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Saba Journal of Information Technology and Networking (SJITN)

Review

Routing Protocols in Mobile Ad-hoc Networks

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Article info

Article history:

Accepted: September, 2017

Keywords:

Ad hoc network,
Routing protocol,
Proactive routing protocols,
Reactive routing protocols,
Hybrid routing protocols.

Abstract

Mobile Ad hoc networking is a concept that is considered as a collection of nodes which connect with each other without any aid of centralized administration or constant infrastructure. The nodes which connect in mobile Ad hoc network can be laptops and/or any personal digital assistants, which are often limited resources; such as CPU capacity, storage capacity, battery power and bandwidth. In MANET there are lots of challenges that may affect the process of connection between the nodes. One of these challenges is routing protocols through the communication between nodes, and because of the dynamic movement of nodes, the process of routing will be more difficult .The concept of routing protocols in Mobile Ad hoc network is the way of sending and receiving the packets between the source and the destination. In general the routing protocols are classified into three types. These are; proactive routing protocols, reactive protocols and lastly hybrid routing protocols. All routing protocols are used to manage, the process of routing through the connection of nodes in the MANET. In this paper we discuss the descriptions of different routing protocols in mobile Ad hoc networks.

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1. Introduction

MANET [1] is a group of mobile nodes that communicate with each other independently by radio waves. The mobile nodes which are in domain of a radio can be communicated with each other directly, while others need the help of intermediate nodes to route their packets. In MANET the node connects with other nodes directly without any aid of centralized administration or constant infrastructure like a base station or an access point. As shown in the (Figure 1) the node 2 will be in the middle range between two nodes 1 and 3, both nodes cannot connect with each other directly because they are not located in the same range, so the node 2 will be a common node that allows nodes 1 and 2 to connect with each other. Node 2 in this situation can be considered as a router and these three nodes altogether compose an Ad-hoc network.

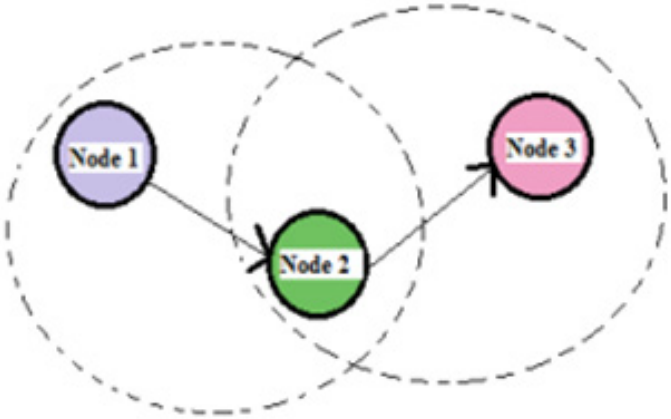

Fig. 1 Example of mobile ad-hoc network

2. Classification Of Current Routing Protocols

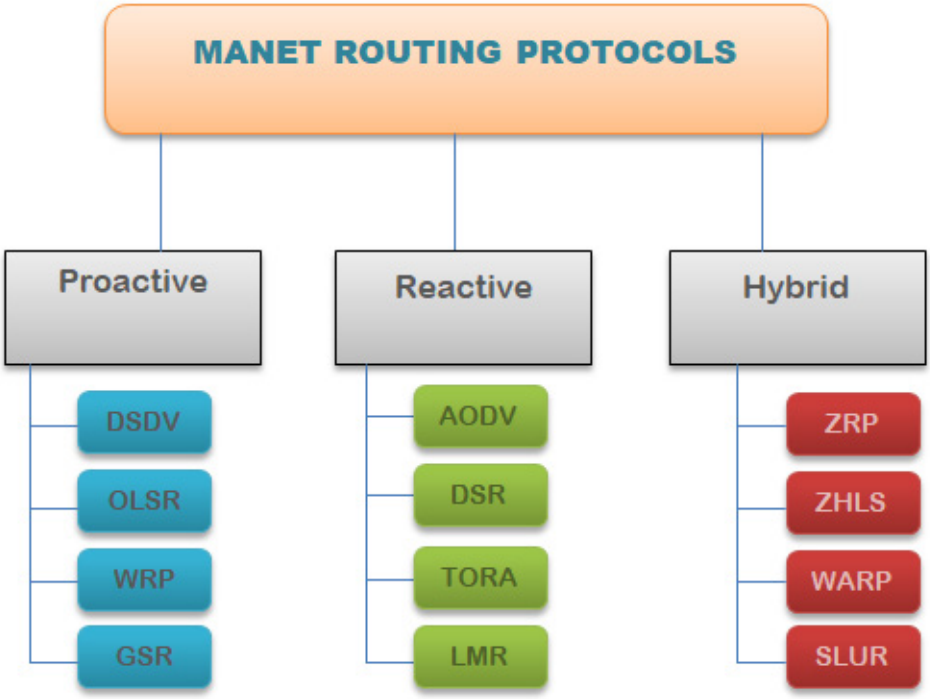

Fig. 2: Classification of routing protocols

A routing protocol [2] will be required when the source needs to transfer the data packet to the destination, by the intermediate nodes. There are many protocols proposed for this kind of communication through the Ad hoc network. The routing protocol is used to find the optimal path and deliver the packet data to the right destination. The study of different routing protocols in mobile Ad hoc network became very active in the process of research for many years. As shown in (Figure 2) there are three types of routing protocols in MANET and which can broadly be classified as [3].

2.1 Proactive routing (Table-Driven) Protocols

In these protocols, the nodes will update the routing information continuously within a network. Each node preserves the entire topology of the network and has the ability to connect with any other node. The routing information table in each node will be updated regularly, so the necessity of routing is required, and the path will be known already. When any node requires the communication with other nodes, the connection throughout the network will be available, and that will make a short latency. When there are a lot of nodes movements in the network, maintaining the route information in the topology will be high.

2.2 Reactive Routing (On-Demand) Protocols:

Unlike the proactive routing, the reactive routing protocols collect the information of route whenever it is required. The route decision will be taken depending on the source, when the source sends the Route Request throughout the network. So whenever the source needs the path of destination, it sends the request query and finds the destination in the network. The destination sends the query back to the source, and this process will make a high latency, however, no important control messages are required.

2.3 Hybrid routing Protocols:

These protocols commingle the terms of proactive and reactive routing protocols as well. The nodes in the network will be collected into zones based on the distance from each other or geographical locations. The routing in the single zone will be held using proactive mechanism, while reactive routing will be utilized for routing beyond the zone limits.

3. Description Of Proactive Protocols

3.1 Proactive Routing Protocols

The nodes in the network [4] contain their own routing tables, and each node broadcasts the data packet as well as starts the establishment connection, with all other nodes throughout the topology of network. Each node maintains the presented destination of all other nodes in the network and has the ability to connect with them; numbers of hops are required to reach the destination in the routing table. The proactive protocols are: Destination-sequenced distance vector (DSDV), Wireless routing protocol (WRP), Global state routing (GSR), and Fish eye state routing (FSR).

3.2 Destination-sequenced distance vector (DSDV)

DSDV [5] is a proactive routing protocol for MANET, and it is used to find a single path from the host to the destination based on an Algorithm called Bellman-Ford. This algorithm helps to disband the issue of the routing loop in the network. Each node in the network saves its own routing table. The Content of the routing table in DSDV contains the destination number of hops and the sequence number produced by the destination. The DSDV routing protocol requires all nodes in the topology of the network to share their routing table with each other. The process of sharing can be by broadcasting or multicasting. When they communicate with each other, each node will be able to determine the other routing tables and have a chance to connect with them, and any update that might occur in the topology of network will be maintained in the routing table of each node.

3.3 Optimized Link State Routing (OLSR)

The OLSR [6] is improvement of the clear link state protocols that decreases the size of control packets as well as the number of control packet transmissions required. The key notion of OLSR is the Multipoint Relays (MPRs); this concept in OLSR is used to diminish the control of traffic overheads. The connotation of Multipoint Relays is a node's one-hop neighbor which has been chosen to forward packets, instead of clear overflowing of the network, the packets are sent by the nodes MPRs. That will restrict the overhead in the network and make it be more efficacious

than clear link state routing protocols. The usage of MPRS in the OLSR will give it the ability to be convenient for large and intense mobile networks.

3.4 Wireless routing protocol (WRP)

WRP [7] is considered as a proactive routing protocol because it saves distance table, routing table, link cost table, and lastly maintains message transmission list (MRL) to avert the looping of a provisional routing. The WRP routing protocol uses the process of updating message transmission to neighbor nodes. When the node has the update, it should inform others in the network as well as forward an acknowledgement. The node can only have a chance to make the decision; whether to update or not, after receiving the update message from the neighbor. The WRP routing protocol is also used to select the best path from the source to destination. When the node finds the best path, it sends the reply message, then, the source will update its message transmission list (MRL).

3.5 Global state routing (GSR)

In GSR protocol [8] the idea is comparable to the DSDV routing protocol. The GSR is based on link state routing protocol, but the distinction is that the GSR protocol progresses by evading the overflow of routing messages. Each node in GSR routing algorithm preserves a Neighbor list, a Topology table, a Next Hop table, and a Distance table. The list of Neighbor in each node will contain the list of its Neighbors as well. The destination of each node of the topology table will contain the information of link state as notified by the destination, and the time stamp of information. Within each node destination in the network, the next hop table contains the next hop to which the packets for this destination must be transmitted.

4. Description Of Reactive Protocols

4.1 Reactive Routing Protocols

Reactive routing protocols [9] are designed to defeat the wasted effort in maintaining routes that are unused. The routing discovery will initiate when there is need for it, and will save the overhead of maintaining unused routes at each node. On the other hand, the latency forwarding data packets will increase. Reactive routing protocols overflow through the topology of networks until a destination is found. They are not perfect in term of bandwidth utilization, but they are scalable in the frequency of topology change. This strategy is appropriate for High Mobility networks.

These protocols [10] act when the host sends the date through the network topology. The first step will be taken by the decision procedure to the destination node, and connection will be established between the nodes to take the decision procedure. The source node will request the packet by overflow through the topology of network. The overflowing process is a dependable method of spreading the information over the network. Some of the reactive protocols are: Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA),Light-weight mobile routing (LMR),Associativity-based routing (ABR),Signal stability adaptive (SSA),Location-aided routing (LAR), and Ant-colony-based routing algorithm (ARA).

4.2 Ad hoc On-Demand Distance Vector (AODV)

AODV [11] is a combination of DSDV and DSR. It is the process of sharing the feature of route discovery in DSR, to find the path of destination .AODV selects conventional routing tables; one entry per destination but in the DSR there is contrast because it preserves multiple route cache entries for each destination. The design of AODV was early undertaken after experiment with DSDV protocol. When the link is broken in the network, the AODV provides free loop route like DSDV but AODV doesn't need global route advertising periodically. The AODV routing algorithm discovers the route of the destination and then receives a unicast reply route message.

4.3 Dynamic Source Routing (DSR)

DSR [12] is a reactive routing protocol which is based on the source routing. The source broadcasts the packet to its neighbors that by turn forward the packet to the next hop until it reaches the destination. The DSR depends on two processes: the first one is routing discovery. When the source wants to find the path to destination, it initially checks the route cache. If the path of destination is not available in the route cache,

then a source node will start the process of route discovery again to find the optimal destination. If a source knows the Packet already, it will be cancelled. Otherwise, the route looks up its route caches to find a route to destination. If it's not found, it supplements its address into the packet, for rebroadcast. If a route is found in its route cache, then it will send a route reply packet, which is sent to the source by route cache or the route Discovery. The second is route maintenance. When the source route forwards the packet, the intermediate nodes responsible for transmission will be in charge to preserve the route, and will confirm that the packet has been received by the next hop along the source route.

4.4 Temporally Ordered Routing Algorithm (TORA)

TORA [13], the key merit of this protocol is the way of interaction with link failure by deleting the invalid routes in the network; it looks for a new route and builds it in a single pass of distributed algorithms. TORA routing algorithm has three main functions, they are: Route Creation, Route Maintenance and Route Erasure. The first function Route Creation uses the process of transforming an undirected network into a DAG (Directed Acyclic Graph) at a destination by specifying the directions to the link. And the second function Route Maintenance will be used to invert some of the link failures that happen due to which, some nodes lose all paths to destination. And finally the Route Erasure process deletes all routes in partitions that do not have the destination.

4.5 Light-weight Mobile Routing (LMR).

The LMR protocol [14] is used as an overflowing technique to decide its routes .The nodes will save multiple routes to each required destination. This will increase the accuracy of the protocol to give the nodes a chance to choose the next available route to a specific point, without initiating a route discovery procedure. In LMR each node will only preserve the information of routing to their neighbors. That will help avoid extra delays and storage overheads associated with maintaining complete routes. LMR may also provide temporal invalid routes, which define extra delays in deciding a right loop.

5. Description Of Hybrid Protocols

5.1 Hybrid Routing Protocols

Hybrid Protocols [15] are the integration of both previous routing protocols, proactive and reactive. The hybrid routing protocols are proposed to minimize the control overhead in table-driven (proactive) routing protocols as well as to diminish the latency in On-demand (reactive) routing protocols. The topology of network in hybrid routing protocol is zone or region based. The process of transmitting data within the region is simply pursuing proactive routing protocols, and if the procedure of data transmission happens between diverse zones or regions, it is fulfilled through reactive routing protocols. Some of Hybrid protocols are: Zone Routing Protocol (ZRP), Zone-based Hierarchical Link State (ZHLS), Scalable Location Update Routing Protocol (SLURP), and Distributed Spanning Trees based routing protocol (DST).

5.2 Zone Routing Protocol (ZRP)

ZRP [16] was deemed as the first Hybrid Routing algorithm with both table-driven (proactive) routing protocols and on-demand (reactive) routing protocols. The purpose of zone routing protocol is to minify the control overhead of table-driven (proactive) routing protocols, as well as to diminish the latency that is caused by the routing discovery in on-demand (reactive) routing protocols. ZRP is constructed of two sub-protocols; Intra-zone Routing Protocol (IARP) which is considered as a proactive routing protocol and it is utilized inside the routing zones. The second sub-protocol is Inter-zone Routing Protocol (IERP) and it is a reactive routing protocol. The IERP sub-protocol is used between routing zones.

5.3 Zone-based Hierarchical Link State (ZHLS)

ZHLS [17] is another proactive routing protocol. Each mobile node in ZHLS will presume that it knows its physical location with the help from the system location like GPS. The network in this protocol will be split into non-overlapping zones based on geographical information. ZHLS utilizes a hierarchical addressing scheme that consists of zone ID and node ID. A node selects its zone ID according to its location and the pre-defined zone map is well known to all nodes in the topology of a network. It is supposed that a virtual

link relates two zones if at least one physical link exists between the zones. A two-level network topology structure is defined in ZHLS, the node level topology and the zone level topology. Respectively, there are two kinds of link state updates; the node level LSP (Link State Packet) and the zone level LSP. A node level LSP contains the node IDs of its neighbors in the same zone and the zone IDs of all other zones.

5.4 Wireless Ad hoc Routing Protocol (WARP)

WARP [18] is a Hybrid Routing Protocol. This routing algorithm has the same concept like ZRP but the only difference is that it has a supplementary enhancement advantage than the ZRP routing protocol, and that feature is the Quality of Service (QOS). The routing discovery and route maintenance in WARP will be executed by using user datagram protocol (UDP). In WARP, the term Neighbor Discovery Protocol (NDP) is utilized to locate one hop neighbor. Another term used in WARP is Proactive Routing Protocol (PRP) and it is a timer based link state routing protocol. The WARP routing algorithm provides obvious source routing, which supply End to End the Quality of Service support.

5.5 Scalable Location Update Routing Protocol (SLURP)

SLURP is similar to ZLHS in concept of the nodes that are regulated into a number of non-overlapping zones. SLURP is another proactive routing protocol which has the ability to adapt with changes that occur in the node consistency and mobility. This routing algorithm utilizes the GPS information to administer the location of the node and remove global routing. Each node in the network will be correlating with a home zone and forward its new location to its home zone as it moves. Hence, the only host node has to query the home zone of the destination when the route is desired. The SLURP routing protocol is appropriate for massive networks where the mobility of nodes are elevated [19, 20].

6. Conclusion

MANET is considered as a new technology that has a great application in the new arena of Telecommunication, Internet Systems, and Internet mobility. The concept of routing protocols has a large impact on wireless topology of network and mobile Ad hoc networks. The appropriate selection according to the network will increase and support its credibility and scalability. This article studies different routing protocols for MANET, which are broadly categorized as proactive, reactive and Hybrid protocols. In proactive routing protocols the nodes will update the routing table constantly within a network that will let all the nodes throughout the topology of network to recognize each other, and will be easier to find any destination node. But this process of communication will increase the packet overhead which reduces the network performance. The reactive routing protocols create the route when the source needs to forward the packet data. The route discovery overflows within the network to find the optimal path, but the process of flooding in the network will be more overhead. Finally, hybrid routing protocols are commonly deemed as integration of both previous protocols (proactive and reactive), with a latency more than that of the proactive protocols [21].

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