

COMPARISON OF OLSR AND ENERGY CONSERVED OLSR

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Abstract— An ad hoc wireless network contains mobile networks which creates an underlying architecture for communication without the help of traditional fixed-position routers. Nevertheless, the architecture must maintain communication routes although the hosts are mobile and they have limited transmission range. There are different protocols for handling the routing in the mobile environment. This paper will focus on two well know algorithms: Optimized Link State Routing Protocol and Optimized Linked State Routing Protocol for Energy Consumption.

Key words— EOLSR, OLSR, Routing.

I. INTRODUCTION

Wireless communication technology is growing daily; with such growth sooner it would not be physically possible to have a fixed architecture for this kind of network. Ad hoc wireless network must be capable to self-organize and self-configure due to the fact that the mobile structure is varying all the time. Mobile hosts have a restricted range and sending the message to another host, which is not in the sender's host transmission range, must be forwarded through the network using other hosts which will be used as routers for transporting the message throughout the network. The mobile host must use broadcast for sending messages and should be in fast mode for message throughout the network. The mobile host must use broadcast for sending messages and should be in fast mode for accepting any messages that it receives. In the ad hoc network there can be unidirectional hosts that can transmit only to the one direction, so that the communication is not bi-directional as in the usual communication systems. [4, 5, 8]

The routing protocols for ad hoc wireless network should be able to handle a large number of hosts with limited resources, such as bandwidth and energy. The main inspiration for the routing protocols is that they must also deal with host movability, meaning that hosts can appear and disappear in various places. Therefore, all hosts of the ad hoc network behave as routers and must play a role in the route discovery and maintenance of the routes to the other hosts. For ad hoc routing protocols it is important to minimize routing messages overhead in spite of the increasing number of hosts and their mobility. Maintaining the routing table small is another important issue, because the increase of the routing table will have an impact on the control packets transmitted in the network and this in turn will affect large link overheads. [4, 5, 8].

Routing protocols are partitioned into two categories based on how and when routes are found, but both find the shortest path to the destination. Proactive routing protocols are table-driven protocols, they always maintain current up-to-date routing information by transmitting control messages frequently between the hosts which alter their routing tables. When there are alterations in the structure then the updates are propagated throughout the network. The proactive routing

protocols consist of link-state routing algorithms which frequently flood the link information about its neighbors. Other routing protocols are on-demand routing protocols, in other words reactive, ones which establish routes when they are needed by the source host and these routes are maintained while they are required. When nodes exchange vectors of information, each host alter own routing information when needed. The ad hoc routing protocols are usually classified as a pure proactive or a pure reactive protocol, but there are also hybrid protocols.

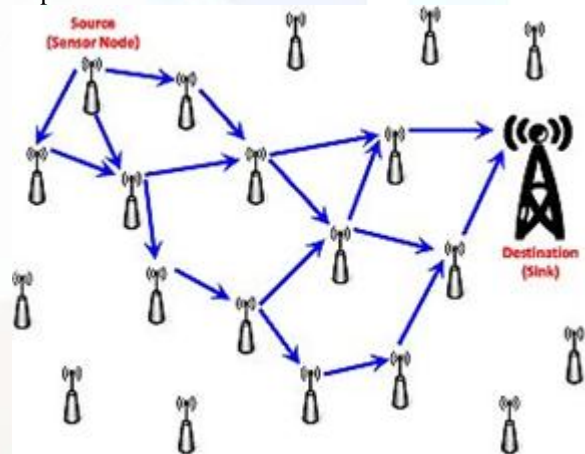


Fig. 1 Routing in wireless sensor network [1]

II. OPTIMIZED LINK STATE ROUTING PROTOCOL (OLSR)

A. Introduction

Optimized Link State Protocol (OLSR) is a proactive routing protocol, so the routes are always instantly accessible when needed. OLSR is optimization version of a pure link state protocol. So the topological changes cause the flooding of the topological information to all accessible hosts in the network. The idea of MPR is to minimize flooding of broadcasts by minimizing the same broadcast in some regions in the network. Another minimization is to provide the shortest path. Minimizing the time interval for the control messages transmission can bring more reactivity to the topological changes. [3, 4, 5, 10, 11, 12, 7] OLSR proposes two kinds of the control messages: Hello and Topology Control (TC). Hello messages served for finding the information about the link status and the host's neighbors. With the Hello message the Multipoint Relay (MPR) Selector set is built which describes which neighbors has selected this host to act as MPR and from this information the host can calculate its own set of the MPRs. The Hello messages are transmitted only one hop away but the TC messages are broadcasted throughout the complete network. TC messages are utilized for broadcasting information about own advertised neighbors which includes at least the MPR Selector list. The TC messages are broadcasted frequently and only the MPR hosts can forward the TC

messages [2, 3, 10, 11, 12, 7]. There is also Multiple Interface Declaration (MID) messages which are utilized for informing other host that the announcing host can have multiple OLSR interface addresses. The MID message is broadcasted throughout the complete network only by MPRs. There is also a "Host and Network Association" (HNA) message which serves the external routing information by giving the possibility for routing to the external addresses. The HNA message gives information about the network- and the netmask addresses, so that OLSR host can consider that the reporting host can act as a gateway to the reporting set of addresses. The HNA is considered as a generalized version of the TC message with only difference that the TC message can inform about path cancelling while HNA message information is eliminated only after expiration time.

B. Routing

The link in the ad hoc network can be either unidirectional or bidirectional so the host must aware of this information about the neighbors. The Hello messages are broadcasted frequently for the neighbor sensing. The Hello messages are only broadcasted one hop away so that they are not forwarded afterwards. When the first host accept the Hello message from the second host, it sets the second host status to asymmetric in the routing table. When the first host sends a Hello message and it understands that, it has the link to the second host as asymmetric, the second host set first host status to symmetric in own routing table. Finally, when second host transmit again Hello message, where the status of the link for the first host is indicated as symmetric, then first host changes the status from asymmetric to symmetric. In the end both hosts understand that their neighbor is alive and the corresponding link is bidirectional. [2, 8, 11, 9] The Hello messages are utilized for getting the information about local links and neighbors. The Hello messages periodic broadcasting is used for link sensing, neighbor's discovery and MPR selection method. Hello message contains: information how often the host transmits Hello messages, willingness of host to act as a Multipoint Relay, and information about its neighbor. Information about the neighbors contains: interface address, link type and neighbor type. The link type shows that the link is symmetric, asymmetric or simply lost. The neighbor type is just symmetric, MPR or not a neighbor. The MPR type shows that the link to the neighbor is symmetric and that this host has chosen it as Multipoint Relay. [2]

The Multipoint Relays (MPR) is the main idea behind the OLSR protocol to minimize the information exchange overhead. Instead of pure flooding the OLSR uses MPR to minimize the number of the host which broadcasts the information throughout the network. The MPR is a host's one hop neighbor which may forward its message packets. The MPR set of host is kept small in order for the protocol to be efficient. In OLSR only the MPRs can forward the data throughout the complete network [2]. Each host must have the information about the symmetric one hop and two hop neighbors to calculate the optimal MPR set. Information about the neighbors is taken from the Hello messages. The two hop neighbors are found from the Hello message because each Hello message contains all the hosts' neighbors. Selecting the minimum number of the one hop neighbors which covers all the two hop neighbors is the aim of the MPR selection algorithm. Each host has the Multipoint Relay Selector set,

shows which hosts has chosen the current host to act as a MPR [9, 10, 12, 7]. When the host gets a new broadcast message, which is require to be scatter throughout the network and the message's sender interface address is in the MPR Selector set, then the host must convey the message. Due to the possible alteration in the ad hoc network, the MPR Selectors sets are updated repeatedly using Hello messages. [2]

The algorithm constructs the MPR set which contains less number of the one hop symmetric neighbors from which it is possible to reach all the symmetrical strict two hop neighbors. The host must have the information about one and two hop symmetric neighbors to start the needed calculation for the MPR set. All the transfer of information is broadcasted using Hello messages. The neighbors which have status of willingness different than WILL_NEVER in the Hello message can be chosen to act as MPR. The neighbor must be symmetric in order to become an MPR.

In order to exchange the topological information and build the topology information base the host that were selected as MPR need to sent the topology control (TC) message. The TC messages are broadcasted throughout the network and only MPR are allowed to forward TC messages. The TC messages are generated and broadcasted periodically in the network. [2] The TC message is sent by a host in order to advertise own links in the network. The host must send at least the links of its MPR selector set. The TC message includes the own set of advertised links and the sequence number of each message. The sequence number is used to avoid loops of the messages and for indicating the freshness of the message, so if the host gets a message with the smaller sequence number it must discard the message without any updates. The host must increment the sequence number when the links are removed from the TC message and also it should increment the sequence number when the links are added to the message. The sequence numbers are wrapped around. When the hosts advertised links set becomes empty, it should still send empty TC messages for specified amount of time, in order to invalidate previous TC messages. This should stop sending the TC messages until it has again some information to send. [2, 8, 11, 9] The size of the TC message can be quite big, so the TC message can be sent in parts, but then the receiver must combine all parts during some specified amount of time. Host can increase its transmission rate to become more sensible to the possible link failures. When the change in the MPR Selector set is noticed, it indicates that the link failure has happened and the host must transmit the new TC message as soon as possible.[2]

The host maintains the routing table, the routing table entries have following information: destination address, next address, number of hops to the destination and local interface address. Next address indicates the next hop host. The information is got from the topological set (from the TC messages) and from the local link information base (from the Hello messages). So if any changes occur in these sets, then the routing table is recalculated. Because this is proactive protocol then the routing table must 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. [2, 8, 3] The routing table is changed if the changes occur in the following cases: neighbor link appear or disappear, two hops neighbor is created or removed, topological link is appeared or 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. For finding the routes for the routing table entry the shortest path algorithm is used. [2, 8, 3]

III. OPTIMIZED LINKED STATE ROUTING PROTOCOL FOR ENERGY CONSUMPTION

In this section, the modification steps for OLSR protocol are discussed. The modified protocol is named as EOLSR. The OLSR protocol is modified in two processes i.e. while selecting MPR nodes and while calculating route for forwarding data [6].

A. MPR Selection

The existing OLSR consumes more energy in energy constrained applications which results in less network lifetime. To improve network lifetime as well as energy efficiency OLSR is modified by using two approaches as below;

1. By setting threshold for Residual Energy
2. By setting threshold for Energy Consumption

For MPR selection we have decided a threshold value, which is one third of initial energy for both residual energy and energy consumption approach.

1. If the residual energy of node is less than threshold value then node having LOW-MPRWILL while residual energy of node is more than threshold value then node having HIGH-MPR-WILL.
2. If the energy consumed by node is less than threshold value then node having HIGHMPR-WILL while consumed energy of node is more than threshold value then node having LOW-MPR-WILL.

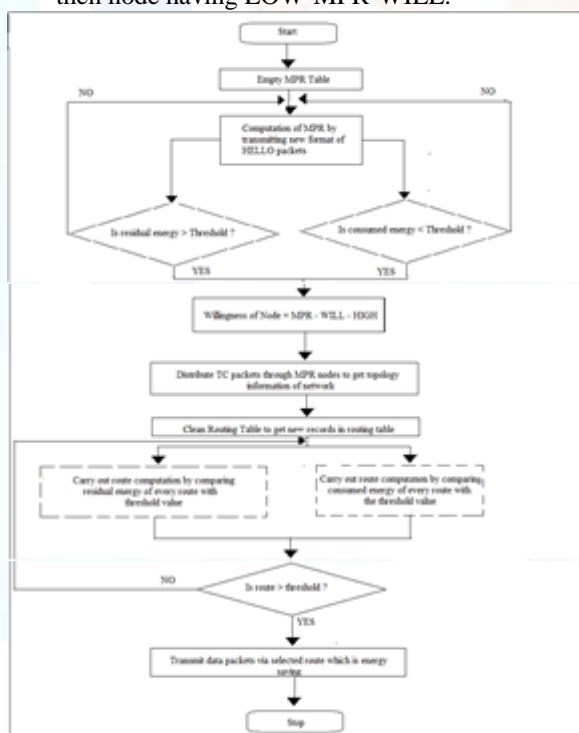


Figure 2. Flow Chart for residual Energy and Energy Consumption Approach

B. New HELLO and TC packet format

HELLO packets are used for selection of MPR nodes. For selection of MPR each node having,

1. Highest residual energy
2. Lowest energy consumption

There is requirement to change residual energy of each node at regular interval. For this purpose the value of residual

energy and energy consumed by node is included in HELLO packet. The reserved part in OLSR HELLO packet format is assigned to residual energy in EOLSR-RE and energy consumption in EOLSR-EC. Each node sends HELLO packet with entry for current residual energy and depending on threshold value set it selects MPR node.

The reserved part in TC packet is modified with entry for residual energy and energy consumption of node. The TC packets are transmitted to entire network with the help of MPR nodes. The TC packets are used to disseminate topology information over complete network. The modified TC packet format forwards residual energy of each node and energy consumed by each node over complete network. After knowing topology information for each node in network the route computation is performed.

No. of Connection	Energy Consumption		
	EOLSR-RE	OLSR	EOLSR-EC
16	10.3874	10.5285	10.4421
18	9.98939	12.5364	10.2235
20	10.7527	13.9693	11.9932
22	13.5147	15.7888	14.3235
24	15.6768	17.9791	16.5433

Table 1. Impact of variation of number of connections on Energy Consumption

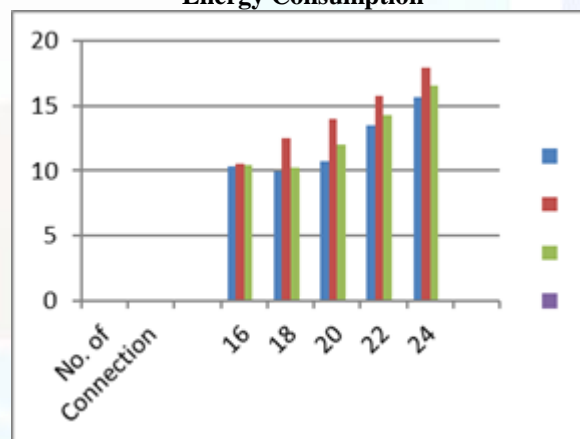


Figure 3: Impact of Variation of number of Nodes on Energy Consumption

IV. CONCLUSION

In this paper, we compared EOLSR-RE and EOLSR-EC over OLSR. From this discussion, we can say that EOLSR-RE is best protocol in terms of energy efficiency.

The average energy consumption increases with node density, node speed. Control overheads are directly proportional to node density while it remains constant for alteration of node speed. EOLSR-RE is suitable option in military applications, disaster recovery areas and remote areas such as forests where energy saving is important requirement.

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