Routing Protocols of Mobile Ad-hoc Network MANET

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Abstract

Today persons sitting at either end of the world can speak with each other with the aid of wireless technology. Mobile ad hoc Network (MANET) is a type of wireless ad hoc network which is a collection of mobile devices that creates a random topology for communication. The advantage of MANET is that it does not require any central controller or base station. MANET is only a network in which devices work as a host as well as a router. Routing in ad hoc networks has become a popular research topic. There are several routing protocols developed for ad hoc networks. In MANET, it is a very difficult task to predict the performance of routing protocol under varying network conditions and scenarios. This review paper is discussing the three approaches of routing protocols such as Reactive (On demand), Proactive (table driven) and Hybrid routing protocols with their advantages and disadvantages.

Keywords: MANET; AD HOC; Reactive; Proactive; Hybrid;

1. Introduction

Routing refers to the process of route selection in a network to move a pack of data from the source to the destination. A routing protocol is created through a routing algorithm with a set of rules controlling the network operations. The major issue in MANET is the fact that routing protocols should be able to rapidly respond the topologic changes in the network. Routing protocols mainly are found in three forms as follows: Reactive, Proactive, and Hybrid.

Proactive (Table-driven) protocol:

Proactive protocols are also known as Table-driven protocols. Package changes are held in nodes periodically and each node presents a real image of the network and the routers update their tables from each node to the other one. This characteristic renders them the biggest advantage that this protocol is appropriate for the delay in sensitive applications. These results lead to increase traffic overhead and the reduction of the power. Also they consume a great deal of energy to distribute public periodical messages.

Routing protocols in MANET:

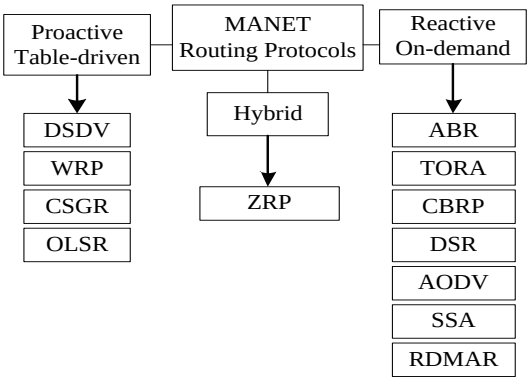

Fig.1. MANET routing protocols

Reactive (On-demand) Protocol:

Reactive protocol refers to a class of routing protocols for ad hoc networks designed to save energy. Reactive protocol works based on demand. This means that whenever a node needs to send its package, it searches for a new route from the source to the destination and sends the package through that route.

One of the greatest advantages of this protocol is its bandwidth efficiency. Routes created based on the demand reduce traffic overhead considerably unlike proactive protocols in which there are a lot of traffic overheads and bandwidth consumption and energy consumption. However, reactive protocols have some weak points such as primary delay in transferring the data because unlike the proactive protocols, the route is not active rapidly and there is a need to search for the proper route which results in unwanted delays for transferring the data.

Hybrid Protocol:

This protocol is a combination of the two proactive and reactive protocols. This protocol uses proactive routing to find the shortest route and reports the routing data only when there is a change in network topology. Each node has a routing zone in the network and routing data records are held in these zones (such as ZRP or zone routing protocol). In this research we briefly investigated about the major characteristics of four protocols below: AODV, DSDV, DSR, OLSR.

DSDV Protocol:

DSDV (Destination-Sequenced Distance Vector) is a proactive routing protocol or a table-driven routing protocol. DSDV algorithm is the reformed DBF which guarantees the least loop routes and supplies a unitary route towards a destination. It uses a distance vector to select the shortest route with the routing algorithm. In order to reduce the amount of transfer overhead through the network, two types of the updated packages are utilized. One is full dump and the other is progressive. A ‘full dump’ package carries all accessible routes’ data and the progressive package only carries the data related to the last full dump. Progressive updated messages mainly are sent through full dump packages. However, DSDV still introduces a great deal of overhead for the network to update messages periodically and such overhead is progressive. Therefore, this protocol is not used in a network extensively and utilizes a great deal of bandwidth in a network to do updating.

OLSR Routing Protocol:

OLSR (Optimized Link State Routing) is developed for MANET goals and is a proactive routing protocol or a table driven routing protocol. OLSR is a point to point routing protocol based on a common link-state algorithm. In this protocol, each node retains the topologic data of the networks and periodical changes of message exchanges in the form of link-state. OLSR is used to minimize the size of any controlling message and the resending number of nodes within each updating using multipoint relay or MPR. To do so, while each topology updating, each node selects a set of neighboring nodes in the network to resend its package. This set of nodes is known as MPR. Each node in the set is able to read and process each package but it is not able to resend it. Every node sends a list in each step (stage) using hello messages to its neighbors.

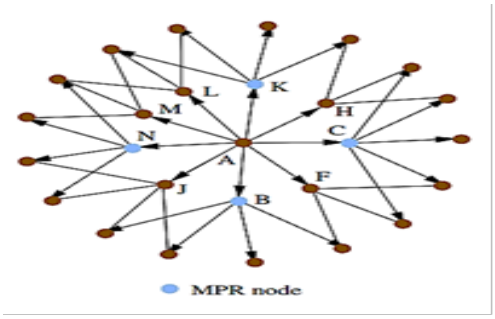

Fig.2. Studying the behavior of all operators with adaptive controllers

Each node selects a subset of step neighbors (hop) from among the list of nodes that have received hello message covered by both two neighboring nodes of the step. For example, in fig. 4, node A can select nodes B, C, K, and N to be among MPR nodes. Since these nodes cover all nodes containing two distant jumps, each node identifies an optimal route (regarding the steps) towards each predetermined destination using its topology data (through topology table and neighbor tables) and saves the data in a routing table. Therefore, routes to any destination is rapidly accessible to start data transfer.

AODV routing protocol:

AODV (Ad Hoc On-demand Distance Vector) routing protocol is a reactive protocol based on DSDV and DSR protocols. AODV utilizes periodical direction and sequence reduction of DSDV procedures and a DSR route discovery procedure. However, there are two major differences between DSR and AODV. The most outstanding difference is that in DSR, each package carries the complete routing data while in AODV, the package carries the destination address. This means that the routing overhead in AODV is less than DSR. The other difference is that DSR protocol carries the responses entered from each route in each node solely while in AODV, it carries only the destination address IP and the sequence number. An advantage of AODV is its high compatibility with dynamic networks. Meanwhile, the node may experience a long delay during routing and may link the unsuccessful routing to the successful discovered route.

DSR routing protocol:

DSR (Dynamic Source Routing) protocol is a reactive protocol. A DSR protocol requires package carrying completely from the source to the destination (each jump in the route) and this means that such a protocol will not be effective in big networks. For example, the amount of overhead of package carrying increases permanently. Therefore, in very big and dynamic networks, overhead may be higher than the consumed bandwidth. However, such a protocol has more advantages than other routing protocols such as AODV, LMR, or TORA and in medium to low networks (probably up to several hundred nodes), such a protocol may have a better performance.

One of the advantages of DSR is that nodes can save several routes within their route. This means that the source node can probe the pushing of a valid route before primary route discovery and if it finds a valid route there would not be a need to discover a route. This would be very useful for a network with low movements. Since their routes are saved in the route push, they would be valid. Another advantage of DSR is that they do not need any (exchange or hello message) direction. Therefore, nodes can enter sleep nodes to preserve their energy. This will save a considerable amount of bandwidth in the network.

Summary

The concepts of proactive and reactive routing will become clearer when we have a look at their differences. These differences are represented in table 5.

Table 1- Major features of Reactive routing protocols

Protocol	RS	Multiple routes	Beacons	Route metric method	Route maintained in	Route reconfiguration strategy
AODV	F	No	Yes, hello	Freshest & SP	RT	Erase route then SN or local route repair
DSR	F	Yes	No	SP, or next available in RC	RC	Erase route the SN

RS = routing structure; F = flat; RT = route table; RC = route cache; SP = shortest path; SN = source notification

Table 2- Major features of Proactive routing protocols

Protocol	RS	Number of tables	Frequency of updates	HM	Critical nodes	Characteristic feature
DSDV	F	2	Periodic and as required	Yes	No	Loop free
OLSR	F	3 (Routing, neighbour and topology table)	Periodic	Yes	No	Reduces CO using MPR

RS = routing structure; HM = hello message; F = flat; CO = control overhead;

Table 3- A comparison of complexities in Reactive routing protocols

Protocol	TC[RD]	TC[RM]	CC[RD]	CC[RM]	Advantage	Disadvantage
AODV	O(2D)	O(2D)	O(2N)	O(2N)	Adaptable to highly dynamic topologies	Scalability problems, large delays, hello messages
DSR	O(2D)	O(2D)	O(2N)	O(2N)	Multiple routes, Promiscuous overhearing	Scalability problems due to source routing and flooding, large delays

TC = time complexity; CC = communication complexity; D = diameter of the network; N = number of nodes in the network;

Table 4- A comparison of complexities in Proactive routing protocols

Protocol	CT	MO	CO	Advantages/disadvantages
DSDV	O(D.1)	O(N)	O(N)	Loop free/high overhead
OLSR	O(D.1)	O(N^2)	O(N^2)	Reduced CO and contention/2-hop neighbour knowledge required

CT = convergence time; MO = memory overhead; CO = control overhead; (1) = a fixed number of update tables is transmitted; N = number of nodes in the network; D = diameter of the network;

Table 5- A comparison of Reactive and Proactive routing protocols

Proactive Protocols	**Reactive Protocols**
Efforts to preserve is compatible. The routing data from any node to another node in the network tries to be updated.	The route is made when it is needed.
The delay of primary package is less compared with reactive protocol.	The delay of primary package is less compared with proactive protocol.
A route to each node in Ad-hoc network is always accessible.	It is not accessible.
It incurs a considerable traffic and power consumption which creates a lot of difficulties in mobile computers.	It does not have periodical updates. Control data are not in spread mode unless there is a change in topology.
The spread of routing data even when topology change does not occur.	There is considerable traffic and power consumption compared with proactive routing protocols not incurred.

The analyses of routing protocols are represented based on qualitative parameters in tables 6 and 7 for Reactive and Proactive routing protocols, respectively.

Table 6- A qualitative study of Proactive protocols

Parameters	**DSDV**	**OLSR**
Approach	Table Driven	Table Driven
Loop Freedom	Yes	Yes
Routing Scheme	Flat	Flat
Unidirectional Link Support	No	Yes
Security	No	No
Sleep	No	Yes
Multicasting	No	No
Routing Metric	Shortest Distance	Shortest Distance

Table 7- A qualitative study of Reactive protocols

Parameters	AODV	DSR
Approach	On Demand Routing	On Demand Routing
Loop Freedom	Yes	Yes
Routing Scheme	Flat	Flat
Unidirectional Link Support	No	Yes
Security	No	No
Sleep	No	No
Multicasting	Yes	No
Routing Metric	Shortest path	Shortest path

Qualitative parameters follow the characters in routing protocols. For example, regarding energy constrains, we select protocols that can work in sleep state too. In an environment where the links are bidirectional, accessibility would not be possible. We select a protocol that can work in the presence of a pair of unidirectional connection. Similarly, regarding multicasting features, safety and … we do the same.

However, we do not analyze protocols based on their performances. Performance assessment is done based on parameters such as delay, operational power, well application and … after simulations using tools such as NS-2, OPNET, and others.

Conclusion

MANET network was investigated regarding routing. Different routing protocols such as AODV, DSR, DSDV, and OLSR were investigated and analyzed qualitatively in a table format. This network is in progress but is threatened through issues such as safety attacks, and weak routing. Many research projects have been carried out and still there is a need for more investigations. The administration and implementation of MANET led towards networks such as wireless sensor networks and ad hoc networks of vehicles.

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