Study of Routing Protocols for Mobile Ad-Hoc Networks

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Abstract- A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point, infrastructure, or centralized administration. To establish a data transmission between two nodes, typically multiple hops are required due to the limited transmission range. Every node in MANET work as router. Mobility of the different nodes makes the situation even more complicated due topology change. Multiple routing protocols especially for these conditions have been developed during the last years, to find optimized routes from a source to some destination. Routing protocols in MANET are classified in to proactive (table driven), reactive (on-demand) and hybrid protocols. The nodes in MANET have low processing capabilities and these are connected by low bandwidth wireless links. To cope with low processing capabilities of nodes and limited bandwidth, a suitable routing protocol needs to be adopted. The aim of this paper is to study various routing protocols (DSDV, AODV, DSR) used in MANETs.

Keywords – DSDV, AODV, DSR, MANET.

I. INTRODUCTION

In the last couple of years, the use of wireless networks[1] has become more and more popular. There exist three types of mobile wireless networks: infrastructured networks, ad-hoc networks and hybrid networks which combine infrastructured and ad-hoc aspects. An infrastructured network consists of wireless mobile nodes and one or more bridges, which connect the wireless network to the wired network. These bridges are called base stations. A mobile node within the network searches for the nearest base station (e.g. the one with the best signal strength), connects to it and communicates with it. The important fact is that all communication is taking place between the wireless node and the base station but not between different wireless nodes. While the mobile node is traveling around and all of a sudden gets out of range of the current base station, a handover to a new base station will let the mobile node communicate seamlessly with the new base station. In contrary to infrastructured networks, an ad-hoc network lacks any infrastructure. There are no base stations, no fixed routers and no centralized administration. All nodes may move randomly and are connecting dynamically to each other as shown in figure 1. Therefore all nodes are operating as routers and need to be capable to discover and maintain routes to every other node in the network and to propagate packets accordingly. Mobile ad-hoc networks may be used in areas with little or no communication infrastructure: think of emergency searches, rescue operations, or places where people wish to quickly share information, like meetings etc.

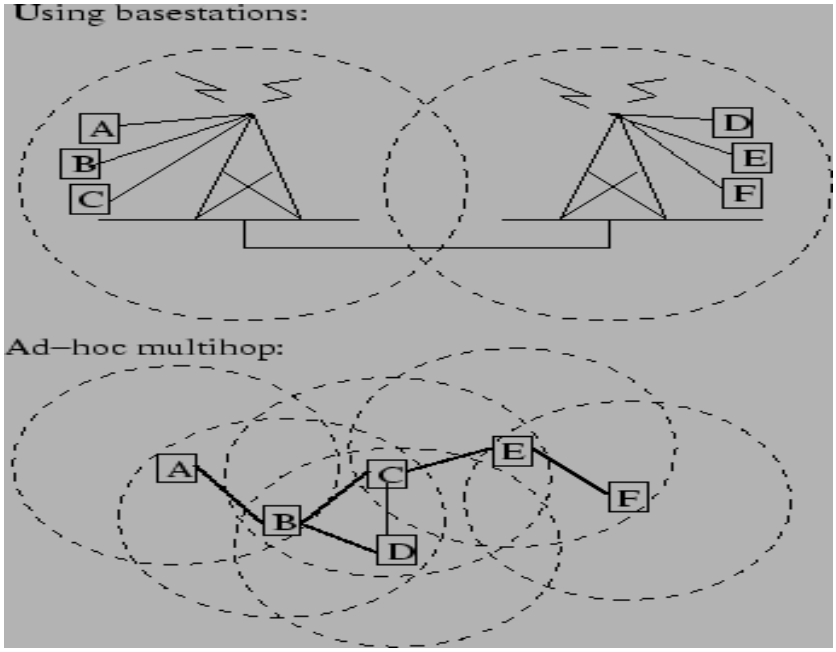

Figure 1: A traditional base station scheme compared to an ad-hoc multi-hop network.

II. ROUTING PROTOCOLS

Routing protocols[2] define a set of rules which governs the journey of message packets from source to destination in a network. In MANET, there are different types of routing protocols each of them is applied according to the network circumstances. Figure 2 shows the basic classification of the routing protocols in MANETs.

A. Proactive Routing Protocols -

Proactive routing protocols are also called as table driven routing protocols. In this every node maintain routing table which contains information about the network topology even without requiring it. The routing tables are updated periodically whenever the network topology changes. Proactive protocols are not suitable for large networks as they need to maintain node entries for each and every node in the routing table of every node. There are various proactive routing protocols. Example: DSDV, OLSR, WRP etc.

B. Reactive Routing Protocols-

Reactive routing protocol is also known as on demand routing protocol. In this protocol route discovered whenever it is needed Nodes initiate route discovery on demand basis. A route is acquired by the Initiation of a route discovery process by the source node. The on- demand routing protocols have two major components.

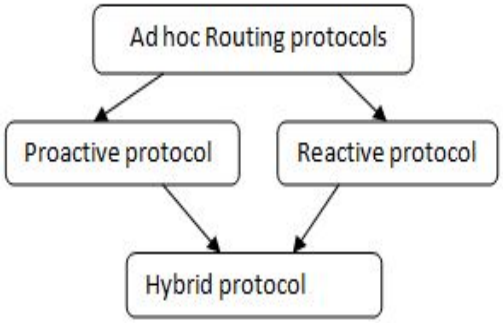

Figure 1: Classification of routing protocol

Route discovery: In this phase source node initiates route discovery on demand basis. Source nodes consults its route cache for the available route from source to destination otherwise if the route is not present it initiates route discovery. The source node, in the packet, includes the destination address of the node as well address of the intermediate nodes to the destination.
Route maintenance: Due to dynamic topology of the network cases of the route failure between the nodes arises due to link breakage etc, so route maintenance is done. Reactive protocols have acknowledgement mechanism due to which route maintenance is possible. There are various reactive routing protocols for example DSR, AODV, TORA and LMR.

C. Hybrid Routing Protocol –

This type of protocol is a trade-off between proactive and reactive protocols. Proactive protocols have large overhead and less latency while reactive protocols have less overhead and more latency. So a Hybrid protocol is presented to overcome the shortcomings of both proactive and reactive routing protocols. Hybrid routing protocol is combination of both proactive and reactive routing protocol. It uses the route discovery mechanism of reactive protocol and the table maintenance mechanism of proactive protocol so as to avoid latency and overhead problems in the network. Hybrid protocol is suitable for large networks where large numbers of nodes are present. In this large network is divided into set of zones where routing inside the zone is performed by using reactive approach and outside the zone routing is done using reactive approach. There are various popular hybrid routing protocols for MANET like ZRP, SHRP.

DSDV Protocol -

Destination sequenced distance vector routing [4] (DSDV) is adapted from the conventional Routing Information Protocol (RIP) to ad hoc networks routing. It adds a new attribute, sequence number, to each route table entry of the conventional RIP. Using the newly added sequence number, the mobile nodes can distinguish stale route information from the new and thus prevent the formation of routing loops. Packet Routing and Routing Table Management in DSDV, each mobile node of an ad hoc network maintains a routing table, which lists all available destinations, the metric and next hop to each destination and a sequence number generated by the destination node. Using such routing table stored in each mobile node, the packets are transmitted between the nodes of an ad hoc network. Each node of the ad hoc network updates the routing table with advertisement periodically or when significant new information is available to maintain the consistency of the routing table with the dynamically changing topology of the ad hoc network. Periodically or immediately when network topology changes are detected, each mobile node advertises routing information using broadcasting or multicasting a routing table update packet. The update packet starts out with a metric of one to direct connected nodes. This indicates that each receiving neighbor is one metric (hop) away from the node. It is different from that of the conventional routing algorithms.

Ad Hoc On-demand Distance Vector (AODV) -

The AODV [3] routing protocol is an "on demand" routing protocol, which means that routes are established when they are required. This routing protocol is based on transmitting Route Reply (RREP) packets back to the source node and routing data packets to their destination. Used algorithm consists of two steps: route discovery and route maintenance. Route discovery process begins when one of the nodes wants to send packets. That node sends Route Request (RREQ) packets to its neighbors. Neighbors return RREP packets if they have a corresponding route to destination. However, if they don't have a corresponding route, they forward RREQ packets to their neighbors, except the origin node. Also, they use these packets to build reverse paths to the source node. This process occurs until a route has been found. Routing tables which only have information about the next hop and destination are used for routing information maintenance. When a route link disconnects, for example, a mobile node is out of range, neighbor nodes will notice the absence of this link. If so, neighbor nodes will check whether there is any route in their routing tables which uses a broken link. If it exists, all sources that send traffic over the broken link will be informed with Route Error (RRER) packet.

Dynamic Source Routing (DSR) Routing protocol -

DSR [4] uses explicit source routing, which means that each time a data packet is sent, it contains the list of nodes it will use to be forwarded. In other words, a sent packet contains the route it will use. Routes are stored in memory, and data packets contain the source route in packet header. Mechanism allows nodes on route to cache new routes, and also, allows source to specify the route that will be used, depending on criteria. This mechanism, also, avoids routing loops. If a node has to send a packet to another one, and it has no route, it initiates a route discovery

process. This process is similar to AODV route discovery process. In other words, the network is being flooded with RREQ packets. Each node that receives a RREQ packet, broadcasts it, except for destination node or nodes that have a route to destination node in their memory. A route through network is built by RREQ packet, and RREP packet is being routed backward to the source.

IV.CONCLUSION

Routing protocol DSDV uses proactive "table driven" routing, while AODV and DSR use reactive "on-demand" routing. Protocol DSDV periodically updates its routing tables, even in cases when network topology doesn't change. AODV protocol has inefficient route maintenance, because it has to initiate a route discovery process every time network topology changes. Both protocols, AODV and DSR, use route discovery process, but with different routing mechanisms. In particular, AODV uses routing tables, one route per destination, and destination sequence numbers as a mechanism for determining freshness of routes and route loops prevention. On the other hand, DSR uses source routing and route caching, and doesn't depend on any periodic or time-based operations. Generally, we can conclude that in low mobility and low load scenarios, all three protocols react in a similar way, while with mobility or load increasing DSR outperforms AODV and DSDV routing protocols.

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