ROUTING PROTOCOL IN AD-HOC MOBILE NETWORKS: A SURVEY

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Abstract—

Mobile Ad hoc Network (MANET) is a collection of mobile nodes and characterized by multi-hop wireless connectivity and frequently changing network topology. These nodes requires efficient routing protocols. A routing protocol is used to discover routes between nodes for communication. The primary goal of such an ad hoc network routing protocol is correct and efficient route establishment between a pair of nodes so that messages may be delivered in a timely and efficient manner. In this paper we examines routing protocols for ad hoc networks and evaluates these protocols based on a given set of parameters. The paper provides an overview of different protocols by presenting their characteristics and functionality, and then provides a comparison and discussion of their respective merits and drawbacks.

Keywords- MANET, Routing Protocols, DSDV, AODV and ZRP.

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I. Introduction

A network of mobile nodes using peer-to-peer communication [6] is called an ad- hoc network. The nodes in an ad hoc network are limited by power, memory, band width and computational constraints. Such networks have the ability to provide cheap communication without any fixed infrastructure. Hence, they are very useful in disaster recovery, collaborative computing, rescue operations and military surveillance.

A Network is defined as the group of people or systems or organizations who tend to share their information collectively for their business purpose. A network [4] can be characterized as wired or wireless. Wireless can be distinguished from wired as no physical connectivity between nodes is needed. Ad-hoc networks are wireless networks where nodes communicate with each other using multi-hop links. There is no stationary infrastructure or base station for communication. Each node itself acts as a router for forwarding and receiving packets to/from other nodes. Routing is the act of moving information from a source to a destination.

The rest of this paper is organized as follows: Section II discusses the basics classification of routing protocols. Section III gives brief introduction of DSDV Routing Protocol. Section IV gives introduction of AODV Routing Protocol and its advantages and disadvantages. Section V gives introduction of Zone Routing Protocol and finally conclusion is given in section VI.

II. Routing Protocols

This section provides the overview of different routing protocols, which will be evaluated in this paper. A MANET includes many challenges and issues such as Dynamic topologies, Frequency of updates or network overhead, energy, speed, routing and security. The routing protocol is required whenever the source needs to transmit and delivers the packets to the destination. Many routing protocols have been proposed for the mobile ad hoc network and classified as Proactive or Table Driven routing Protocol, Reactive or On Demand Routing Protocol and Hybrid protocol. Figure 1 shows the Classification of Routing Protocol in MANET's.

A. Proactive Or Table-Driven Routing Protocols

The proactive routing protocols are table-driven [3]. They usually use link-state Routing algorithms flooding the link information. Link-state algorithms maintain a full or partial copy of the network topology and costs for all known links. Thus, link-state routing algorithms are more reliable, less bandwidth-intensive, but also more complex and compute- and memory-intensive.

These are called table driven protocols. In these protocols, each node maintains routing information to every other node in the network. The routing information is usually kept in number of different routing tables. These tables are periodically updated if the network topology changes. The difference between these protocols exists in the way the routing information is updated, detected and type of information kept at each routing. Some of the most used on proactive routing protocols are DSDV [2] and WRP [2].

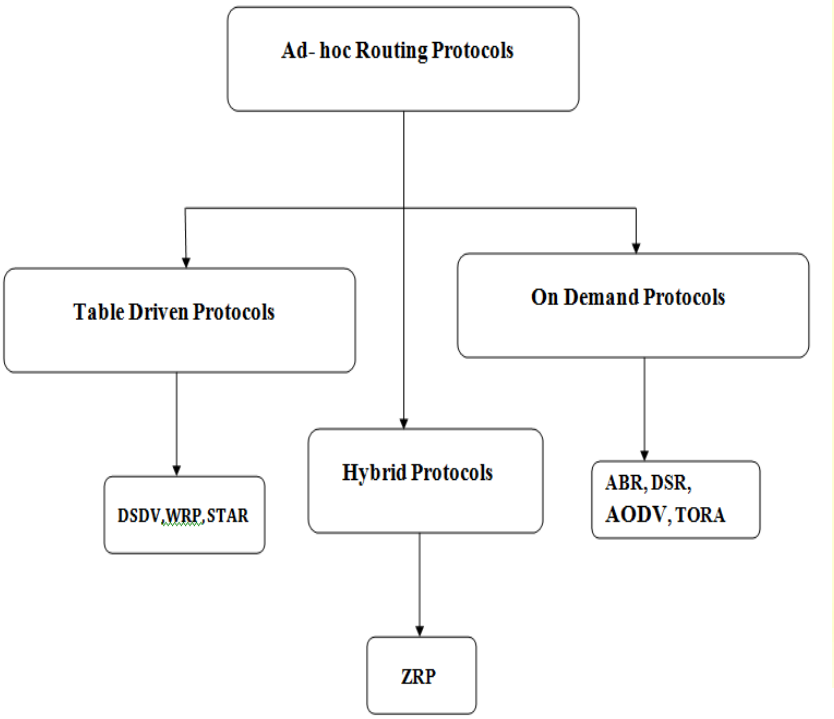

Figure 1. Classification of Routing Protocol in MANET's [4]

B. Reactive or On Demand Routing Protocol

In Reactive routing protocols, when a source wants to send packets to a destination, it invokes the route discovery mechanisms to find the route to the destination. The route remains valid till the destination is reachable or until the route is no longer needed. Unlike table driven protocols, all nodes need not maintain up-to-date routing information. Some of the most used on demand routing protocols are DSR [8] and AODV [4].

C. Hybrid Routing Protocol

Hybrid routing protocol combines the advantages of both proactive and reactive routing protocols. The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding. Some of the existing hybrid protocols are ZRP [8].

III. Destination-Sequenced Distance-Vector Routing (DSDV)

Destination Sequenced Distance Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm.If a router receives new information, and then it uses the latest sequence number. If the sequence number is the same as the one already in the table, the route with the better metric is used. Stale entries are those entries that have not been updated for a while. Such entries as well as the routes using those nodes as next hops are deleted. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks.

IV. AODV Routing Protocol

AODV [4] routing protocol is designed for use in ad-hoc Mobile networks. AODV is based on the principle of discover routes as needed AODV is a reactive protocol: the routes are created only when they are needed. It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops.

The following control packets are used: routing request message (RREQ) is broadcasted by a node requiring a route to another node, routing reply message (RREP) is unicasted back to the source of RREQ, and route error message (RERR) is sent to notify other nodes of the loss of the link. HELLO messages are used for detecting and monitoring links to neighbours.

The request is made on-demand rather than in advance, to account for the continually changing network structure, which is likely to in validate routing tables over time. The routing table stores information about next hop to the destination and a sequence number which is received *request* (RREQ) *packet* to its neighbours. The RREQ has following fields:

< source_addr, source_sequence-#, broadcast_id, dest_addr, dest_sequence_#, hop_cnt >

When intermediate nodes receive a *route request packet*, they update their routing tables for a reverse route to the source and like this process, when the intermediate nodes receive *route reply packet* (RREP), they update the forward route to the destination. The *route reply packet* contains the following fields:

<source_addr, dest_addr, dest_sequence_#, hop_cnt, lifetime>

The AODV [5] protocol is divided in to two phase: routing search and routing maintenance. The main character of AODV is to keep timer-based state of every node. Routing table will expire when a route is rarely used. A route discovery consists of:

- Route Request (RREQ)
- Route Reply (RREP).

Route maintenance consists of:

- Data
- Route update
- Route Error (RRER)

A. Route Discovery

The figure 2 illustrates the route discovery process by broadcasting RREQ. The RREQ receiving node set the backward pointer to the source node and generates a RREP unicast packet with a lifetime, sent back to the source if it is the destination or contains a route to the destination i.e. intermediate node. An intermediate node set up a reverse route entry with lifetime for the source node in its route table to process the RREQ and forwards a RREP to the source. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism.

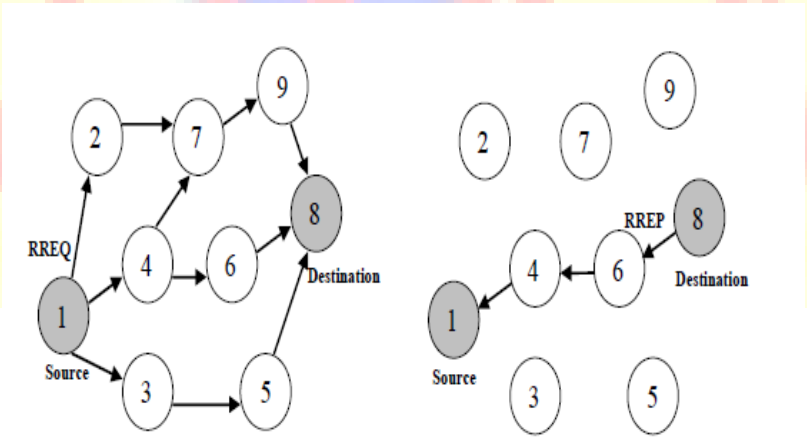

Figure 2. AODV route discovery process [2]

B. Route Maintenance

A route discovered between a source node and destination node is maintained as long as needed by the source node. If the source node moves during an active session, it can reinitiate route discovery mechanism to establish a new route to destination. When either destination or intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached. When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still needed. . If an intermediate node loses connectivity or break with its next hop, it initiates, a Route Error (RERR) message and broadcasts it to its neighbor nodes and marks the entry of the destination in the route table as invalid, by setting the distance to infinity. This mechanism can be found at Figure 3.

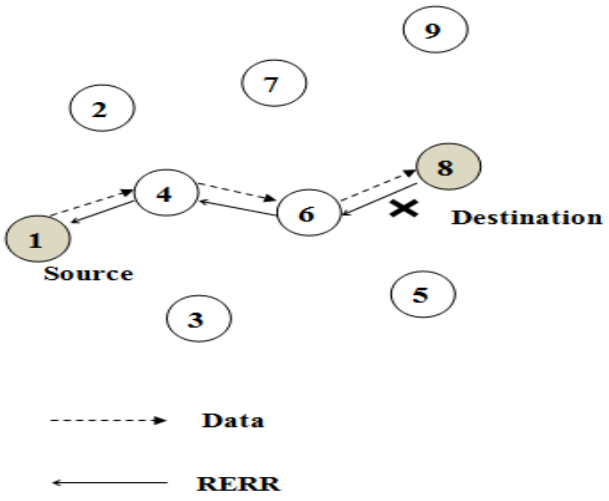

Figure 3. Data (Route Update) and Route Error [9]

C. Advantages And Disadvantages

The AODV has great advantage in having less overhead over proactive protocols and it also supports both unicast and multicast packet transmissions even for nodes in constant movement.AODV use destination sequence number for each route entry. This causes considerable delay [6] and AODV does not support security. This allows an attack from an unknown node in the Manets [6].

V. ZRP

The Zone Routing Protocol (ZRP) [5] combines the advantages of both reactive and pro-active protocols into a hybrid scheme, taking advantage of pro-active discovery within a node's local neighborhood, and using a reactive protocol for communication between these neighborhoods. In a MANET, it can safely be assumed that the most communication takes place between nodes close to each other. The ZRP is not so much a distinct protocol as it provides a framework for other protocols. The separation of a nodes local neighborhood from the global topology of the entire network allows for applying different approaches - and thus taking advantage of each technique's features for a given situation. These local neighborhoods are called zones ; each node may be within multiple overlapping zones, and each zone may be of a different size. The ``size'' of a zone is not determined by geographical measurement, but is given by a radius of length,where is the number of hops to the perimeter of the zone. By dividing the network into overlapping, variable-size zones, the Zone Routing Protocol consists of several components, which only together provide the full routing benefit to ZRP. Each component works independently of the other and they may use different technologies in order to maximize efficiency in their particular area. Components of ZRP are IARP, IERP and BRP.

VI. Conclusion

In this paper we provide descriptions of several routing schemes proposed for ad hoc mobile networks. We also provide a classification of these protocols for MANET. We have presented a comparison of these two categories of routing protocols. While it is not clear that any particular algorithm or class of algorithm is the best for all scenarios, each protocol has definite advantages and disadvantages, and is well suited for certain situations. The field of ad hoc mobile networks is rapidly growing and changing,

and while there are still many challenges that need to be met, it is likely that such networks will see widespread use in future.AODV is based on the principle of discover routes as needed. AODV is a reactive algorithm that has some capabilities such as: low processing, memory overhead, low network utilization, and it works well even in high mobility situation.

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