Survey of Modified Routing Protocols for Mobile Ad-hoc Network

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Abstract— In last few years extensive research work has been done in the field of routing protocols for Ad-hoc Network. Various routing protocols have been evaluated in different network conditions using different performance metrics. A lot of research has been done how to modify standard routing protocol in ad-hoc network to improve its performance. The hop count is not only metric that gives efficient routing path. There are various modified protocols which make the use of other parameters along with hop count to select the best routing path to the destination. In standard Ad-hoc On-demand Distance Vector (AODV) routing protocol only hop count is used for selecting the routing path. In this paper we have studied variants of AODV protocols with modified routing metric.

Keywords: Mobile Ad-hoc Network, cross layer, AODV, HMAODV, Bypass AODV, AODV-BR, E-AODV, F-AODV.

I. INTRODUCTION

Mobile Ad-hoc Network (MANET) [1] is collection of mobile nodes which are connected with each other without any infrastructure. We can also call it as infrastructure less network. An Ad-hoc network is highly dynamic in nature means that nodes are free to move, they can join or leave the network at any time. In ad-hoc network adjacent nodes which are within each other’s range can communicate directly while non-adjacent nodes which are not within each other’s range have to communicate through one or more intermediate node/s. The topology of network keep on changing as nodes keeps on joining and leaving the network. Hence we need to have efficient routing protocol to maintain the communication between nodes.

The routing protocols for wireless ad-hoc network are classified as proactive, reactive and hybrid. In proactive routing, the routes in the network are continuously evaluated so that when any node has data to send, it also knows the path to destination. Each node maintains a routing table which contains network related parameters and metric values. These routing tables are exchanged between the nodes periodically. It is also known as Table Driven routing protocol. In reactive routing, the routes are discovered and established only when they are needed. The nodes are unaware of network topology. Each node has to go through route discovery and route maintenance procedure. The routes remain valid till the destination is reachable or until route is no longer needed. So paths are established on demand of nodes which avoids unnecessary broadcasting of network information. It is also known as on-demand routing protocol. Hybrid routing protocol combines both proactive and reactive routing strategy. The routing is initially established with any proactive route and then demand for additional nodes through reactive flooding. So the network is partitioned into two layers, inner layer uses proactive while outer layer uses reactive routing.

The Ad hoc On-Demand Distance Vector (AODV) [2] [3] is designed for ad-hoc networks. It is purely on demand routing protocol as routing does not depend on fixed path and routing information is exchanged only when needed. In AODV routing protocol messages, sequence number is used by the node to determine the freshness of the information contained with the node. Route Request (RREQ), Route Replies (RREP) and Route Errors (RERR) are the various types of message used in AODV routing protocol. AODV routing procedure can be characterized into following phases

A. *Route Discovery Process:*

Route discovery process is started when any node wants to send data to other node and it does not have valid path to that node. Here each node maintains two different counters a node sequence number and broadcast ID. Broadcast ID is incremented every time source node initiates new RREQ message. The RREQ message is broadcasted to all the neighbors of source node .When any intermediate node receives RREQ, it replies to source if it has path to the destination node. If it does not have path to destination node, it further broadcasts the RREQ message to its neighbors. When the destination node receives the RREQ, it sends RREP. Route Reply message is unicasted by the node.

B. *Reverse Path Set Up:*

As RREQ message is traversed from source to the various nodes to the destination, the reverse path is automatically setup from all nodes back to the source. In order to set up this reverse path, each node stores the address of the neighbor from which it has received the RREQ message.

C. *Forward Path Set Up:*

When RREQ message is received by destination node itself, it replies to the source node. If an intermediate node has route to the destination node, before sending RREP to source it checks the freshness of the path information it has. If the sequence number of the path is greater than or equal to sequence number in the RREQ, then it replies with path to source. If the sequence number in the RREQ message is greater than that of path with the node then instead of sending this path information to source, it broadcasts the RREQ message to its neighbors.

D. *Route Maintenance:*

HELLO messages are used for maintaining active route. Each node maintains a precursor list which contains the list of nodes which needs to be notified in the case of link break. When any node detects link break for the next node in its path towards the destination, it sends RERR message to all the nodes in its precursor list. Once the source node receives the notification of the broken link, the source node can restart the route discovery process if it has data to send to the destination.

II. LITERATURE SURVEY

The standard AODV routing protocol had been modified previously considering different parameters as mobility, energy level, congestion, bandwidth and node load. In this section we are going to discuss some of these modified AODV routing protocols.

Heterogeneity and Mobility aware AODV (H-MAODV) [4] have considered the relative velocity and the distance between each node and node which is one hop away from it to calculate one weight metric. This weight metric is calculated at each node and this parameter is added as an entry in the RREQ message. If the calculated value of the metric at any node is more than that in the RREQ, the value of the metric is replaced else the parameter value is kept unchanged. The destination node selects the path whose metric value in RREQ is least among all the paths. This protocol mainly focuses on increasing the lifetime of the routing path. It improves the packet delivery ratio than basic AODV protocol. The weight function (*Fij*) is the parameter that allows nodes to select best path as shown in equation 1.1.

$$Fij = \alpha \times \frac{Dij}{Tri} + \beta \times \frac{Vrij}{Vrmaxij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.1)$$

Where,
α and β are the weights satisfied $\alpha + \beta = 1$.
Dij is the distance between node *i* and node *j*.
Tri is transmission range of node *i*.
Vrij is relative velocity between node *i* and node *j*.
Vrmaxij is maximum relative velocity between node *i* and node *j*.

In Throughput Enhancement in AODV Routing Using Mobility Awareness [5] the movement of the nodes is considered for selecting best route to the destination. Here each node broadcasts its current location in the network at regular time intervals inside the HELLO packet. Hence each node is aware of the mobility of its neighbors. The RREP is sent that neighbor which has more stability or less movement. So path to destination has maximum possible stable nodes. Hence it increases route lifetime, reduces re-route discoveries and link breakage. Here throughput is improved.

Bypass AODV [6] uses cross layering to identify link breaks due to mobility and set up the bypass path between the end nodes whose link is broken keeping rest of the path same. Here MAC layer is modified and channel has assigned different states which are used to distinguish packet loss due to link break. Two new messages bypass-RREQ and bypass-RREP are used for bypassing purpose. The information about bypass route is stored in bypass routing-table. This bypass routing table is used when any node receives RREQ or RREP message to invalidate that particular route entry. Bypass AODV shows continuously improved performance as node density increases. Bypass AODV results higher packet delivery ratio than standard AODV as it buffers the packets for transmission over bypassed route. It reduces the invocation of unnecessary route error messages which in turn reduces routing overhead in the network.

Backup Routing in AODV (AODV-BR) utilizes a mesh network to provide multiple alternate paths to existing on demand routing protocols without producing additional control messages [7]. Instead of depending on single path, alternative paths are maintained at each node by overhearing route reply messages of the nodes within the range. As soon as link breakage is identified by any node it broadcasts packets to its neighbors hoping that at least one of them will have alternate route to the destination. That node also sends RERR message to the source node so that source can start new route. This mechanism is similar to that of DSR's routing mechanism. In this scheme mesh link is used to skip the broken link in the route while in DSR node uses route cache information to replace the entire route till destination node on routing path. This algorithm results into better packet delivery ratio and end to end delay for mobile nodes network. But this is not that much effective in heavily loaded network as it is in lightly loaded network.

In [8], cross layering mechanism is used to improve route selection metric in which route is selected based on various parameters as hop metric, node load, bandwidth etc. The cross layering mechanism integrates the parameters from different stack layers. The parameters from network layer, MAC layer and physical layer are combined. The modified route selection mechanism is done by combining different metrics into single metric to get better performance. The result shows that when multiple metrics are used for route selection, performance is improved in terms of end to end delay, packet delivery ratio and route load especially for high speed mobile network.

In E-AODV [9] the main goal is to route the data packets through the nodes which are expected to have better residual energy. The energy consumption rate specifies how fast node is consuming its remaining energy. In F-AODV [10] main goal is to optimize the data forwarding in MANET by minimizing number of forwarding nodes. The selection of forwarding node is based on maximum battery level and queue occupancy. Maximum battery level and queue occupancy information are injected in route request and route reply messages.

In [11], two modified protocols E-AODV which considers energy consumption rate and F-AODV which uses cross layer forwarding mechanism are compared. Both E-AODV and F-AODV give better packet delivery ratio for variable node density. Due to high reactiveness of E-AODV and F-AODV to the link changes compared to AODV, E-AODV and F-AODV have lower routing overhead compared to AODV protocol. For lower data rates all three protocols perform approximately same but for higher data rates E-AODV and F-AODV outperforms AODV.

III. CONCLUSION

We have studied and reviewed various modified AODV routing protocols for mobile ad-hoc network. In standard AODV routing protocol the basic metric used for selection of path is hop count. The use of other parameters with hop count gives more efficient routing path that result into improved network performance. As some network parameters are varied, there was dip in the performance. We conclude that there is need of a protocol that can adapt itself according to network parameters to perform optimally.

IV. FUTURE WORK

As future enhancement, energy parameter of node with hop count can be used as path selection metric to establish more efficient routing path. Residue Energy Battery Model along with AODV routing can be used for this. The initial energy of any node is given the parameter DEFAULT_FULL_BATTERY_CAP. In our algorithm we will use one threshold energy paramater which will be initialised as shown in equation 1.2.

$$\text{ENERGY\_THRESHOLD} = \alpha \times \text{DEFAULT\_FULL\_BATTERY\_CAP} \ldots\ldots\ldots\ldots (1.2)$$

Where,

$$\alpha = Constant\ value\ such\ that\ \ 0 < \alpha \leq 1$$

To get the optimal value of α that gives best results, analysis needs to be done on this modification in route discovery process. Every node will first check its residue energy with this threshold value. If the node has energy equal or more than that of threshold value then only broadcast the RREQ packets to its immediate neighbors. This process will be continued until route is established or RREQ message is received at destination.

REFERENCES

[1] S. Corson, Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations, RFC-2501, 1999.
[2] C.Perkins, Ad hoc On Demand Distance Vector (AODV) routing, RFC-3561, 2003.
[3] Luke Klein-Berndt, A Quick Guide to AODV Routing, National Institute Of Standards And Technology (NIST).
[4] Bisngar Ahmed, Zytoune Ouadoudi, RzizaMohamed and Ouadou Mohamed, "A mobility aware Modified AODV for heterogeneous mobile ad hoc networks", IEEE 2012.
[5] Dr.S.A.Hussain, Dr.E.Garcia and M.Idrees, "In Throughput Enhancement in AODV Routing Using Mobility Awareness", Unpublished.
[6] Ahed M. Alshanyour, Uthman Baroudi, "Bypass AODV: Improving Performance of Ad Hoc On-Demand Distance Vector (AODV) Routing Protocol in Wireless Ad Hoc Networks", ICST February 2008.
[7] Sung-Ju Lee and Mario Gerla, "AODV-BR:Backup Routing in Ad-hoc Networks", Defence Advanced Research Projects Agency(DARPA).
[8] Jihong Shi, Jiang Yu, Haiyan Li and Rong Zong, "AODV Protocol Optimization Based on Cross-Layer Design of WMN", IEEE, 2011.
[9] Lamia Romdhani, Christian Bonnet, "Energy consumption speed-based routing for mobile ad hoc networks", Tokyo, Japan, WWAN 2004.
[10] Lamia Romdhani, Christian Bonnet, "A cross-layer feature for an efficient forwarding strategy in wireless ad hoc networks", 20th IEEE, Vienna, Austria, AINA 2006.
[11] Lamia Romdhani, Christian Bonnet, "Energy-based routing optimization in MANET: Cross-layer benefits", proceeding of 9th international conference on mobile and wireless communication networks, 2007.