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An Efficient Routing Protocol for Discovering the Optimum Path in Mobile Ad Hoc Networks

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Abstract

Mobile ad hoc networks include mobile nodes which move freely and communicate through wireless links. Due to high mobility of nodes, energy and bandwidth limitation and coverage range limit of nodes, routing in these networks is very complicated. Many routing protocols have been proposed for ad hoc networks. These protocols include a wide range of designing methods, and each has its own particular advantages and disadvantages; thus they can be used in a particular environment with specific conditions. In this paper, we choose an appropriate protocol (AODV) among existing protocols for congestion conditions of a network and fast mobility of nodes. Then we present a method for path backup in order to reduce control overhead and improve the performance of this protocol. Simulation results show that the proposed method has a high performance compared to similar ones.

Keywords: Backup, End to End Delay, Local Recovery, Routing Protocol

1. Introduction

Ad hoc networks[1] are a new kind of wireless networks which have been considered for their unique characteristics. In this kind of network, a primary base, an amplifier or a fixed switching center never exists but the nodes perform the switching data amplifying operation and routing. Regarding the constant change in network topology because of mobility of nodes, routing protocols[2] should support these changes by using a strategy in a way that the sent data will be received intact in the destination. In recent years several works have been done on routing in mobile ad hoc networks, particularly in the field of path backup for reducing the control overhead. AODV-BR method[3,4] which states path backup by using Associativity Based Routing (ABR) is shown in Figure 1. The method AODV-ABL[5] was presented, this algorithm is achieved by combining Local Recovery (LR) protocols by using Associativity Based Routing (ABR), So LR and ABR approaches are merged in this algorithm. In the proposed method, if the number of steps is less than MAX-REPAIR-TTL, ABL acts like LR; otherwise it uses the shaking hand (ABR) method for recovery. The proposed method in[6], AR-AODV, the proposed protocol improves the AODV algorithm path[7] by reducing the maintenance overhead. In this protocol each node in the network keeps a unit alternate path to send and receive packets. If a path between two intermediate nodes breaks, the sender can use the alternate path instead of dropping the packet. The packet carries some information about the node which had the alternate path. The proposed method in [8] BFABL for bidirectional scenarios which conducted two general improvements: First, it merges the primary and alternate routing tables, i.e. only one entry to each destination

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exists in the table. When better alternate paths are heard, they replace the corresponding entry in the table as soon as possible. Second, BFABL hears the packet from the two directions, source to destination and vice versa, in order to prevent one step paths to destination from breaking. The proposed method in AR-AODV is presented in detail in the next section.

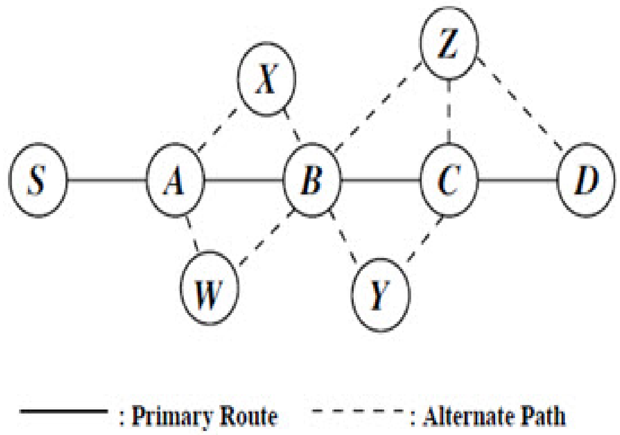

Figure 1. A primary route and its alternate path in a mobile ad hoc network[9].

2. AR-AODV Method

The proposed protocol[6] improves the AODV routing protocol[3,7] by reducing the path maintenance overhead. In this protocol each node keeps an alternate path to send and receive packets. If a path between two intermediate nodes is broken, the sender can use the alternate path instead of dropping the packet. The packet carries some information about the node which had the alternate path. In the case of link failure or absence of an alternate path, packets are checked for alternate paths. If an entry is found, then the node which detected failure sends the packet to the node that has the alternate path and finally the packet is sent to the destination. Two phases of the proposed protocol are as follows:

1- The alternate path entry in a node: in the main version of AODV each destination sends a RREP message corresponding to a RREQ and ignores the remaining RREQs. When an intermediate node receives the RREP messages, it puts the better one in the routing table and the worse one in the alternate table. When a failure occurs in the path, the sender node searches in its own alternate routing table and sends the packet toward that direction.

```
TapData ( Packet p){
   if(routing entry to D is not exist || routing entry to S is not exist){
      creates routing entry to D  or(and) S;
      update those newly created routing  entry;
      return;
   }
else{
      analyses packet head of p, look for
         (1)get hops count to D and S;
         (2)sequence number of  D and S;
       then calculates the new route to S and the new route to D;
       finds out corresponding routing entry to D and S;
       compares  the new route to the route in routing table.
       if (the sequence number in new route is less than that in routing
table entry || (the sequence number in new route is equal to that in routing
table entry && the hops is no more than that in table entry))
        {
          updates the corresponding routing entry with new route;
        }
     }
}
```

Figure 2. AODV-BFABL: Pseudo-code for hearing packets BFABL[8].

Then it sends a RERR message to the source in order to preform path rediscovery.

2- The alternate path information in a packet: if an error occurs in the path and the alternate path is not available in the sender node, then the packet can be dropped. To handle these conditions there are two extra fields in the packet header.

- Backward-ID (BID): the address of the closest node to failed link from the node which detected failure and has the alternate path to destination.
- Backward-Hop-Count (BHC): the length of alternate path from BID to destination. When the source sends a packet which contains the alternate path to destination, it puts its address in BID field and the alternate path length in BHC field. When the packet arrives to the intermediate node, the node checks its alternate table. If a path exists, the BID field is replaced by intermediate node address and BHC fills with the alternate path length plus the traversed path. In this case if the link is broken, the node uses the alternate path available in its table or the information available in the packet. If by reading the packet, the intermediate node finds out the source node is BID, it looks for the path by sending RREQ to its neighbors. If the neighbor has a path to the destination node, it sends RREP message to the intermediate node which detected the error like[9] (AODV-BR). Then the intermediate node sends the packet through this new path. Otherwise RERR message is resent to the source node in order to rediscover the path.

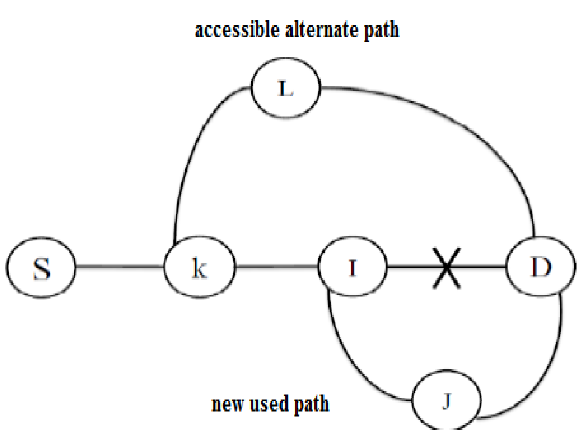

Figure 3. The alternate path available in the upstream node of the failed link.

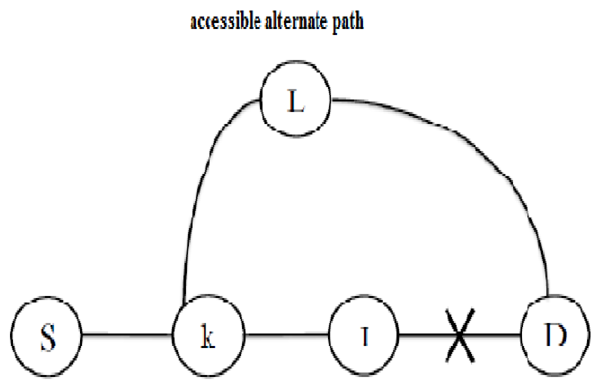

Figure 4. The packet sent to BACKWARD_ID of node k to send data through alternate path.

For example, in Figure 3, when the link between the nodes I and D breaks, node I searches in the alternate cache (alternate path table). If it finds a path to D from, for instance, node J, it sends the packet through it. Otherwise, then as shown in Figure 4 it searches the packet and finds the address of node K and sends the packet to node K in the reverse path so that it sends the packet to D through the alternate path.

3. Proposed method

In order to reduce the control overhead in mobile ad hoc networks we can use the ideas deployed in routing protocols AODV-ABL[5] and AR-AODV[6]. We divide the whole routing operation into two phases: first we act like AR-AODV algorithm and try to use the alternate path available in the packet or the node itself. If we don't find a path or the alternate path is expired, we enter the second phase which is to use ABR protocol, i.e. Local Recovery (LR) or associativity base routing with the distance of one step[9] (ABR). In this case we avoid sending control messages as much as possible. For real-time synchronization we can use the idea of AODV-BFABL protocol[8], i.e. we force nodes to hear the sent packets from their neighbors which are in their telecommunication distance. The difference is that in contrast to BFABL we don't use one routing table; but we benefit from two routing tables similar to ABL protocol. With each packet hearing, we convince the node to pay attention to the number of steps to the source and to the destination and the order number of the source and the destination. This information is compared to corresponding information of the same source and destination and if the new information is optimum, the routing entry is transferred from the primary table to the alternate table (the previous alternate path entry is eliminated) and the new discovered path immediately replaces the corresponding entry in the primary table.

4. Simulation

In this section, 3 protocols mentioned in this paper are simulated using the ns2 network simulator[10] in two different scenarios. The movement model of nodes is random way point. The range of simulation environment is assumed to be a square with a length of 1000. The simulation time is 500 and 1000 seconds and the packet size is 512 bytes. The bandwidth is 10 mbps, the pause time is assumed to be zero. The pause time of nodes in the simulation of the first scenario is taken to be between 0s to 400s and the number of nodes in the simulation of the second scenario is ranged from 60 to 100 (60, 70, 80, 90, 100).

4.1 Simulation Result

The simulation of the mentioned protocols is performed in one of the two following conditions based on the node pause time and the number of nodes.

- Simulation in node pause time
  In this case the environment size is 1000m* 1000m, the pause time of nodes is between 0s to 400s (0, 50, 100, 200, 300, 400) and the number of nodes is 50 in this scenario. Bandwidth is 10mbps and the simulation time is 500s.
- Simulation in different number of nodes
  In this case the number of nodes is ranged from 60 to 100 (60, 70, 80, 90, 100) and the environment dimensions are 1000m* 1000m. The node velocity is 10m/s and the pause time is 0. Bandwidth is 10mbps and the simulation time is 1000s.

4.2 Simulation Metrics

To evaluate and compare the performance of routing protocols mentioned in this paper, 3 metrics average packet delivery ratio, average end to end delay and control overhead are evaluated in two different simulation cases. Simulation results and the diagrams related to separation of these 3 presented metrics have been examined as follows.

- Simulation results of the first scenario
- Simulation results of the second scenario

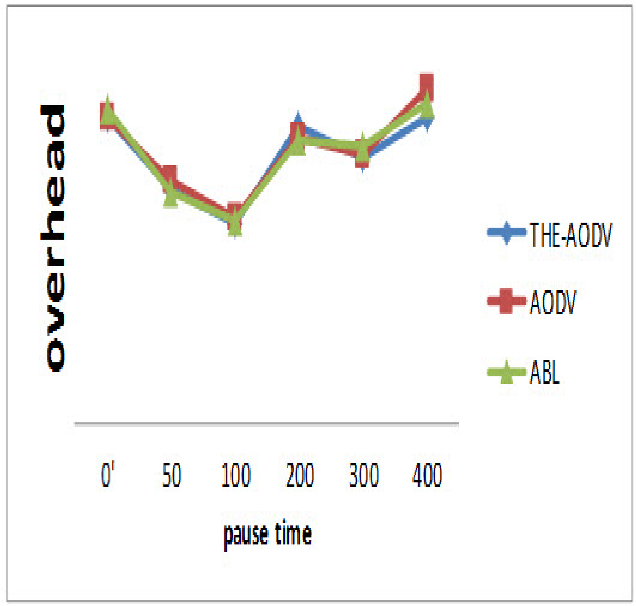

Figure 5. Average control overhead to pause time.

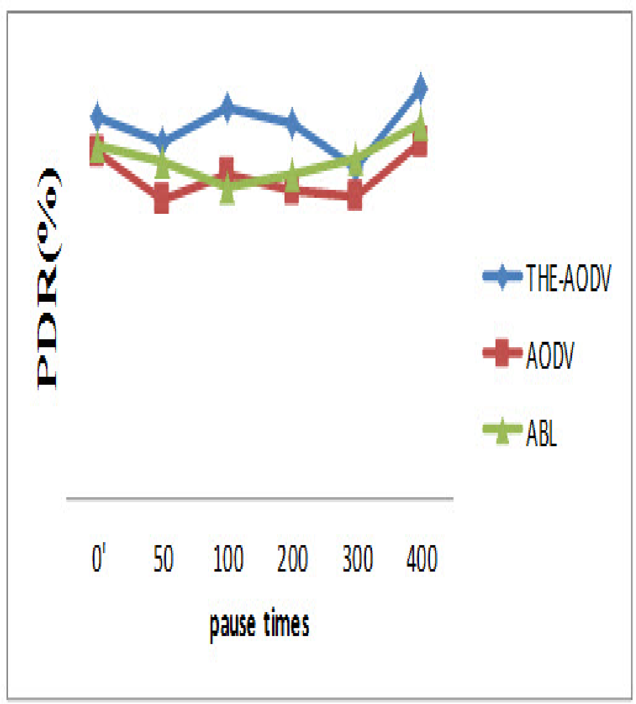

Figure 6. Average packet delivery ratio to pause time.

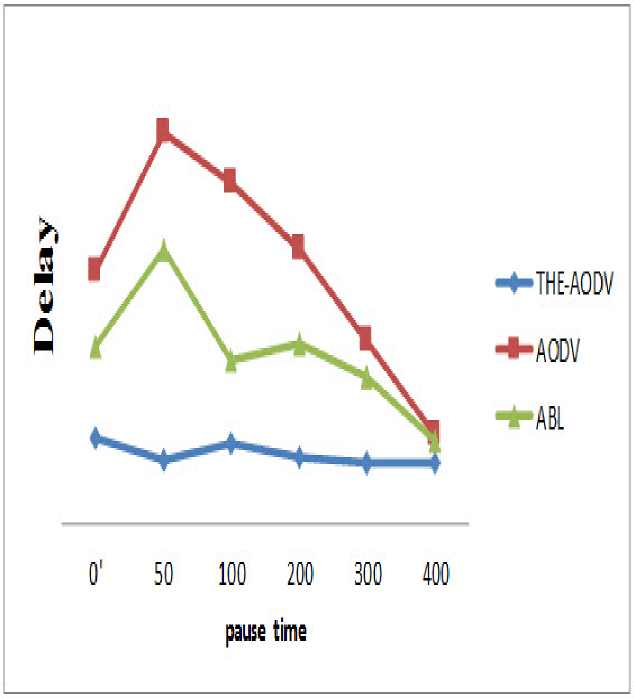

Figure 7. Average end to end delay to pause time.

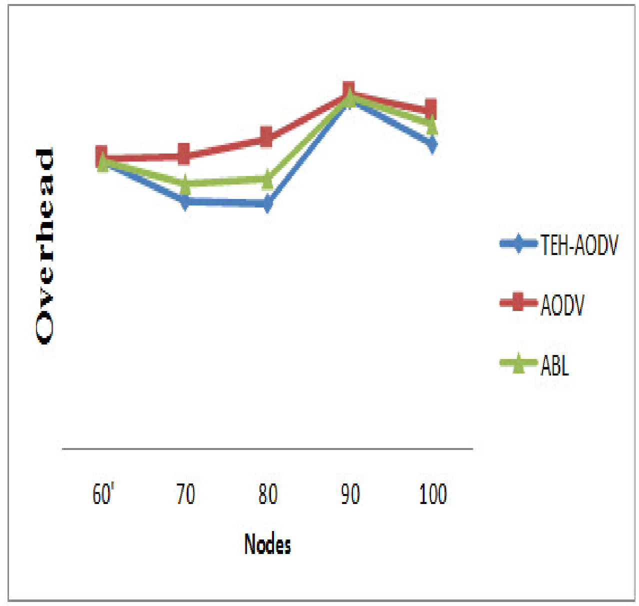

Figure 9. Average control overhead to number of nodes.

5. Conclusion

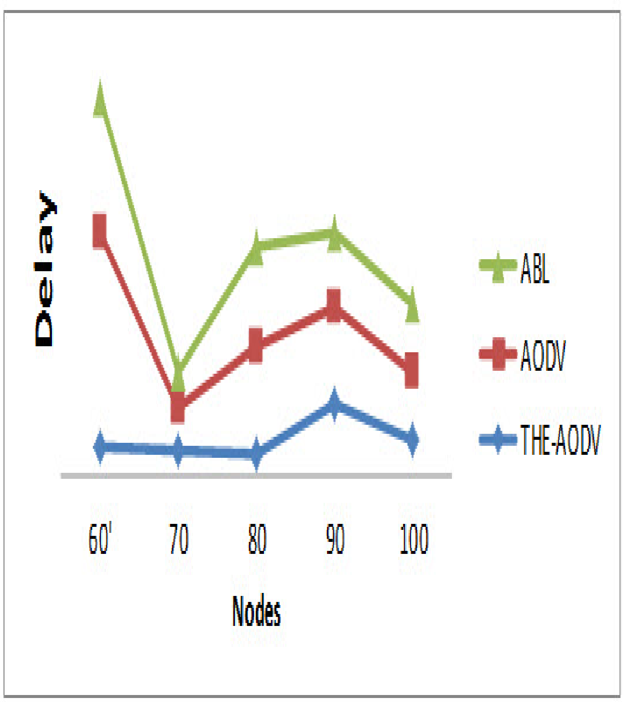

Figure 8. Average end to end delay to number of nodes.

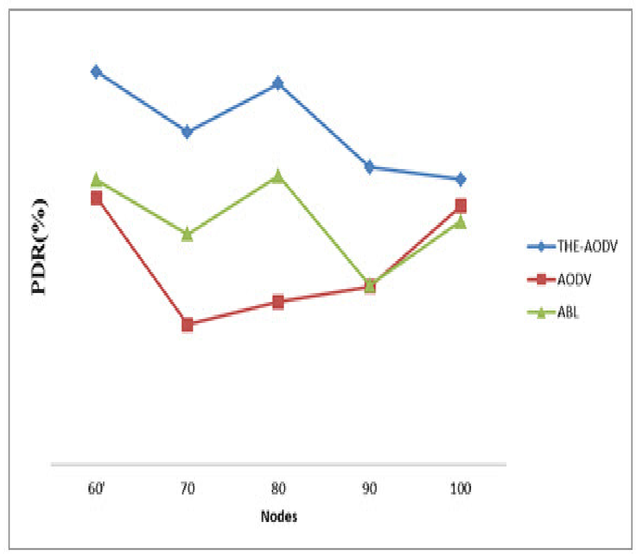

Figure 10. Average packet delivery ratio to number of nodes.

Three routing protocols, AODV, ABL and M-AODV have been evaluated and compared by using NS-2 network simulator. Based on obtained results from simulation and analysis of these 3 metrics mentioned above, it can be concluded that compared to ABL and AODV, THE-AODV routing protocol (the proposed method) has lower delay and control overhead and higher average packet delivery ratio since it chooses better and optimum path by using the alternate path available in the packet or alternate path available in the node itself and also by using local recovery mechanisms or associativity base routing with one step distance. The proposed method has a considerable performance in ad hoc networks..

6. References

1. Lin T, Midkiff SF, Park JS. A framework for Wireless Ad hoc Routing Protcols. IEEE; 2003.
2. Boukerche A, Turgut B, Aydin N, Ahmad MZ, Boloni L, et al. Routing protocols in Ad Hoc networks: a survey. Computer Networks. 2011 Sep; 55:3032–80. doi:10.1016/j.comnet. 2011.05.010.
3. Lee SJ, Royer E, Perkins CE. Scalability study of the ad hoc on demand distance vector routing protocol. Int J Netw Manag. 2003; 13(2):97–114.
4. Lee S-J, Gerla M, Chiang C-C. On-demand multicast routing protocol. Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC); New Orleans, LA: 1999 Sep. p. 1298–302.
5. Lai WK, Hsiao S-Y, Lin Y-C. Adaptive backup routing for ad-hoc networks. Elsevier; 2007 Jan 15. p. 453–64.
6. Patil VP, Patil KT. Kharade AR, Gote DD. Performance enhancement of reactive on demand routing protocol in wireless Ad Hoc network. IJSSAN. 2012; 1(4):2248–9738.
7. Perkins CE, Royer EM, Das S. Ad hoc On-demand Distance Vector (AODV) routing. 2003. IETE RFC 3561.
8. Zhou P, Li W. A bidirectional backup routing protocol for mobile Ad Hoc networks. 2012 Second International Conference on Business Computing and Global Informatization (BCGIN); 2012 Oct 12-14; Shanghai: IEEE; 2012. p. 603–6. Availaible from: http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6380634
9. Lee S-J, Gerla M. AODV-BR: backup routing in Ad hoc networks. Wireless Communications and Networking Confernce, 2000, WCNC 2000, vol 3; IEEE; 2000. p. 1311–6.
10. NS-2 simulator. Availaible from: http://www.isi.edu/nsnam/ns/