A Review of Routing Protocols for MANETs and AEERP

Arjun Krishnappa

Electrical and Computer Engineering, University of Dayton, Dayton, OH 45469

Abstract – *Different routing protocols (such as DSDV, DSR, AODV) for mobile ad-hoc networks (MANETs) are discussed. Applications, strengths, and weakness for the routing protocols are studied. The limitations of Efficient power aware routing (EPAR) are shown. To overcome the limitations of EPAR, this research paper presents a distinct protocol "Average energy efficient routing protocol (AEERP)." The applications, strengths, and weakness for both EPAR and AEERP are looked at.*

***Key Words*: DSDV, DSR, AODV, EPAR, AEERP.**

1. INTRODUCTION

Wireless Networks is a technology that allows users to access information electronically regardless of their geographic position. There are two types of wireless networks: infrastructure and infrastructureless (ad hoc) networks. Infrastructured network consists of a network with fixed gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. In ad hoc networks, all nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. (Nodes communicate directly with the neighbors when they are within the communication range, or else neighboring nodes are used as a router, which is called as multihop communication.) Routing protocols are necessary in order to deliver the message efficiently [7].

2. Destination-Sequenced Distance Vector Routing (DSDV)

Each mobile station maintain all the route in the routing table. The station does not need to find any route. The routing table contains description of all the available routes. The routing table lists all available destinations, the number of hops to reach the destination, and the sequence number assigned by the destination node. The sequence number is generated by the destination, which should be used by the sender to send any update. The sequence number is even if the link is not absent, otherwise it is odd. The update is time-driven and event-driven. The routing tables are updated periodically and updated if there is any change in the topology [5] [6].

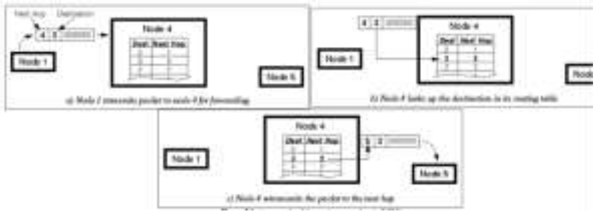

Fig-1: DSDV Routing [1].

Applications

- It is not preferable for highly dynamic networks, because the neighboring nodes have to be updated frequently, which consumes more power in the network.
- As it does not need to find any route, there is no delay to send any packet.

Strengths

- End to end delay is lower in DSDV.
- DSDV maintains only best paths to a destination, in routing table. Because of which, space consumed by routing table is reduced.
- Link breakage does not interrupt the data communication.

Weakness

- It requires periodic updating of routing tables, which uses up battery.
- For larger network, it is difficult to maintain routing table.

3. Dynamic Source Routing (DSR)

In this routing technique, the sender determines the complete sequence of nodes through which the packet has to pass. The sender explicitly lists this route in the packet's header. This protocol has route discovery process. When the source node wants to send any packet, it looks up its route cache to see if it already contains the route to the destination. If the route that is not expired exists, then it uses this route. If the node does not have such a route, then it initiates the route discovery process. It broadcasts a route request packet. The route request packet contains the address of the source and the destination. Each intermediate node checks if it knows the route to the destination. If it does not know, it appends its address to the route record of the packet and forwards the packet to its neighbors. To limit the number of route requests propagated, a node processes the route request packet only if it has not already seen the packet and it's address is not present in the route record of the packet. A route reply packet is generated when the packet reaches the destination. Once the route reply packet reaches the source node, the source node uses the route in the route reply packet to transmit a message [5] [6] [7].

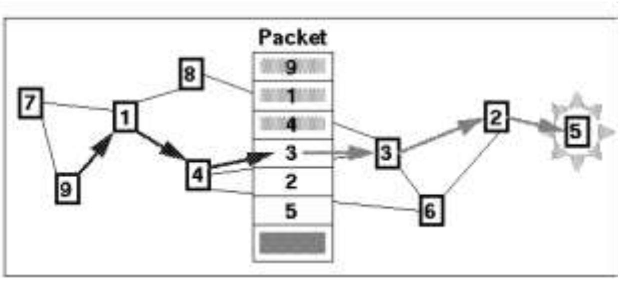

Fig-2: DSR Routing [1].

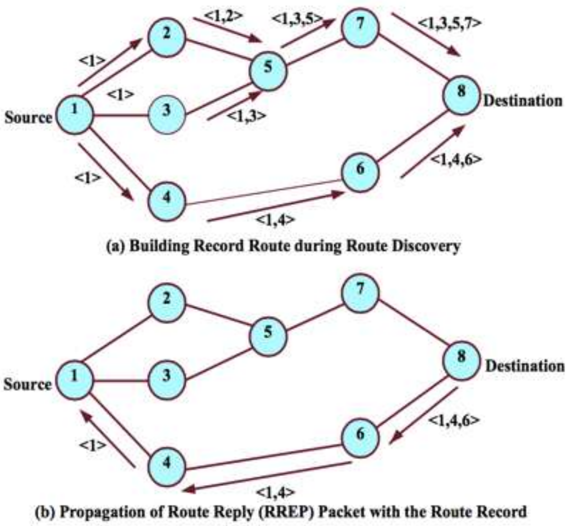

Fig-3: Route Discovery Process [2].

Applications

- It is not preferable for large networks, because the overhead could consume most of the bandwidth.

Strengths

- DSR does not need any periodic updating like DSDV.

Weakness

- For larger network, it is not applicable.
- End to end delay is higher than DSDV.
- Routing load is higher in DSR.
- It needs an additional step (Route discovery) in finding the route.

4. Ad hoc on-demand Distance Vector Routing (AODV)

This routing is a combination of DSDV and DSR. From DSDV it uses routing table, whereas from DSR it follows route discovery process. When the source node wants to send any packet, it initiates route discovery process. It broadcasts a route request packet. The route request packet contains the address of the source and the destination. Each intermediate node checks if it knows the route to the destination. If it does not know, it appends its address to the route record of the packet and forwards the packet to its neighbors. To limit the number of route requests propagated, a node processes the route request packet only if it has not already seen the packet and it's address is not present in the route record of the packet. When a node forwards the route request packet to its neighbors, it records in its table the node from which the route request packet came. A route reply packet is generated when the packet reaches the destination. Once the route reply packet reaches the source node, the source node uses the route in the route reply packet to transmit a message. The benefit over DSR is that route does not need to be included with each packet [5] [6] [7].

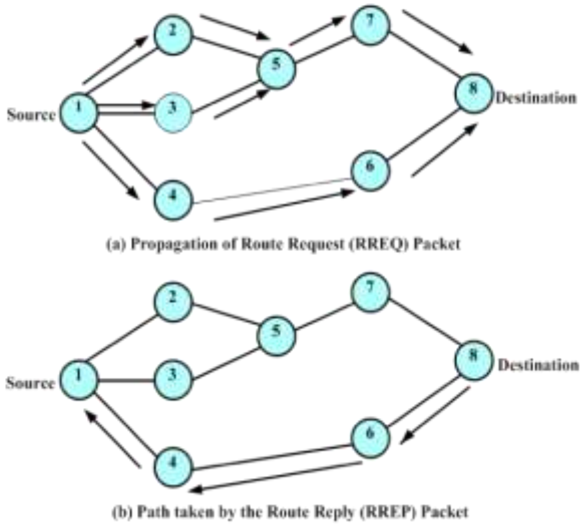

Fig-4: AODV routing [2].

Applications

- It is preferable for large networks, because of the absence of overhead.

Strengths

- In DSR, the whole route is carried with the message as an overhead, whereas in AODV, the routing table is maintained.
- End to end delay is lower in AODV when compared to DSR.
- Routing load is lower than DSR.

Weakness

- It needs an additional step (Route discovery) in finding the route.

5. AODV-based Secure Routing against Blackhole attack

Black Hole Attack

An internal or external node can launch this attack. When a route discovery process starts and if attacker node is present in the network, on receiving RREQ message, attacker will send a false RREP message. This false RREP message reach the source node ahead of other ones because attacker will send that without checking its route table. This RREP claims to have the shortest route to the destination. The source node selects this path and send data packets. The attacker node simply drops these packets after receiving the data packets [3][8].

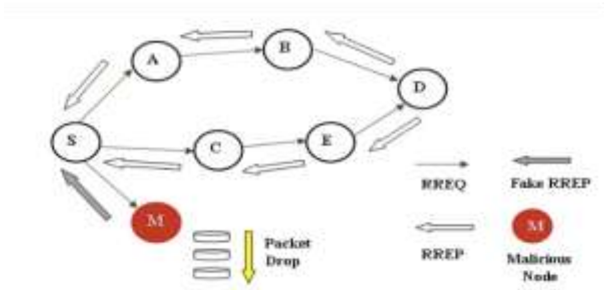

Fig-5: Black Hole Attack [3].

AODV-based Secure Routing

In this protocol, an additional field for validity value is used in RREP message of AODV protocol. The routing table consists of the validity value field. Each time a node receives a route reply packet, it will process that only if the validity bit in the RREP is set. Attacker will not be aware of the validity field, he will reply without looking in its routing table. As a result, the bit has null value [3].

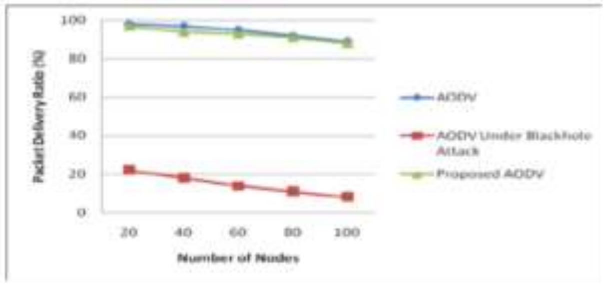

Fig-6: Comparison of packet delivery ratio [3].

Applications

- The network where secured transmission of data is required.

Strengths

- Prevents Black Hole Attack.
- Improves the packet delivery ratio.

Weakness

- As the number of nodes increases, the average end to end delay.

6. Energy Routing Protocol with Power Utilization Optimization in MANET

The DSR picks up the route using the minimal number of hops, but efficient power aware routing (EPAR) selects the route using the energy. The protocol selects the route which has the highest power at nodes and will take the lowest power to transmit the packet. For that, distance between each node and energy of each node are calculated. Neighbors of a source are found. The coordinates of the neighbors are determined. The corresponding node for the sorted distance value following by finding the next hop node is found. Then router is found out. The hop count of each path is calculated. Therefore, the total energy of each path is found. The max-min formulation for the selected paths is applied.

For example, suppose there are two routes, the first path has an energy of three hops with value 15, 26, and 90. And the second route has an energy of four hops with value 34,20, 45 and 80. The minimum battery power of the first route is 15 while the minimum battery power of the second route is 20. Since 20 is more prominent than `15, the second route would be picked [4][7].

Applications

- Network where the lifetime of the nodes is high.

Strengths:

- EPAR consumes less power than DSR.
- The lifetime of a network is longer than DSR.
- The delay in EPAR is less compared to DSR.
- Routing load is lower than DSR.

Weakness

- With bigger network size, the execution of EPAR is difficult.

7. Average Energy Efficient Routing Protocol for MANETs (AEERP)

To improve the lifetime of nodes in MANETs, the power consumption for moving the packets should be minimized. The nodes are operated by battery. As the energy stored in the battery is limited, the communication between nodes is broken when the nodes run out of the energy. The energy efficient routing protocols, in the previous research, considered the following parameters: Energy in a route, Energy required for the transmission, and the number of hops. In order to improve the previous protocols, this research paper has proposed a new protocol called "Average Energy Efficient Routing Protocol for MANETs (AEERP)." The main concept underlying this technique is that the routes are considered based on the average energy in any given route. If the average energy is more when compared to the other routes, then the route is selected.

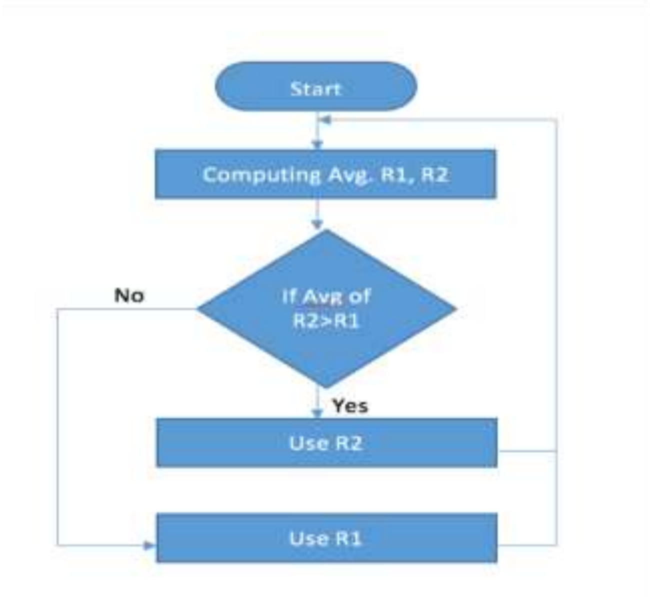

Fig-7: Flow Chart for AEERP.

For example, suppose there are two routes, the first path has an energy of three hops with value 15, 26, and 90. And the second route has an energy of four hops with value 34,20, 45 and 80. The average energy of the first route (R1) is 43.66 (131/3) while the average energy of the second route (R2) is 44.75 (179/4). So R2 would be picked. In EPAR, the minimum battery power of the first route is 15 while the minimum battery power of the second route is 20. Since 20 is more prominent than`15, the second route would be picked. In both the protocols, R2 is picked but using different process. In EPAR to calculate the minimum power, the energy at the nodes should be compared with one another. The algorithm for calculating the minimum value or maximum value in a given list is complex when compared to that for computing the average. For larger networks, the size of the list is large. So computing average value consumes lesser power than computing the minimum value.

Applications

- High energy networks.
- Large networks.
- Average Energy at any given route is the same.

Strengths

- Computation in selecting the routes decreases.
- Energy efficient.

Weakness

- For networks having very low energy is not applicable.

8. CONCLUSION

Different routing protocols (such as DSDV, DSR, AODV) for mobile ad-hoc networks (MANETs) are discussed. Applications, strengths, and weakness for the routing protocols are studied. The limitations of Efficient power aware routing (EPAR) are shown. To overcome the limitations of EPAR, this research paper presents a distinct protocol "Average energy efficient routing protocol (AEERP)." The applications, strengths, and weakness for both EPAR and AEERP are looked at.

REFERENCES

[1] http://ghost.lesiuk.org/AdHoc/adhoc/- I43

[2] S. Naing, Z. Naing and H. Tun, "Performance evaluations and comparisons of routing protocols in MANETs," JSETR 1, 1-6, (2012).

[3] S. Deshmukh, P. Chatur, and N. Bhople, "AODV-Based secure routing against blackhole attack in MANET," RTEICT, 1960-1964, (2016).

[4] N. Bhople and J. Waghmare, "Energy routing protocol with power utilization optimization in MANET," 1371-1371, (2016).

[5] A. Sharma and R. Kumar, "Performance comparison and detailed study of AODV, DSDV, DSR, TORA and OLSR routing protocols in AD HOC Networks," PDGC, 732-736, (2016).

[6] T. Ali, L. Khalil and Y. Majeed, "Review and performance comparison of VANET protocols: AODV, DSR, OLSR, DYMO,DSDV and ZRP," AICMITCSA, (2016).

[7] S. Dodke, D. Mane, and M. Vanjale, "A Survey on energy efficient routing protocol for MANET," iCATccT, 160-164, (2016).

[8] S. Shah and R. Jhaveri, "A trust-based scheme against packet dropping attacks in MANETs," iCATccT, 68- 75, (2016).