Performance Comparison of OLSR and Fisheye in Mobile Wireless Sensor Networks

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ABSTRACT

The Optimized Link State Routing (OLSR) and Fisheye State Routing (FSR) protocol are link state based routing protocols that are suitable for large scale MANETs. Ad-hoc wireless sensor networks are a subset of mobile ad-hoc networks with limited resources. In this paper performance of OLSR and FSR protocol on dense mobile wireless sensor network has been analyzed for various parameters. To analyze the performance various parameters like average end-to-end delay, jitter, throughput, control overhead and energy consumption have been used. For simulation purpose QualNet5.0 has been used as the tool.

General Terms

Wireless Sensor Networks, Routing, OLSR, FSR

Keywords

OLSR, FSR, Wireless Sensor Networks, Simulation

1. INTRODUCTION

Wireless sensor networks (WSN) form a particular class of wireless networks which are composed of large number of energy constrained devices that autonomously form networks through which sensed information is transported from the region of interest to the central control station (known as sink). These networks are capable of measuring physical phenomenon like temperature, pressure, humidity, sound etc. Each device in WSN is capable of sensing, computing and communicating with other devices on the network. The major purpose of interaction among these devices is to gather local information to make global decisions about the environmental changes [1].

The sensed information flows through the network from the region of interest to the central control station (sink) which passes the collected information to the user [2]. Depending upon the type of sensor nodes deployed there are number of potential applications of the wireless sensor networks like air traffic control, distributed robotics, environment monitoring, agriculture, military surveillance, industrial sensing, weather forecasting etc [3].

There are several design and architectural issues which needs to be handled in order to efficient working of WSN [4]. As the sensor networks are generally used in sensing sensitive information their efficiency is of major concern. Their performance depends upon three tasks of sensing, data gathering and routing of the information to the sink.

2. ROUTING IN WIRELESS SENSOR NETWORKS

The routing of the information is the most challenging task due to the inherent characteristics of the wireless sensor networks like dense deployment, mobility of nodes and energy constraint. The major issues related to this are: maximizing network lifetime, minimum latency, resource awareness, topological changes, location awareness and scalability. As such there is a rigorous requirement for the routing protocols. A number of routing protocols have been specifically designed for wireless sensor networks. But as the sensor networks are a type of wireless mobile ad hoc networks (MANET), hence same routing protocols can also be used for wireless sensor networks [5].

2.1 Optimized Link State Routing (OLSR)

OLSR protocol is a proactive routing protocol. It uses periodic messages to update the topological information of the network among the nodes. The nodes exchange this information to establish a route to the destination node in the network. The advantage of this scheme is that routes are immediately available at each node to the destination node. This routing protocol is an optimization of the pure link state routing protocol based on the concept of multi-point relays (MPR). The use of multipoint relays reduces the size of the control messages as a node declares only the links with its neighbors that have been selected as MPRs. Also this reduces the flooding of the control traffic as only MPRs forward control messages as such the number of retransmissions of broadcast messages. The functioning of OLSR routing protocol consists of two major tasks:

1) Neighborhood discovery:

Each node collects the information about its one- hop and two-hop neighbors by sending Hello message periodically. From its one hop neighbors, a node selects MPRs such that these MPRs are capable of covering all its two hop neighbors.

2) Topology Dissemination:

Each node maintains topological information about the network by using TC (topology control) messages which are broadcasted by MPRs (Multi-point Relays). The neighborhood discovery information and the topology dissemination information are refreshed periodically so that each node has route to the destination node at any point of time. The routes at each node are calculated using Dijkstra's shortest path algorithm as such they are optimal considering the number of hops. The routing table is computed every time there is a change in the neighborhood discovery information or topology dissemination information. [6]

2.2 Fisheye State Routing (FSR)

FSR is a table driven hierarchical routing protocol. It uses the "fisheye" technique [7], i.e. the eye of a fish captures more details of the pixels that are near to the focal point. These details decrease as the distance from the focal point increases. In routing, this approach corresponds to maintaining accurate distance and path quality information about the immediate neighbors of a node, with progressively less detail as the distance increases. This protocol is similar to link state based routing protocols as it maintains topology information at each node. The difference lies in the way in which routing information is disseminated in the network. In link state routing, the link state messages are generated and sent into the network whenever a node detects a topology change. But in FSR, link state messages are not flooded in the entire network rather each node maintains a link state table based on the recent information received from neighboring nodes, and periodically exchanges this information with its local neighbors. A considerable number of link state entries are thus reduced. As such this method produces timely updates from nearby nodes, but creates large latencies from the nodes afar. The insufficient knowledge about the best path to a destination is compensated by the fact that the route becomes progressively accurate as the message gets closer to destination. [8]

3. SIMULATION SET-UP

The simulation was carried out using QualNet 5.0 network simulator [9]. 300 sensor nodes were deployed over an area of 1500*1500 m2 using random node placement technique. Out of these 300 nodes, 299 were configured as sensor nodes and 1 node was configured as the sink node. Some of the sensor nodes generate CBR traffic towards the sink node at varying intervals of time. The sensor nodes were made mobile using random waypoint mobility model [10]. To depict a real world like scenario the speed of nodes was varied as: walking 1.3-1.78 meter per second (mps) [11], cycling 6.70-7.15 mps [12], speed of a bike 12.5-16.66 mps, speed of a car 16.66-18.05 mps [13] and speed of a plane 178.81-268.24 mps. Effect of the changing mobility of the sensor nodes on the average end to end delay, average jitter, network throughput, control overhead and overall energy consumption has been analyzed. All the simulations parameters have been enlisted in Table-1

Table 1. Simulation Parameters

Parameter	Value
Area of Simulation	1500*1500 m^2
Network Density	300 nodes
Simulation time	1800 seconds
Physical/MAC layer Protocol	802.15.4
Node Mobility Model	Random Waypoint Mobility Model
Schedulers / Queues	DiffServ/ FIFO
Routing Protocol	OLSR/ FSR
Battery Model	Linear Model
Energy Model	Micaz
Transmission Power	3 dBm
Battery Charge Monitoring Interval	30 seconds
Full Battery Capacity	1200 mA.h (sensor nodes) 12000 mA.h (Sink node)
Traffic Type	CBR
Number of connections	150
Source ID	Variable
Destination ID	1 (Sink node)
Start/ End Time	Variable

4. SIMULATION RESULTS

4.1 Average end to end delay

End to end delay measures the delay in the delivery of the packet. Average end to end delay is the average delay suffered by all the packets in the network.

Figure 1 shows the variation of the average end to end delay with the increasing mobility of the sensor nodes. It is shown that with the increasing speed of the senor nodes, the variation in the average end to end delay for the FSR remains almost constant whereas there is large variation in the case of OLSR. This indicates that FSR will show high performance in case of delay sensitive applications.

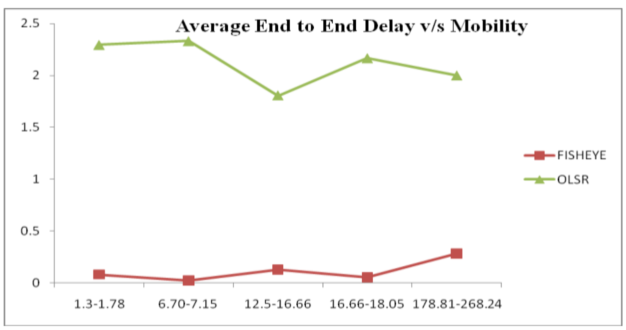

Figure 1. Average end to end delay with the increasing mobility of data gathering nodes

4.2 Average Jitter

The average jitter of a network measures the variability of the packet latency across the network.

Figure 2 shows that the average jitter of FSR is lower than that of OLSR. Also it remains almost constant with the increasing mobility of the sensor nodes whereas on the other hand the average jitter of OLSR is initially high but decreases as the speed increases. As such FSR can be preferred for applications that require in order delivery of data packets.

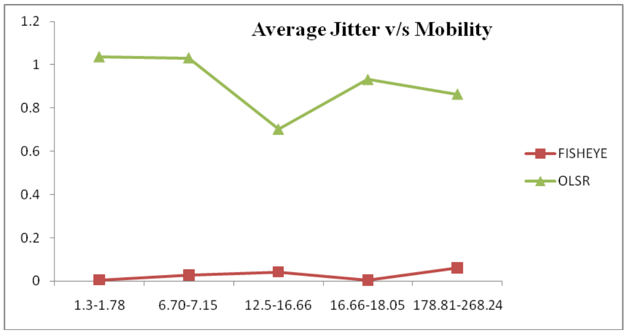

Figure 2: Variation of average jitter with mobility

4.3 Average Throughput

Average Throughput is defined as the average rate of successful message delivery across a network. It is generally measured in bits/ sec.

Figure 3 shows the variation of average throughput with mobility. It can be realized that throughput of OLSR is higher than that of FSR though it varies randomly with the increasing speed. Therefore OLSR is more suitable for the applications in which successful delivery of data is more important than delay.

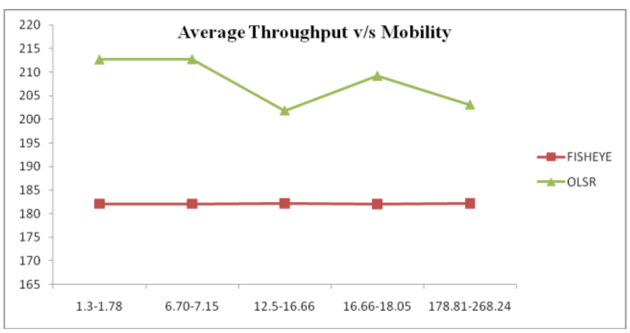

Figure 3. Variation of throughput with mobility

4.4 Control Overhead

The control overhead is defined as the number of packets/bits generated for transmitting the control information across the network by the routing protocol.

Figure 4 shows that the control overhead of OLSR is higher than that of the FSR. But it remains constant with the increasing speed of the sensor nodes whereas it increases with the increasing speed for FSR. Thus, FSR is more suitable for the networks in which there is high resource constraint.

4.5 Energy Consumption

The energy consumption determines the amount of energy consumed by each sensor node while performing different tasks in the network.

Table 2 shows the energy consumed by the network. It is shown that energy consumption is quite high in case of FSR whereas it is comparatively lower in OLSR. Hence, OLSR is more suitable for resource constrained networks.

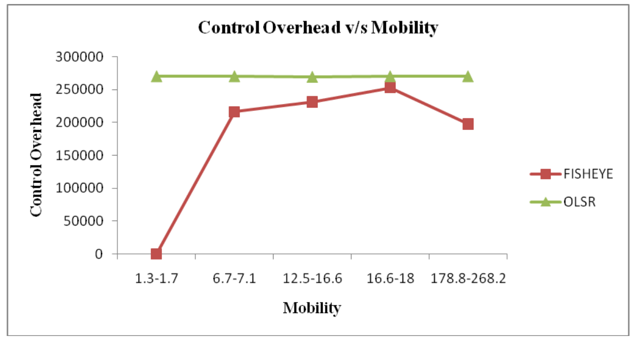

Figure 4: Variation of control overhead with mobility

Table 2. Energy Consumption of the network

Routing Protocol	Energy Consumption (mA.h)
OLSR	2.20
FSR	3.55

5. CONCLUSION

From the simulation analysis it can be concluded that the performance of the OLSR and FSR does not get much affected by the increasing speed of the sensor nodes. As such these protocols can be used for the applications like traffic control. Also as FSR outperforms in case of average end to end delay, average jitter, and average control overhead it can be used preferred for real time applications whereas OLSR can be used for networks that have high resource constraint.

6. FUTURE WORK

The optimized link state routing protocol could be further analyzed for the sensor networks which have higher node density and in the case of mobile sink node. Also the other parameters like change in duty cycles, resource consumption etc. could also be considered

7. REFERENCES

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