Performance Of OLSR Routing Protocol Under Different Route Refresh Intervals In Ad Hoc Networks

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Abstract—An ad hoc wireless network consists of mobile terminals communicating with each other without the help of traditional infrastructure for communication. Optimized Link State Protocol (OLSR) is a proactive routing protocol, wherein routes are discovered and updated continuously and available when required. Route refresh interval time plays a very crucial role for scalable networks with constrained bandwidths. In this paper we propose to evaluate OLSR routing protocol in a high mobility network with different route refresh intervals. The throughput and delivery ratio are also studied to evaluate the efficiency of the routing protocol

Keywords-component; Ad hoc network, OLSR, routing,

I. Introduction

An independent system of mobile nodes which are connected by wireless links and do not have any preexisting communication infrastructure or centralized administration leads to the formation of Mobile ad hoc networks. The nodes or intermediate nodes act as routers through which direct communication is established. Rapid deployment, flexibility, robustness and inherent support for mobility [1] are some of the advantages of using mobile ad hoc network. The ad hoc networks use Routing protocols which must automatically adjust to the surrounding influences that can vary between the extremes of high mobility with low bandwidth, and low mobility with high bandwidth. MANET's performance depends on routing protocols' efficiency in adapting itself to frequently changing network topology and link status.

Table driven (proactive) algorithms and On demand (reactive) protocols are the two main categories of MANET's routing protocols. The necessary information required for routing purposes is stored in tables in Proactive routing algorithms. This information is repeatedly updated through control packets that are sent by each node. DSDV, OLSR are some of the examples for proactive protocols which can also respond to topological changes of the network. Reactive protocols on the other hand, work out the route to a specific destination only when needed. Because of this reason, a routing table which has all the nodes as entries need not be maintained in each node. When a packet has to be sent to a destination by the source, a route discovery mechanism is initiated to find the path to the destination. The validity of the route remains as long as the destination is accessible or until the route is no longer needed. AODV, DSR are some of the examples for reactive routing protocol[2].

Distributed operation, demand based operation, proactive operation, loop-freedom and security are some of the qualities the routing protocol should possess in order to be effective [3]. In distributed operation any host enters or leaves the network without any specification. The useless information sent by the host to nodes which creates overhead is prevented by Loop-freedom. In demand based operation the protocol will be able to acclimatize to the traffic pattern thereby decreasing traffic and using bandwidth resources more efficiently. Proactive operation in contrast to demand-based operation, is used when the latter is unsuitable or when there is enough bandwidth and energy resources for the former operation. Giving priority to security becomes an important criteria in modern communications, and mobile devices are vulnerable to snooping because of broadcasting.

In this paper we study the effect of different route refresh time interval and the QOS provided by the OLSR routing protocol. We examine OLSR's performance with different HELLO intervals. This study tries to understand the effect of protocol overhead which is crucial for limited bandwidth ad hoc networks. This paper is organized into the following sections. Section II introduces us to the OLSR routing protocol, section III describes the experimental setup and section IV analyzes the simulation result.

II. OLSR ROUTING PROTOCOL

Optimized Link State Protocol (OLSR) falls under the class of proactive routing protocol and hence the routes are always available immediately when needed[4]. OLSR is based on the link state protocol and is an optimized version for wireless networks taking into consideration the various issues in wireless data transmission. The topological changes in the mobile nodes cause the flooding of the topological information to all available hosts in the network. To reduce the possible overhead in the network OLSR uses Multipoint Relays (MPR) which reduces the flooding of broadcasts by reducing the same broadcast in some regions in the network. The reduction in the time interval for the control messages transmission can bring more reactivity to the topological changes[5] which is a desired feature as it reduces the control message bandwidth utilization. Hello and Topology control are two types of control messages used in OLSR. Hello messages are used for finding the link status information and the immediate neighbors to the host. Using the Hello message the Multipoint Relay (MPR) Selector set is constructed to describe which neighbors has chosen this host to act as MPR and from this information the host can calculate its own set of MPRs[6]. A major differentiator of the Hello message over the TC messages are that the Hello messages are sent only one hop away whereas the TC messages are broadcasted throughout the network. TC messages are used for broadcasting information about own advertised neighbors which includes at least the MPR Selector list. Only the MPR hosts can forward the TC messages which are broadcasted periodically [7]. In an ad hoc network the link can be either bidirectional or unidirectional which is required by the host to know about its neighbors. The Hello messages are broadcasted periodically to check the presence of the neighbor. Hello messages are only broadcasted one hop away so that they are not forwarded further[8]. When a node receives the Hello message from another node, it sets the host status to asymmetric in the routing table. When the first node sends a Hello message and includes that, it has the link to the second node as asymmetric, the second node set first node status to symmetric in its own routing table. Finally, when second node sends Hello message again, where the status of the link for the first node is indicated as symmetric, then first node changes the status from asymmetric to symmetric. In the end both nodes knows that their neighbor is available and the corresponding link is bidirectional[9].

The Hello messages periodic broadcasting is used for link sensing, neighbor's detection and MPR selection process. Hello message also contains information how often the node sends Hello messages, the degree of willingness of node to act as a Multipoint Relay, and information about its neighbor. Information about the neighbors contains interface address, the type of link which could be either symmetric, asymmetric or lost and the type of neighbor. The neighbor type indicates just symmetric, MPR or not a neighbor. The MPR type indicates that the link to the neighbor is symmetric and that this specific node has chosen it as Multipoint Relay.

The Multipoint Relays (MPR) is an unique concept in OLSR protocol to reduce the information exchange overhead which leads to lower bandwidth. Instead of pure flooding the OLSR uses MPR to reduce the number of the node which broadcasts the information throughout the network. The MPR is a node's one hop neighbor which can forward its messages. The number of node's with MPR capabilities is kept minimal for the protocol to be efficient.

To compute the efficient MPR set each node must have information about the symmetric one hop and two hop neighbors. Hello messages provide the information about the neighbors including two hop neighbors as each Hello message contain all the node neighbors. The goal of MPR selection algorithm is to select the minimum number of the one hop neighbors which covers all the two hop neighbors. Also each node has the Multipoint Relay Selector set, which indicates which nodes has selected the current host to act as a MPR. When the node gets a new broadcast message which is to be sent throughout the network and the message's sender interface address is in the MPR Selector set, then the node must forward the message. Due to the possible change in the ad hoc network, the MPR Selectors sets are updated continuously using Hello messages.

In order to exchange the topological information and build the topology information base the nodes that were selected as MPR need to send the topology control (TC) message. The TC messages are broadcasted throughout the network through the MPR's. The TC messages are generated and broadcasted periodically in the network. The TC message is sent by a node in order to advertise its own links in the network. A minimum criteria for the node is to send at least the links of its MPR selector set. The TC message sent not only includes the own set of advertised links but also the sequence number of each message. The sequence number is used to indicate the freshness of the message and avoid loops and hence if a node gets a message with smaller sequence number it discards the message without any updates. The nodes increment the sequence number when the links are removed from the TC message and also increments the sequence number when the links are added to the message. When the nodes advertised links set is empty, it should still send empty TC messages for specified amount of time, in order to invalidate previous TC messages.

The node maintains the routing table information containing destination address, next address, number of hops to the destination and local interface address. Next address indicates the next hop node and this information is got from the topological set and from the local link information base. If any changes occur in these sets, then the routing table is recalculated. Since OLSR is a proactive protocol the routing table will have routes for all available hosts in the network. The information about broken links or partially known links is not stored in the routing table.

The routing table is updated if new neighbor link appear or a link disappears, two hops neighbor is either created or removed, topological link is available, lost or when the multiple interface association information changes. But the update of this information does not lead to the sending of the messages into the network. Shortest path algorithm is used for finding the routes.

III. EXPERIMENTAL SETUP

We use the OPNET simulator to evaluate our investigation. Twenty five mobile nodes are created with data rate of 11 Mbps and transmit power of 0.005 watts. Each node is capable of creating raw unformatted data and is programmed to transmit data at t=100s. The destination for data transmission is selected randomly. TC interval is fixed at 5 second with IPV4 as the addressing mode. Each node moves randomly within the network range of 500 meter by 500 meter.

The simulation is run with ‘Hello’ intervals of 2 seconds, 4 seconds and 8 seconds. Simulations were carried for a period of 10 minutes in each case. The simulated output is shown in figure 1 and 2.

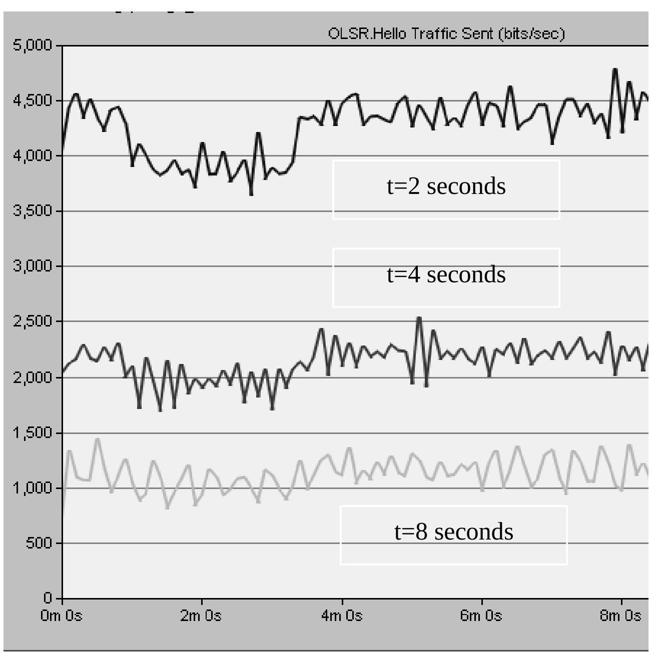

Figure 1 : The graphs show the ‘Hello’ traffic sent when t = 2, 4 and 8 seconds respectively.

As the time between ‘Hello’ message is increased among all the nodes, the total number of network control traffic sent decreases overall in the network. However the throughput plays a crucial role for establishing the quality of service. The throughput for different ‘Hello’ interval is given in figure 2. From figure 2 we see that the throughput is not greatly affected when the ‘Hello’ message interval is increased from 2 to 4. However the throughput decreases drastically when the interval is increased to 8.

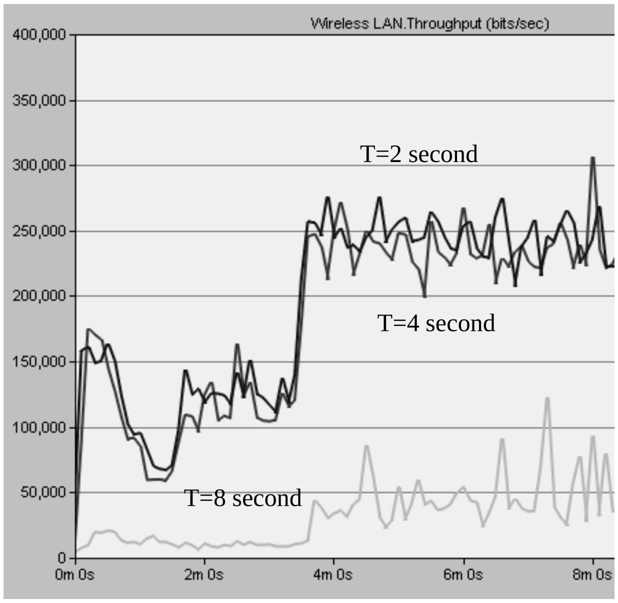

Figure 2. The throughput of simulated network for different 'Hello' intervals.

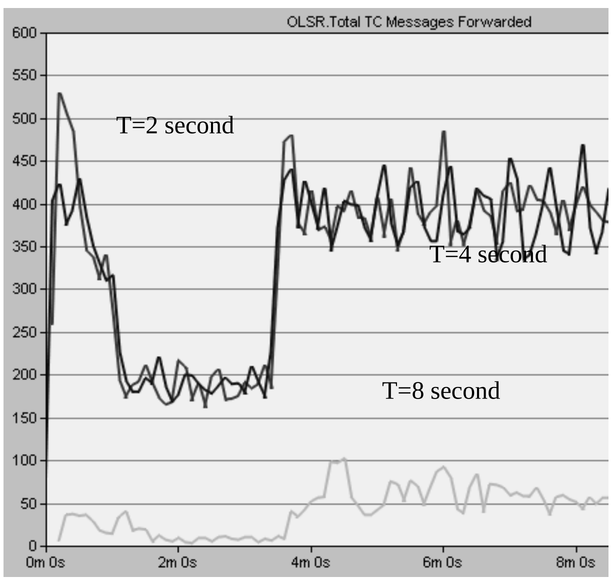

Figure 3. Total TC messages forwarded in all three cases

IV. CONCLUSION

An ad hoc network was simulated with 25 nodes moving randomly in an area of 500 m by 500 m with OLSR routing protocol. 'Hello' message time was varied from t=2,4 and seconds and the throughput studied. From the above simulation it is seen that for a moderately random movement of nodes in a network the throughput of the network is not affected drastically when the time interval is changed from t=2 second to t=4 second. There is considerable saving in bandwidth which could be useful in bandwidth constrained networks. However when the 'Hello' interval is changed to 8 seconds, the throughput is affected which can decrease the quality of service provided. The entire goal is to improve the performance of OLSR which can be achieved by tuning the 'Hello' interval based on the type of network.

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