International Journal of Scientific Engineering and Technology (ISSN : 2277-1581)
www.ijset.com, Volume No.1, Issue No.2 pg:55-58 01 April 2012

Performance Analysis of Routing Protocols for Battlefield monitoring System

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***Abstract*– Many authors have compared various routing protocols such as AODV, DSR, DSDV, TORA, DYMO, OLSR etc in the past [1], [2], [3] and [4]. In this paper, we have compare AODV, DYMO and OLSR routing protocols under Battlefield Monitoring System. In battlefield monitoring system, a sensor nodes act as a source which can vary and a single sink that collects information. The sensors constantly monitor the restricted area. The sensory information observed by each sensor is stored locally at the sensor. The mobile vehicles are moving inside the area where sensors are deployed. These mobile vehicles then collect the data from the sensors and send it to the fusion center (Sink). The sensor network simulator architecture used is for battle field monitoring and provides support for sensing capabilities in network nodes. The simulation is done with the help of Qualnet 5.0.2. The performance parameters taken for comparison are energy consumption, throughput, average jitter and average end to end delay. The simulation result shows that AODV performed better in terms of throughput while OLSR performed better in average end to end delay, jitter. DYMO performed better in terms of energy consumption.**

Keywords: AODV, DYMO, OLSR, Energy consumption, Battlefield monitoring system, Qualnet5.0.2 simulator.

1. INTRODUCTION

Motes are equipped with suitable sensors and deployed across the battlefield to monitor troop and vehicle movement in Battlefield Monitoring system or Surveillance system. The sensors are providing valuable tactical information about the area and the enemy. Ad hoc wireless network can be very useful in establishing communication among a group of soldiers for tactical operation. In the WSN military application the routing protocol should be able to provide quick, secure and reliable multicast communication with support for real time traffic.

Sensors are randomly deployed in an observation region. The sensors constantly monitor the area. The sensory information observed by each sensor is stored locally at the sensor. The mobile vehicles are moving inside the area where sensors are deployed. Here ground sensors are termed as Unattended Ground Sensors (UGS), and the moving vehicle as Unmanned Ground Vehicles (UGV). UGV collects the data from the ground sensors i.e. UGS and send it to the Fusion Centre (FC) where the decision has to be taken.

The paper is distributed as follows. In section 2 we have discuss three routing protocols taken for comparison. Section 3 gives the details of simulation environment. The simulation results are shown in section 4. Sections 5 describe conclusion and future scope.

2. MANET ROUTING PROTOCOLS

Both the protocols i.e. AODV and DYMO are reactive or on-demand protocols which find route to destination when there is traffic between the nodes or when it is demanded. Following section describe two on demand protocols.

2.1 Adhoc on Demand Distance Vector Protocol: The Ad hoc On Demand Distance Vector (AODV) [6] is a routing protocol designed for ad hoc mobile networks. AODV is capable of both unicast and multicast routing. It builds and maintains routes between nodes only as desired by source nodes. AODV consists of a routing table which contains the sequence number and next hop information. The protocol consists of two processes: route discovery and route maintenance.

In route discovery process a source node broadcasts a route request (RREQ) packet across the network. RREQ packet contains the source node's IP address, current sequence number, broadcast ID and the most recent sequence number for the destination of which the source node is aware. A destination node after receiving the RREQ may send a route reply (RREP) back to the source node. The source node receives the RREP, and begins to forward data packets to the destination. A route is considered active as long as there are data packets periodically traveling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. In route maintenance process if a link breaks occurs while the route is active; the node upstream of the breaking link propagates a route error (RERR) message to the source node to inform it of the now unreachable destinations. After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

2.2 Dynamic MANET On-demand (DYMO): The DYMO [7] routing protocol enables reactive multihop unicast routing between participating nodes. The working of DYMO is similar to AODV with slight modification. The protocol also consists of route discovery and route maintenance process. During route discovery, the source node initiates dissemination of a Route Request (RREQ) throughout the network to find a route to the destination. During this hop-by-hop dissemination process, each intermediate node records a route to the source. When the destination receives the RREQ, it responds with a Route Reply (RREP) sent hop-by-hop toward the source. Each intermediate node that receives the RREP creates a route to the target, and then the RREP is unicast hop-by- hop toward the source. When the source node receives the RREP, routes have been established between the source and destination.

Route maintenance consists of two operations. In order to preserve routes in use, node extends route lifetimes upon successfully forwarding a packet. In order to react to changes in the network topology, DYMO routers monitor links over which traffic is flowing. When a data packet is received and a route for the destination is not known or the route is broken, then the DYMO source router is notified. A Route Error (RERR) is sent toward the source to indicate the current route to a particular destination is invalid or missing. When the source receives the RERR, it deletes the route. If the source node later receives a packet for forwarding to the same destination, it will need to perform route discovery again for that destination.

2.3 Optimized Link State Routing protocol (OLSR): The OLSR [5] is based on link state algorithm and it is proactive in nature. OLSR is an optimization over a pure link state protocol as it squeezes the size of information send in the messages, and reduces the number of retransmissions. It provides optimal routes in terms of number of hops. For this purpose, the protocol uses multipoint relaying technique to efficiently flood its control messages [5]. Unlike DSDV and AODV, OLSR reduces the size of control packet by declaring only a subset of links with its neighbors who are its multipoint relay selectors and only the multipoint relays of a node retransmit its broadcast messages. Hence, the protocol does not generate extra control traffic in response to link failures and node join/leave events. OLSR is particularly suitable for large and dense networks [5]. In OLSR, each node uses the most recent information to route a packet. Each node in the network selects a set of nodes in its neighborhood, which retransmits its packets. This set of selected neighbor nodes is called the multipoint relays (MPR) of that node. The neighbors that do not belong to MPR set read and process the packet but do not retransmit the broadcast packet received form node. For this purpose each node maintains a set of its neighbors, which are called the MPR Selectors of that node. This set can change over time, which is indicated by the selectors in their HELLO messages. The smaller set of multipoint relay provides more optimal routes. The path to the destination consists of a sequence of hops through the multipoint relays from source to destination. In OLSR, a HELLO message is broadcasted to all of its neighbors containing information about its neighbors and their link status and received by the nodes which are one hop away but they are not relayed to further nodes. On reception of HELLO messages, each node would construct its MPR Selector table. Multipoint relays of a given node are declared in the subsequent HELLO messages transmitted by this node.

3. SIMULATION ENVIRONMENT

The scenario consists of 100 UGS nodes (nodes from 1 to 100) with linear battery model and micaZ radio energy model, 5 UGV (nodes from 100 through 105) with random way point inside the area where sensors are deployed (velocity range 0.1-0.4 damp). Fusion centre is node 121. Linear Battery model and micaZ radio energy model are configured for UGS's and UGV's. Unattended Ground Sensors (UGS) which refers to ground sensors, Unmanned Ground Vehicles (UGV) which refers to mobile vehicles, Fusion centre refers to remote site.

In this scenario, the vehicles have short range communication to sensors and long distance communication to a remote site which is called fusion centre. The sensors send their locally stored data packets to the vehicles which at any time are within their radio range. The vehicles then relay sensory data packets to fusion centre using long distance communication to that centre. UGS and UGV are both battery-powered devices. Short range communication between UGS's and UGV's has been configured as ZigBee. PHY and MAC protocol is 802.15.4 and routing protocol is Mesh Routing (AODV). Long distance communication between UGV's and fusion centre is configured as WiFi (802.11a) and the routing protocol is OSPFv2.

Simulation was created using Qualnet 5.0.2 Simulator [8]. The evaluation of protocols was based on the simulation setting. The basic scenario parameters are listed in table 1 and figure 1 shows the snap of simulation environment.

Table 1.Basic Scenario

Parameters	**Values**
The number of nodes	105 nodes
Simulation network space	500m x 500m
Node placement	Randomly deployment
MAC protocol	IEEE 802.15.4
User mobility	Random way point
User speed	10m/s
Simulation time	1800 s
Energy Model	MICAZ
Battery Model	Simple Linear, 1200 mAhr

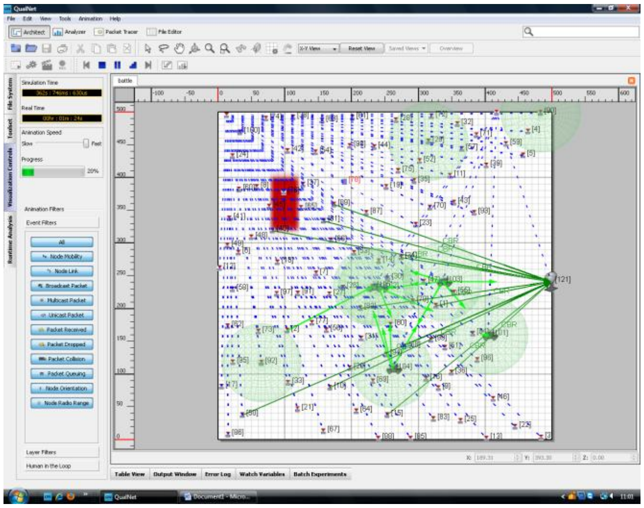

Figure1. Scenario of Battlefield monitoring system

4. RESULTS

By comparing AODV, DYMO and OLSR protocols, following result was observed.The average end to end delay, throughput, average jitter and energy consumption are taken as four metrics to evaluate the performance of above protocol.

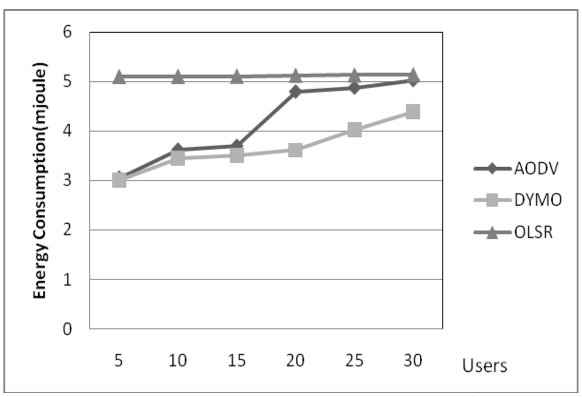

Figure 2: Energy consumption Versus Number of Users

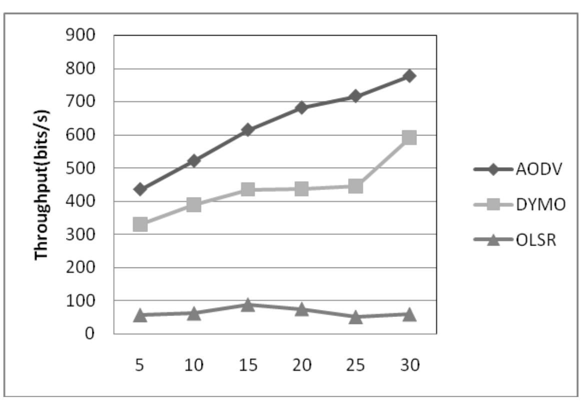

Figure 3: Throughput versus Number of Users

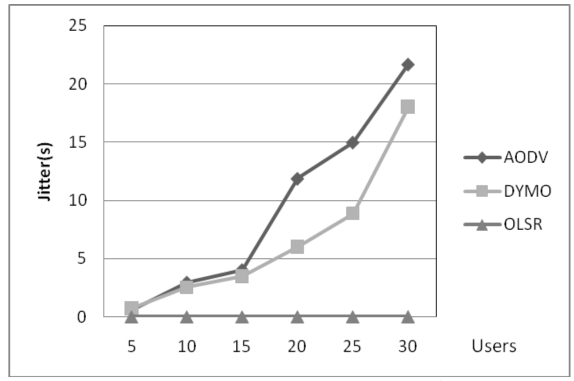

Figure 4: Average Jitter versus Number of Users

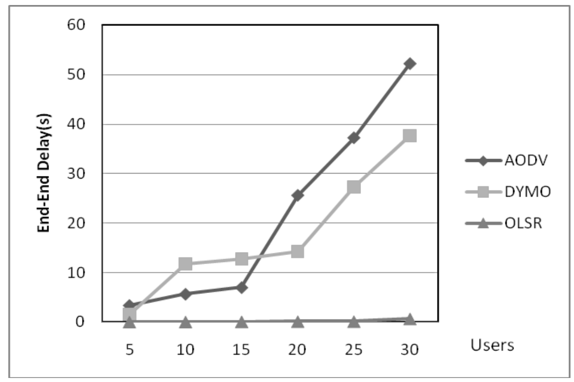

Figure 5: Average End to End Delay versus Number of Users

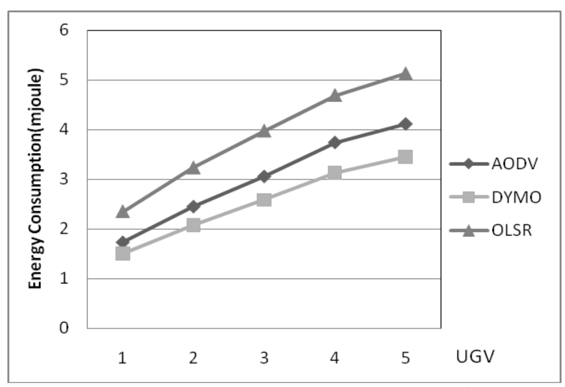

Figure 6: Energy consumption Versus Number of UGV

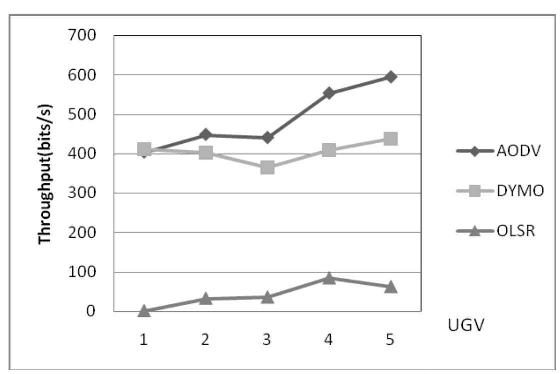

Figure 7: Throughput versus Number of UGV

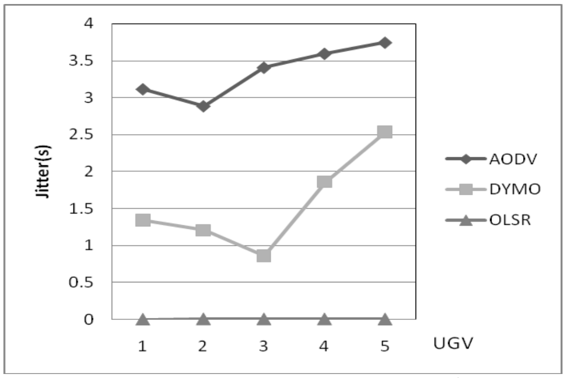

Figure 8: Average Jitter versus Number of UGV

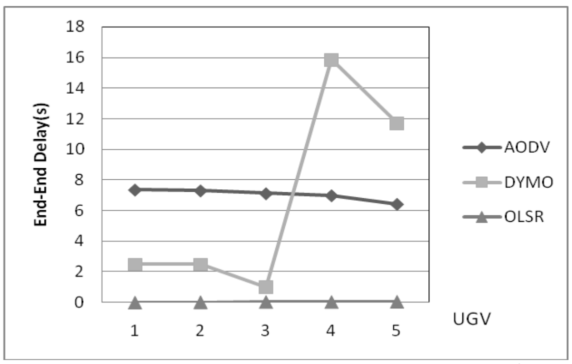

Figure 9: Average End to End Delay versus Number of UGV

Figure 2 shows the energy consumption versus number of user. The result shows that DYMO consumes less energy than AODV and OLSR in the battlefield monitoring system. OLSR consume higher energy than AODV and DYMO.

Figure 3 shows the throughput versus number of user and result shows that AODV perform better in terms of throughput. Other ad-hoc networks and scenarios show that DYMO perform better but in battlefield scenario AODV is performing better. DYMO perform better than OLSR.

Figure 4 shows the average Jitter versus Number of Users.The result shows that OLSR performed better than AODV and DYMO but DYMO perform better than AODV.

Figure 5 shows the average end to end delay versus number of nodes.OLSR performed better than AODV and DYMO. DYMO performed better than AODV. The results are different from the conventional results where DYMO has better throughput while have worst delay and energy consumption as compared to AODV.

Figure 6 shows the energy consumption versus number of user. The result shows that DYMO consumes less energy than AODV and OLSR in the battlefield monitoring system. OLSR consume higher energy than AODV and DYMO.

Figure 7 shows the throughput versus number of user and result shows that AODV perform better in terms of throughput. Other ad-hoc networks and scenarios show that DYMO perform better but in battlefield scenario AODV is performing better. DYMO perform better than OLSR.

Figure 8 shows the average Jitter versus Number of Users.The result shows that OLSR performed better than AODV and DYMO but DYMO perform better than AODV.

Figure 9 shows the average end to end delay versus number of nodes.OLSR performed better than AODV and DYMO. DYMO performed better than AODV. The results are different from the conventional results where DYMO has better throughput while have worst delay and energy consumption as compared to AODV.

5. CONCLUSION AND FUTURE WORK

From the simulation results, we conclude that for battlefield monitoring system:

- AODV have better throughput than DYMO and OLSR.
- DYMO have less energy consumption, jitter and average end to end delay than AODV.
- OLSR have better jitter and end to end delay than AODV and DYMO.

6. REFERENCES

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