International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.2, 2015

RESEARCH ARTICLE

ISSN: 2321-7758

COMPARATIVE ANALYSIS OF EFFICIENT PACKET TRANSMISSION PROTOCOLS FOR WIRELESS SENSOR NETWORKS

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Article Received: 28/02/2015

Article Revised on:05/03/2015

Article Accepted on:07/03/2015

ABSTRACT

Routing in MANET is a critical task due to highly forceful atmosphere. A routing protocol is needed whenever a packet needs to be transmitted to destination via number of nodes and numerous routing protocols have been proposed for ad-hoc network. The impact of both reactive as well proactive type protocols are analyzed by increasing the nodes in the network. The performances of the routing protocol have been analyzed to progress and select efficient routing protocol for network setup and it is designing for practical scenario. The performance matrix includes throughput, packet delivery ratio and packet delay.

Keywords: MANET, ad-hoc network, proactive, reactive, throughput

INTRODUCTION

A Mobile ad-hoc network is a self-configuring infrastructure less network. The main test in building a MANET is equipping each device to continuously maintain the information. Such networks may be connected to larger Internet. MANET'S are a kind of wireless ad-hoc networks that usually has a routable networking environment on top of a Link Layer ad-hoc network.

There are several ways to study MANET'S. One solution is the use of simulation tools like OPNET, Netsim and NS2. Our goal is to carry out a systematic performance study of five routing protocol for ad-hoc networks such as Ad Hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Destination Sequenced Distance Vector (DSDV),Ad Hoc On-Demand Multipath Distance Vector (AOMDV) and Optimized Link State Routing (OLSR).

Mobile Ad hoc Network is an autonomous system of mobile nodes connected by wireless devices. Every node operates as an end system and a router for all other nodes in the network. An Ad hoc network is often defined as an "infrastructure less" network means that a network without the usual routing infrastructure, link fixed routers and routing backbones. However, following protocols that is used for mobile ad-hoc networks.

2. ROUTING PROTOCOLS IN MANET

2.1 On-Demand (Reactive Routing)

This type of protocols finds a route on demand[3] by flooding the network with Route Request Packets. It does not maintain a routing table. Each node in a network discovers or maintains a route based on-demand. The main advantage is that this protocol needs less routing information but the disadvantage are that produces huge control packets due to route discovery during topology changes which occurs frequently in MANET'S and it has higher latency. Eg: AODV, DSR and AOMDV

2.2 Table-Driven (Pro-Active Routing)

This type of protocols maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. It maintains a routing table. Each node in a network maintains one or more routing table which is restructured frequently. Each node sends a broadcast message to the entire network if there is a change in the network topology. Additional overhead cost due to maintaining up-to-date information and as a result; throughput of the network may be affected but it provides the actual information to the availability of the network.

This routing protocol maintains special number of tables. The proactive protocols are not fitting for superior networks, as it need to keep up node entries for all and every node in the routing table of every node. This causes added overhead in the routing table leading to utilization of more bandwidth. Eg: DSDV and OLSR

2.3 Ad hoc On-Demand Distance Vector (AODV) Routing Protocol

AODV is a reactive routing protocol which is basically a combination of DSR and DSDV algorithms. It uses the advantageous feature of both these algorithm. Dynamic, self-starting and multi-hop routing is allowed between participating mobile nodes. The basic on demand routing mechanism of route discovery and route maintenance of DSR and the use of hop by hop routing sequencing number and periodic update packets of DSDV are both available in AODV. It employs destination sequence numbers to identify the most recent path. In AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission

Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs) are message types defined by AODV

Route Discovery

A source node send a broadcast message to its neighboring nodes if no route is available for the desired destination containing source and destination address, source and destination sequence number, hop count and broadcast ID. Two pointers such as forward and backward pointer are used throughout route discovery. Forward pointers keep track of the intermediate nodes while message being forwarded to destination node. Finally, while route request message reached to the destination node, after that it unicast the reply message to the source node via the intermediate nodes and the backward pointer keeps track of the nodes.

Route Maintenance

Three types of messages exchanged between source and destination such as hello message, route error message and time out message. Route error message ensures that this message will be transmit to all nodes since while a node observes a unsuccessful link, it will spread this message to the upstream nodes towards source node. Hello message ensures the forward and backward pointers as of conclusion. Time out message guarantees the removal of link as there is no activity for a certain amount of time among source and destination node. **Advantages**

It is an efficient algorithm for mobile ad-hoc networks and it is scalable. It takes short time for convergence and is a loop free protocol. Messaging overhead to announce the link failure is less compared DSR. Lower setup delay for connections and detection of latest route to the destination. Its adaptability to highly dynamic networks and reduced overhead.

Disadvantage

It requires periodic updates. If the source sequence number is very old it leads to inconsistent routes. Unnecessary bandwidth consumption occurs in response to periodic beaconing.

2.4 Dynamic Source Routing (DSR) Protocol

DSR is an on demand routing protocol[4] in which a sender establish the exact sequence of nodes during which a packet is disseminate. The packet header contains a list of transitional nodes for routing. Route cache is maintained by each node which caches the source route that it has educated.

The major components of DSR are “Route Discovery” and “Route Maintenance” which work together for determining and maintaining routes to arbitrary destinations It is designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages mandatory in the table-driven progress. A route is recognized by torrent Route Request packets in the network

Route Discovery

The transmitting node search its route cache to see whether nearby is a valid destination exists and if so, then the node starts transmitting to the destination node and the route discovery procedure end at this point. If there is no destination address afterward the node broadcasts the route request packet to achieve the destination. When the destination node acquires this packet, it returns the academic path to the source node.

Route Maintenance

It is a process of broadcasting a message by a node to all other nodes informing the network or node failure in a network. It provides a premature discovery of node or link failure since wireless networks utilize hop-to-hop acknowledge.

Advantages

Aware of existence of alternative paths that helps to find another path in case of node or link failure. It avoids routing loops. Less maintenance overhead cost as it an on-demand routing protocol. A route is established only when it is required.

Disadvantages

The connection setup delay is higher than in table-driven protocols. It is not suitable for large number of nodes where speed may suffer.

2.5 Destination-Sequenced Distance-Vector (DSDV) Routing Protocol

Destination-Sequenced Distance-Vector Routing (DSDV) [4] is a table-driven routing scheme for ad hoc mobile networks. It eliminates route looping, enlarges convergence speed and condense control message overhead. In DSDV, every node maintains a next-hop table, which it interactions with its neighbors.

There are two types of next-hop table exchanges: Periodic full-table broadcast and event-driven incremental updating. The comparative occurrence of the full-table televises and the incremental updating is determined by the node mobility. In every data packet send during a next-hop table relay or incremental updating, the source node appends a sequence number. This sequence number is propagated by all nodes getting the corresponding distance-vector updates, and is stored in the next-hop table admission of these nodes.

A node, behind receiving a new next-hop table starting its neighbor, updates its route to a destination only if the new sequence number is larger than the recorded one or if the new sequence number is the similar as the recorded one but the new route is shorter. In order to add reduce the control message overhead, a settling time is expected for each route.

A node updates to its neighbors with a new route only if the settling time of the route has expired and the route ruins finest.

Advantages

This protocol guarantees loop free path. Count to infinity problem is reduced in DSDV. Avoid extra traffic with incremental updates instead of full dump updates.

Disadvantages

Wastage of bandwidth, not support for larger network and wastage of battery power.

2.6 Ad hoc On-Demand Multipath Distance Vector (AOMDV) Routing Protocol

Along with the on-demand protocols[3], multipath protocols have a moderately superior capability to reduce the route discovery frequency than single path protocols. On demand multipath protocols find out multiple paths involving the source and the destination in a single route discovery. A new route discovery is needed only when all these paths are unsuccessful. In difference, a single path protocol has to appeal to a new route discovery whenever the only path from the source to the destination fails.

Thus, on-demand multipath protocols root fewer interruptions to the application data traffic when routes fail. It also has the potential to lower the routing overhead since of fewer route discovery operations. AOMDV is based on a prominent and well-studied on-demand single path protocol known as AODV.AOMDV extends the AODV protocol to discover multiple paths between the source and the destination in every route discovery. Multiple paths so computed are guaranteed to be loop-free and disjoint.

2.7 Optimized Link State Routing OLSR Protocol

OLSR[1] is an IP routing protocol optimized for mobile ad-hoc networks, which can also be used on other wireless ad-hoc networks. OLSR is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad-hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths.

3. SIMULATION BASED ANALYSIS USING NETWORK SIMULATOR (NS-2)

From the simulation, described about the tools and methodology used to analysis the ad-hoc routing protocol performance i.e. about simulation tool, simulation Setup(traffic scenario, Mobility model) performance metrics used and in conclusion the performance of protocols is represented by using excel graph.

3.1 Simulation Tool

The simulation tool used for analysis is NS-2. NS is a discrete event simulator embattled at networking research. NS provides substantial sustain for simulation of TCP, routing and multicast protocols over wired and wireless (local and satellite) networks. NS is an object oriented simulator, written in C++, with an OTCL interpreter as a frontend. NS meets both of these needs with two languages, C++ and OTCL. C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTCL runs much slower but can be changed very quickly, making it ideal for simulation configuration.

In NS-2, the frontend of the program is written in TCL. The backend of NS-2 simulator is written in C++ and when the TCL program is compiled, a trace file and NAM file are created which define the movement pattern of the nodes and keeps track of the number of packets sent, number of hops between 2 nodes, connection type at each instance of time.

3.2 Simulation Setup

NS version	Ns –allinone-2.29
Traffic	CBR(Constant Bit Rate)
CBR Packet size	512 bytes
Mobility model	Random Way point mobility
Antenna Type	Omni Antenna
Channel Type	Wireless channel
Propagation Type	Two ray ground
MAC layer Protocol	IEEE 802.11
Routing Protocol	AODV,DSR,DSDV,AOMDV, OLSR
CBR Rate	100Kb
CBR Interval	0.1

3.3 Performance Metrics Used

Packet delivery ratio

It is a ratio of the number of packets received by the destination to the number of packets send by the source

End to end delay

It is defined as the time for a data packet which is received by the destination minus the time for a data packet which is generated by the source

Throughput

It is a ratio of the number of packets received by the sink to the number of packets sent by the source.

4. SIMULATION RESULTS

TABLE 1; Nodes vs Packet Delivery Ratio

NODES	AODV	DSR	DSDV
20	96.0082	99.876	64.9949
30	100	100	90.8905
40	99.4882	100	100
50	99.8976	100	64.6878

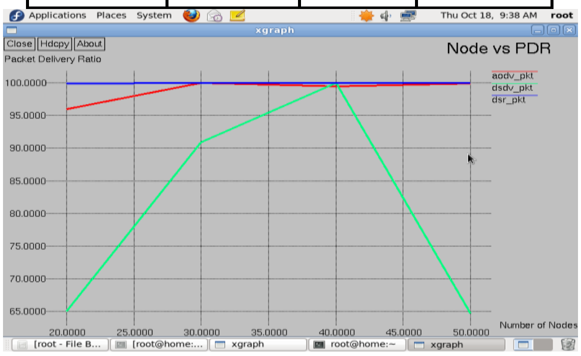

Fig.1. Node vs. pdf

TABLE 2; Nodes vs. End to end delay

NODES	AODV	DSR	DSDV
20	0.0627376	0.00914423	0.00901532
30	0.0118011	0.00576586	0.00769682
40	0.0988914	0.00575494	0.0058643
50	0.00930005	0.00576553	0.00900171

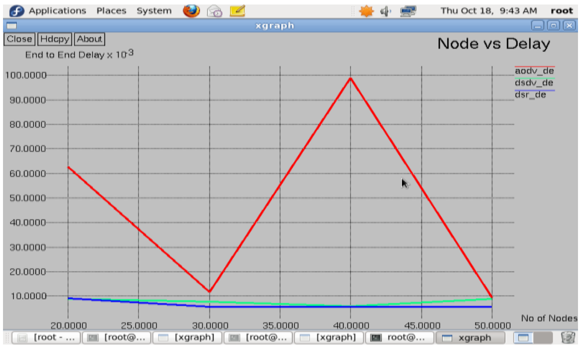

Fig.2. Node vs. delay

TABLE 3; Nodes vs. Throughput

NODES	AODV	DSR	DSDV
20	99860.7	100000	67606.9
30	104013	100102	94541.7
40	103480	100102	104013
50	103906	100102	67283.6

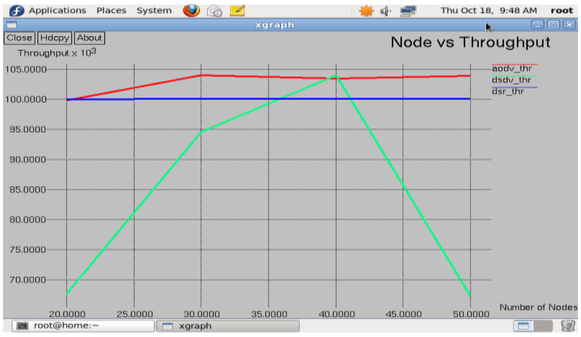

Fig.3. Node vs. throughput

TABLE 4; Nodes vs Packet Delivery Ratio

NODES	AOMDV	OLSR
O	0	0
5	22	40
10	100	120
15	260	310
20	400	365
25	400	365
30	400	365

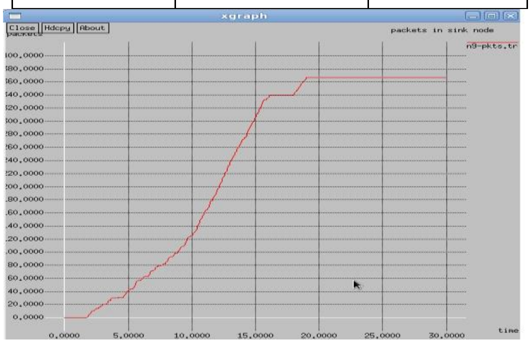

Fig. 4.Node vs Packet Delivery Ratio (AOMDV)

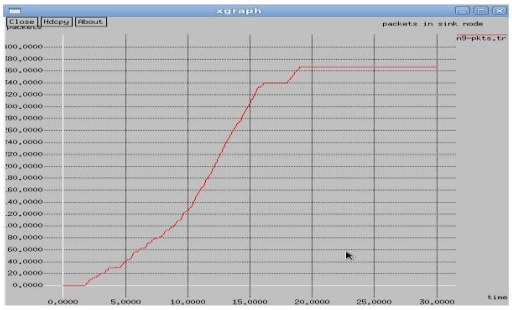

Fig.5.Node vs Packet Delivery Ratio (OLSR)

TABLE 5: Nodes vs Delay

NODES	AOMDV	OLSR
0	0	0
5	0.0003	0.001
10	0.0005	0.002
15	0.00056	0.003
20	0.00058	0.004
25	0.00059	0.004
30	0.00060	0.004

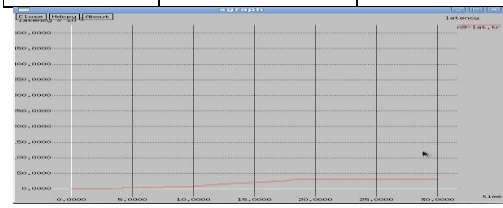

Fig.6.Nodes vs. Delay (AOMDV)

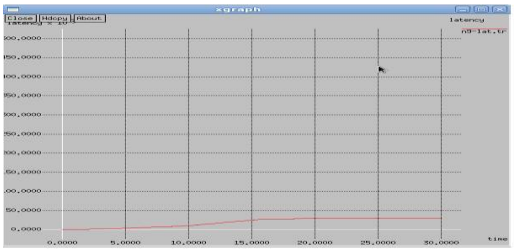

Fig.7.Nodes vs. Delay (OLSR)

TABLE 6: Nodes vs Throughput

NODES	AOMDV	OLSR
0	0	0
5	20	22
10	62	84
15	180	218
20	280	260
25	280	260
30	280	260

Fig.8.Nodes vs. Throughput (AOMDV)

Fig.9.Nodes vs. Throughput (OLSR)

4. CONCLUSION

From the simulation results, compared the performance analysis of packet delivery ratio, end to end delay and throughput using AODV, DSR, DSDV, AOMDV and OLSR. AOMDV is best for packet delivery ratio. If the nodes are increasing means the packet delivery ratio should be constant. The greater value of packet delivery ratio means better performance of the protocol. AOMDV produces higher value compared with protocols. For end to end delay AOMDV is best protocol compared with AODV, DSR, DSDV and OLSR. For Throughput AOMDV is best compared with other protocols.

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