ORIGINAL RESEARCH PAPER
Volume-6 | Issue-10 | October-2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A Survey of Multipath Routing Protocols For Mobile Ad Hoc Networks

Computer Science

Subhankar Ghosh Dept. of Computer Science and Technology, Regent Education and Research Foundation West Bengal, india

Dr. Anuradha Banerjee Dept. of Computer Applications, Kalyani Govt. Engg. College, West Bengal, india

ABSTRACT

Generally during route discovery sessions, multiple routes are discovered from source to destination. Among them, one is elected as optimal and chosen for communication. In case the optimum route breaks, another route discovery session is initiated that consumes a lot more energy and bandwidth in the network. Multipath routing prevents this by introducing the concept of storing multiple paths at source before communication begins. As usual, data packets travel through the optimal path. If the optimal path breaks, communication resumes through the second optimal path instead of flooding more route-request packets in the network.

General Terms:
Ad hoc networks, multipath.

KEYWORDS

Energy efficiency, multipath, optimum, flooding, route-requests.

1.INTRODUCTION:

A mobile ad hoc network lacks a fixed infrastructure and has a dynamically changing topology. The nodes move freely and independently of one another. Ad hoc networks are heavily used in emergency situations where no infrastructure is available, for eg. battlefields, disaster mitigation etc. Design of routing protocols for this kind of networks is difficult due to the inherent uncertainty and unpredictable dynamism. Several protocols have been proposed for mobile ad hoc networks. They can be broadly classified as proactive and reactive routing protocols. Among proactive routing protocols, Optimized Link state Routing (OLSR) [1], Destination Sequenced Distance Vector (DSDV) [2], etc. are important whereas reactive routing protocols include Dynamic Source Routing (DSR) [3], Ad Hoc On-demand Distance Vector (AODV) [4], Temporally Ordered Routing Algorithm (TORA) [5] etc. are mention-worthy. All these are single path protocols but multipath extensions of some of these have come to existence. There are several ways to use and implement multiple paths. In [7] and [8], multiple paths are not used simultaneously. Data packets are transmitted only along one path whereas other paths are kept as backup in case the optimum one is broken. In some other protocols, data transfer may simultaneously take place through multiple paths.

Discovered multiple paths have to be node disjoint and if not node disjoint then link disjoint at least. Node disjointness broadly means that multiple paths should not have nodes in common and link disjointness indicates that certain nodes may be common but there should not be any common links. Node disjointness is a stricter condition than link disjointness. The utility of disjoint paths is that when communication through the optimum route will continue, nodes in alternative paths are not expected to deplete. Therefore, their expected residual lifetime won't change.

2.1. Ad Hoc Multipath Distance Vector (AOMDV):

AOMDV[9] is a loop free extension of AODV that demands at least link disjoint multiple paths for operation. In order to support multipath routing, route tables consist of three different paths for each destination. All paths to a given destination are assigned the same destination sequence number. Once a route request with a higher sequence number is received, all routes with old sequence numbers are removed. Attributes of route table are previous hop and hop count. The node in previous hop i.e. the predecessor must be different in the discovered multiple paths. Different predecessor ensures link disjointness.

2.2. Temporally Ordered Routing Algorithm (TORA):

TORA [10] is a highly distributed protocol where multiple routes in between a given pair of source and destination nodes are maintained in the form of a directed acyclic graph (DAG). Shortest path routing is considered of secondary importance. Longer routes having better lifetime are often used to avoid discovering new routes in case of a link breakage. Each node is assigned a height by the destination. Data packets flow from source to destination like water falls downhill towards a sink. Hello messages are periodically sent from each node ni to its successor nj and the successor replies with an acknowledgement or Ack. This exchange of Hello-Ack indicates that the link from ni to nj is live. In case of a link breakage, ni does not receive an Ack from nj. Therefore, ni transmits an update packet and routes through ni are all locked down unless an update reply is received from all the neighbours. This protocol is particularly useful for low mobility networks.

.

2.3. Co-operative Packet Caching and Shortest Multipath Routing (CHAMP):

CHAMP [11] is a distance vector based protocol that prefers paths with shortest equal cost. Cost is computed based on hop count and delay of a path. The equal cost restriction of CHAMP limits the choice of optimal paths.

.

2.4. Split Multipath Routing (SMR):

SMR [12] is based on DSR. Maximally disjoint routes are elected by the destination and routers in those selected routes do not further respond to new route-request packets (towards other destinations) till the present communication session is over. They do this to preserve energy, to serve the source destination pair for which they have been selected. This is one of the most interesting multipath routing protocol among distance vector based ones.

.

2.5. Multipath Source Routing (MSR):

The Multipath Source Routing (MSR) [13] is also based on DSR where data packets flow simultaneously through multiple paths in a weighted round-robin fashion. This is based on delay of individual routes. The path with high delay is given less number of packets to forward. Intermediate nodes can also reschedule packets on the fly.

.

2.6. Multipath Routing for MANETs (MultRout):

Another multipath routing algorithm based on DSR, is multipath routing for MANETs (MultRout) [14]. The route maintenance and recovery processes are same as DSR's while path discovery has its own novelties. Node disjoint paths are discovered and if completely node disjoint paths are not available, then paths consisting of maximum disjoint links are used. During broadcasting of route-requests, selective broadcast method is applied where a route-request is relayed only if it is the first to receive that or the path included in current message is node disjoint with the paths included in previously cached route query message.

2.7. Multipath Location Aided Routing (MLAR):

MLAR [15] is the multipath extension of Location Aided Routing (LAR) where 3D location of nodes in the grid network is used for

taking routing decisions. This algorithm is particularly useful in the case where nodes have high mobility.

2.8.Energy-aware On-demand Multipath Distance Vector (EAOMDV):

EAOMDV [16] is a multipath routing protocol where routes are selected based on a route cost function. The cost function considers residual battery power of a node and present forwarding load. Three routes with least cost are chosen as optimum.

2.9.Energy-efficient AOMDV with Fitness Function (FF-AOMDV):

FF-AOMDV[17] introduces a fitness function to evaluate effectiveness of each route. The fitness function depends on residual energy and energy depletion rate of nodes along with distances between consecutive nodes and delay in each link. Naturally, a route is considered to be more fit if energy in nodes is high, depletion rate is low, nodes are closely spaced and forward packets without much delay. The particle swarm optimization algorithm is initialized with a population of random candidate solution, conceptualized as particles. Each particle travels through the problem space with random velocity and gets attracted towards best fitness across the whole population.

2.10. Energy Efficient and Robust Multipath Routing (EERM):

EERM [18] particularly applies residual energy and link stability. Routes having high residual energy and stable links greatly reduce the chance of link breakage. Specially those equipped with alternative paths are supposed to survive for larger time duration than the optimal paths.

3. Conclusion:

In order to have reliable communication within an ad hoc network, an efficient routing protocol is very much required. Multipath routing is a concept that emphasizes utilization of alternative paths in case of a link breakage. This saves control message cost and improves packet delivery ratio reducing the delay.

4. REFERENCES:

[1] M. Liu, R. Talpade, A. McAuley, and E. Bommaiah, AMRoute: Ad-hoc multicast routing protocol. Technical Report, CSHCN T. R. 99-1, University of Maryland.
[2] C.E Perkins, E.M Royer, “Ad-hoc On-Demand Distance Vector Routing”,Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications (1999).
[3] D.B.Johnson, D.A,Maltz, “Dynamic Source Routing in Ad Hoc Wireless Networks. Mobile Computing”(1996) 153-181.
[4] D. Waitzman, C. Partridge, S.E. Deering, “RFC 1075,Distance Vector Multicast Routing Protocol”, Nov1988.
[5] J. Moy, RFC 1245, “OSPF Protocol Analysis”, July 1991.
[6] S. Basagni, R.Belding R,“Routing Approaches in Mobile Ad-Hoc Networks”, Wiley-IEEE Press -2004.
[7] C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architecture and Protocols”, Prentice Hall 2004.
[8] Lei Wang, Lianfang Zhang, Yantai Shu and Miao Dong, “Multipath Source Routing in Wireless Ad Hoc Networks”, CCECE 2000, 7
[9] Mahesh K. Marina S. R., “On demand Multipath Distance Vector Routing in Ad Hoc Networks”, 9th International Conference on 11.
[10] V.D. Park, M.S. Corson, “A highly adaptive distributed routing algorithm for mobile wireless networks”, IEEE INFOCOM 1997.
[11] A. Valera, W. Seah, S.V. Rao, “Cooperative packet caching and shortest multipath routing in mobile ad hoc networks”, IEEE INFOCOM 2003.
[12] S. Lee and M. Gerla, “Split Multipath Routing with Maximally Node Disjoint path in Ad Hoc Networks”, IEEE ICC 2001.
[13] L. Wang et. Al., “Adaptive Multipath Source Routing in Ad Hoc Networks”, IEEE International Conference on Communications, 2001.
[14] K. Wu, J. Harms, “On demand multipath routing for mobile ad hoc networks”, EPMCC 2001.
[15] N. Soumendra, S. Robert,”Gray spatial multipath location aided ad hoc routing”, ICCCN 2004.
[16] P. K. Manohari, N.K. Ray, “Energy Aware On demand Multipath Distance Vector Routing”, IEEE Conference on Power, Communication and Information Technology, 2015.
[17] A. Taha et. Al., “Energy Efficient Multipath Routing Protocol for Mobile Ad Hoc Networks using Fitness Function”, IEEE Access vol. 5, May 2017.
[18] K. Singh, S. Moh, “An Energy Efficient and Robust Multipath Routing Protocol For Cognitive Radio Ad Hoc Networks”, Sensors, Sept. 2017 issue.