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A Comprehensive Study of AODVv2-02 Routing Protocol in MANET

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ABSTRACT
A MANET (Mobile Ad hoc Network) is a collection of self-governing mobile nodes that can communicate to each other through wireless links. These are fully distributed networks and can be work at any place without any pre-existing infrastructure. Many protocols are available for such type of Networks. AODVv2-02 is a revised version of AODVv2 (also known as DYMO) developed by IETF. In this paper we will discuss its working and its features which makes it different from other routing protocols. The main goals of this revised version of AODVv2 is to maintain received RREQ table and compare the incoming RREQ message, for the elimination of redundant or duplicate RREQ messages.

Keywords
MANET (Mobile Ad hoc Network), AODV (Ad-hoc on Demand vector routing), Routing Protocols, DYMO (Dynamic On-demand MANET routing protocol), AODVv2-02.

1. INTRODUCTION
A mobile ad-hoc network (MANET) is a infrastructure less and self-governing network of mobile nodes, all nodes which are part of the mobile ad-hoc network can freely transmit the packets through wireless transmission media to any remote node in the network. These type of network are not controlled by any centralized administration or server, whereas the control of the network is allocated among participating nodes. In MANET mobile node are pretended to be move with more or less relative speed in random direction. There is no long term ensured path from one node to another node. MANET have very progressive use in emergency scenarios like military operations & disaster relief operation where there is need of immediate communication network whenever some major event, or some temporary requirement like conference & meetings at new place where there is no pre-existing network infrastructure is available. The figure 1 shows a view of mobile ad-hoc network [12] and the various characteristics of MANET are as follows:

1. Distributed Network: MANET are fully distributed network as there is no central control of the network operations. The control of the network is divided among the nodes. All participating nodes in a MANET should coordinate with other nodes for the communication among themselves [14].

2. Multi hop routing: Whenever any node wants to communicate with other node in the network which is out of its communication scope, the packet should be forwarded through other intermediate nodes.

3. *Light-weight terminals*: In mobile ad-hoc network, all participating nodes are mobile with less CPU capability, low power storage and small memory size.

4. Self-governing nodes: In MANET, all participating nodes are independent in nature i.e. any node can be work as host as well as a router.

5. Shared Physical Devices: The wireless nodes in mobile ad-hoc network shares physical devices through communication medium.

6. Dynamic topology: Nodes are free to move promptly with different speeds, thus the network topology may change randomly and at unpredictable time. The nodes in the MANET dynamically establish routing among themselves as they travel around, establishing their own network.

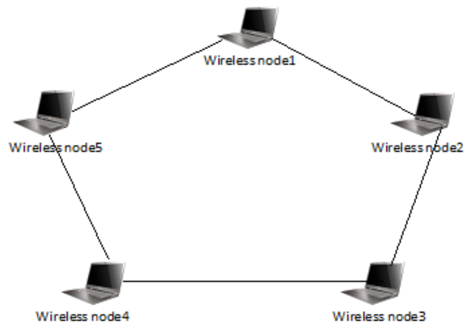

Figure 1. A mobile ad-hoc network

2. CLASSIFICATION OF ROUTING PROTOCOLS
The MANET's routing Protocols can be classified in many ways, but mostly this classification depending on routing strategy and network structure. According to the routing strategy these routing protocols can be categorized as Table-driven, on demand and Hybrid MANET routing protocols. The classification of routing protocols is shown in the figure 2.

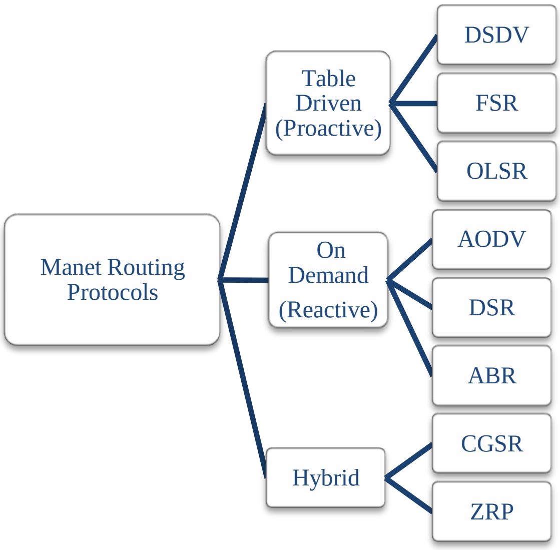

Figure 2. Classification of MANET Routing Protocols

2.1 Table-Driven Routing Protocols (Proactive)

These types of protocols maintain a route information from one node to every other node in the network. Each node maintains a routing table, contains routing information of the network. Each node updates its routing table regularly, so that each node knows the route in advance. Whenever any node wants to send any message to another node than its path is already known. Thus, if a route has already known before traffic arrives, then transmission starts without delay. Otherwise, message packets should wait in queue until the node receives routing information from source to destination. These protocols generally use link-state algorithms which help to maintain and update a routing table by flooding the link information about neighbor nodes. It creates more overhead in routing table to maintains and update the node information entries for each and every node in the network.

2.2 On Demand Routing Protocols (Reactive)

In Reactive Protocols, there is no need to maintain routing information between nodes in the network, if there is no communication [12]. Whenever any node wants to send packets to another node in the network, only than it starts with a route discovery process throughout the network. This process runs until routing information is determined or all possible permutations have been searched. Once a route has been determined, it is maintained by a route maintenance process either until the route is no longer required or until the destination becomes inaccessible to every path from the source. Therefore, theoretically the communication overhead is decrease due to route research [4].

2.3 Hybrid Protocols

Hybrid protocol integrates the features of both proactive as well as reactive protocols [4]. It is a combination of proactive and reactive routing and it is based upon distance vector protocol but contain many features and advantage of link state protocol. Hybrid protocol enhances interior gateway routing protocol.

2.4 Comparison of Table Driven and On-Demand Routing Protocols

1. In Reactive Protocols, Average end-to-end delay or the time taken to send data from source to destination is variable but remains constant in Proactive Protocols for a given mobile Ad hoc network.

2. In On-Demand Protocols, the delivery of packet data is much more efficient than in Proactive Protocols.

3. Reactive Protocols are faster in performance than Proactive protocols.

3. AODVv2-02 PROTOCOL OVERVIEW

AODVv2 (DYMO) is the successor of the AODV reactive routing protocol used for MANET. With many changes DYMO is designed with future enhancements in mind. It is implemented by many researchers to analyze its performance in comparison to other routing protocols designed for MANET. IETF has published its revised version as a draft ‘draft-ietf-manet-aodvv2-02’ and is still in progress. It is purposed by C. E. Perkins, S.Ratliff, and J.dowdell [9]. Using AODVv2 as the basis, AODVv2-02 borrows Path Accumulation and Multi-hop routing from AODVv2. With the help of AODVv2-02 MANET routing protocol, reactive and multi-hop routing can be done between different participating nodes that wants to communicate with each other [13]. Some characteristics of AODVv2-02 Protocol are given below:

- AODVv2-02 Protocol has low routing overhead.
- Protocol Implementation become simple and easy using path accumulation function.
- The basic operation of AODVv2-02 protocol involves route discovery and route maintenance.
- AODVv2-02 can be used in both IPv4 and IPv6.
- ADVv2-02 is a better routing protocol for multi-hop networks.
- This protocol is energy efficient for large networks.

3.1 Working of Aodvv2-02 Protocol

Similar to DYMO, the basic operation of AODVv2-02 protocol are route discovery and route maintenance [7]. Route discovery is performed by sender node to a target node for which it does not have a valid route and route maintenance is performed in order to avoid exiting eradicate routes from routing table and also to decrease packet dropping due to route breakage or node failure. This protocol can be work as both reactive and as proactive protocol.

3.2 AODVv2-02 Route Messages

AODVv2-02 protocol implements three types of route messages during routing operations are Route Request (RREQ), Route Reply (RREP), and Route Error (RERR) [7]. These are route control messages used to find and maintain path from source node to any particular target node.

3.3 Route Discovery

During the Route discovery process, the originating node starts broadcasting of Route Request (RREQ) message throughout the network to find a path to a particular target node. Due to AODVv2-02 path accumulation function, each intermediate node will attach its own address to the RREQ message. Each intermediate node that propagates the RREQ message makes a note to the backward path. Figure 3 shows AODVv2-02 route discovery process, node A is the source node and node I is the target node. Thus, node A generates RREQ message which contains its own address, hop count, sequence number, target node address and then broadcast it on the network. Each intermediate node having a valid path to the target keeps on adding its own address and sequence number with the RREQ message as shown in figure 3 with nodes D and E, till target is reached. Upon sending RREQ message in the network, the source node waits for a RREP (route reply) message. The target node replies with RREP message. Incase no RREP is received within the particular wait time; the source node may try again by sending another RREQ message after some time to discover the route. In this way AODVv2-02 discover the route from Source node to target node [7, 12]. One of special feature of AODVv2-02 is energy efficient .If any node is low on energy; it has option to not engage in route discovery process.

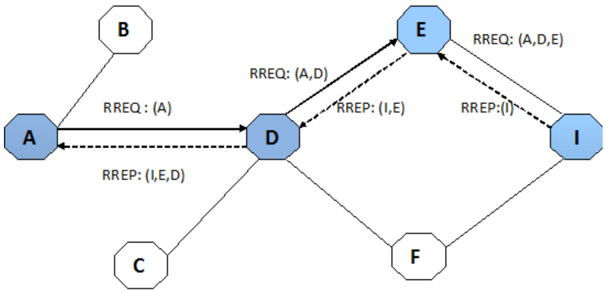

Figure3. AODVv2-02 Route Discovery

3.4 Route Maintenance

During the route maintenance process, each node continuously monitors the status of links and maintains the latest updates within the routing table. If a route to the target is lost or a route to the target is not known, then RERR message is sent towards the message source node, to specify that route is being invalid or missing towards a particular node. Upon receiving RERR message, the route table is being updated and the entry with invalid link is deleted. As shown in Figure 4 , node D received a packet that wants to go to node I , but the route from node D to node I is found broken . After this, a RERR message is generated by node D and forward it to the target node A. All the intermediate nodes on the path immediately update their route table entries with the new updated information regarding invalid path and new route changes. After updating new route information the packet will be forwarded from node D to node F and then to node I in order to reach its target node.

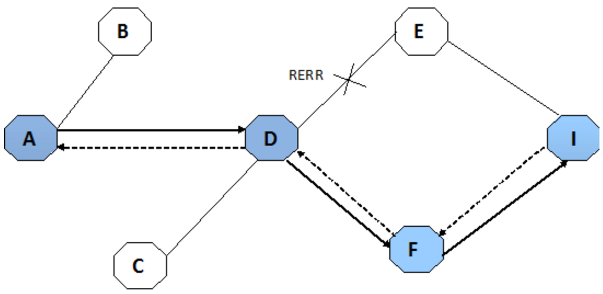

Figure4. AODVv2-02 Route Maintenance

3.5 Working Difference of Aodvv2-02 Manet Routing Protocol

The main difference of AODVv2-02 MANET routing protocol is to maintain a received RREQ table, in-order to eliminate the duplicate RREQ message by comparison of incoming RREQ message with received RREQ table entries. Two RREQ incoming request message can be compared if they were sent to find a route for the same destination with same Metric type by same AODVv2 router. Whenever a router receive an RREQ message, it must check it with previous RREQ message , in order to assure that its response RREP message would not contain any duplicate information. So to avoid retransmission of these duplicate RREQ message, each AODVv2 router needs to save a list of certain information of recently received RREQ messages.

This list of RREQ messages are called AODVv2-02 Received RREQ message table. Two RREQ messages can be compared if they have same Metric type, OrigNode and TargNode addresses. RREQ table contain given fields for each RREQ entry.

Table1. AODVv2-02 Received RREQ Table

Metric type	**Sequence Number**
OrigNode address	TargNode address
Metric	Timestamp

3.6 Elimination of Redundant/Duplicate RREQ Messages

Whenever RREQ messages are multicast in the network for route discovery, in common situations AODVv2 router might reply with redundant or duplicate information to some recently received RREQ message. An AODVv2 must suppress/eliminate these duplicate RREQ message before replying. To determine that recently received incoming RREQ message contains new information or not, is done by checking the received RREQ table list maintained by AODVv2 routers as given below:

a) AODVv2 router checks the received RREQ table entries that the incoming RREQ message have same OrigNode, TargNode and Metric Type, if there is such entry than the RREQ message is suppressed/eliminated , otherwise RREQ table Adds new entry.

b) Even if there is an entry in received RREQ table but incoming RREQ with new sequence number than the previous table entry is updated with new sequence number to reflect the new entry. Otherwise incoming RREQ messages must be suppressed/eliminate to reduce the overhead of replying to these redundant messages again and again.

c) Similarly, if new RREQ message have Same Sequence number but incoming RREQ message offers better metric type, then the new RREQ incoming message is not eliminate and in order to reflect the new metric received RREQ table entry must be updated.

4. CONCLUSIONS

In this paper we have discussed various features of MANET (mobile ad-hoc networks) routing protocols. These protocols are classified in three main categories: Table-driven, On-demand and Hybrid protocols and also their comparison has been done. The AODVv2-02 protocol working with its basic operations like route discovery and route maintenance are discussed in detail. The main differentiating factor of aodvv2-02 routing protocol is to maintain a received RREQ table at each node and then compare the new RREQ messages with it , in order to eliminate the duplicate RREQ messages. Due to changing topology and security attacks in mobile ad-hoc networks, lot of research and development on AODVv2-02 is still required. In future, a comparison of AODVv2-02 routing protocol can be done with different reactive protocols in order to evaluate its performance.

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