol encountering local minima in greedy mode, and thus decrease the chance to invoke inefficient methods.



Secured ad hoc routing protocols are a necessity for securing the routing of data. This approach shows that in the secured routing protocols, the usage of security techniques like digital signatures, and hash chains. Here, SHA-1 algorithm is applied in CA-AOMDV protocol to achieve secure routing in MANET. However CA-AOMDV uses channel state information to select stable links between source and destination. Finally it reduced malicious node between source and destination and increased packet delivery ratio in comparison with the existing multipath routing protocols.

7. CONCLUSION

In wireless mobile ad hoc networks (MANETs), packet transmission is impaired by radio link fluctuations. In this paper we have studied a novel channel adaptive routing protocol which extends the Ad hoc On-Demand Multipath Distance Vector (AOMDV) routing protocol to accommodate channel fading. Specifically, Channel-Aware AOMDV (CA-AOMDV) uses the channel average non-fading duration as a routing metric to select stable links for path discovery, and applies a preemptive handoff strategy to maintain reliable connections by exploiting channel state information. We evaluate our framework using the Network Simulator (NS-2) to check whether the privacy and confidentiality of the originator are met. Using the same information, paths can be reused when they become available again, rather than being discarded. The new way of our proposal is reusability for the downtime and lifetime of a multiple path system, as well as future scope of this recursive mechanism for common network performance measures, providing useful insights into the differences in performance between CA-AOMDV and AOMDV.

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