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Stable MPR Selection in OLSR for Mobile Ad-Hoc Networks

Mr. Mohit[#1], Mr. Suraj Pal[#2]

Research Scholar (M.Tech)[#1], Assistant Professor[#2]
Department of Computer Science and Engineering
Golden College Of Engineering And Technology, Gurdaspur
Punjab-India

Abstract: **Mobile wireless network are capable of autonomous operation which operates without base station infrastructure. In it, nodes cooperate to provide connectivity and services without centralized administration. OLSR is a proactive protocol, which maintains 3 types of table viz. Neighbor Table, Topology Table and Routing Table. It uses MPR (Multipoint Relay) Mechanism in order to avoid redundant dissemination over same network area. Here we have introduced W-OLSR which is an extension to existing OLSR. OLSR doesn't consider signal strength or transmission delay in order to select MPRs. By inculcating these metrics, we were able to get healthier MPRs. Simulation result shows that W_OLSR has outperformed OLSR in terms of Mobility and Packet Loss.**

***Keywords*— MANET, OLSR, STABLE MPR SELECTION.**

INTRODUCTION

A wireless ad hoc network or Mobile Ad hoc Network (MANET) [1] is a decentralized type of wireless network. The network is called ad hoc because it does not rely on a pre-existing infrastructure, such as access points in managed (infrastructure) wireless networks or routers in wired networks. Instead, every node participates in routing by forwarding data for other nodes, so the determination of which node forwards data is made dynamically on the basis of network connectivity.

Adhoc Networks do not rely on any infrastructure to work. Every node can communicate directly with other nodes inside network, so no access point controlling medium access is necessary. Nodes within an ad-hoc network only communicates only if they can reach each other physically, i.e., if nodes are within each other's radio range or if other nodes can forward the message. In ad-hoc networks, the complexity of each node is higher because every node has to implement medium access mechanisms, mechanisms to handle hidden terminal or exposed terminal problems, and perhaps priority mechanisms are required, to provide a certain quality of service to them. This kind of wireless network exhibits the greatest possible flexibility as it is, for example, needed for quick replacements of infrastructure, unexpected meetings or communication scenarios far away from any infrastructure. Sometimes fixed structure exits but cannot relied upon, such as during disaster recovery.

Routing in MANETs

The absence of fixed infrastructure in MANET poses several types of challenges. The biggest challenge among them is routing. Routing is process of selecting paths in network along which to send data packets. An adhoc routing protocol is a connection or standard that controls how nodes decided which way to route packets between computing devices in mobile adhoc network. Each node learns about nearby nodes and how to reach them and may announce may reach that it can reach them too.

Routing is the act of moving information from source to destination in an internetwork. A routing protocol [2] specifies how routers communicate with each other, and disseminating information that enables them to select routes between any two nodes on a computer network. Routing algorithms mostly determine the specific choice of route.

Classifications of Routing Protocols:

Protocols can be classified under various categories. Here we have categorized it under Scheduling i.e. when a source obtains route information; it initiates traffic flow to destination. Under this category, 3 most popular classifications are most popular viz. Proactive, Reactive and Hybrid protocols.

Hierarchy of this classification is as below:

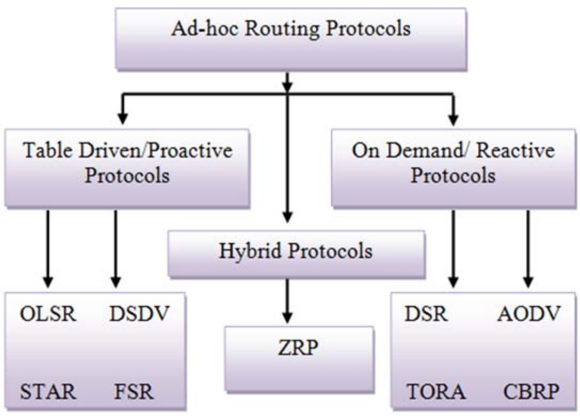

Fig 1.: Adhoc Routing protocols

Proactive Routing Protocols:

Proactive routing protocols attempt to maintain consistent and up-to-date routing information from each node to every other node in the network. The routing information is always kept in a number of different tables and they respond to changes in network topology by propagating updates throughout the network in order to maintain a consistent. The Proactive routing approaches designed for ad hoc networks are derived from the traditional routing protocols. These protocols are sometimes referred to as table-driven protocols since the routing information is maintained in tables. There are different types of proactive protocols are Destination-Sequenced Distance-Vector Routing (DSDV) [6] Optimized Link State Routing (OLSR) [7].

The main advantage of these Proactive routing protocols is that hosts can quickly obtain route information and quickly establish a session but the control overhead for maintain tables can be significant in large networks or in networks with rapidly moving nodes.

Reactive Routing Protocol:

Reactive routing approaches take a departure from traditional Internet routing approaches by not continuously maintaining a route between all pairs of network nodes. Instead in this routes are only discovered when they are actually needed. Whenever a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route. If no such route exists, then it performs a route discovery procedure to find a path to the destination. Some of Reactive protocols are; Dynamic Source Routing (DSR) [8], Temporally-Ordered Routing Algorithm (TORA) [9], Adhoc On demand Distance Vector Routing Protocol (AODV) [10]

Reactive routing protocols dramatically reduce routing overhead because they do not need to search for and maintain the routes on which there is no data traffic but the route acquisition latency is imparted. That is, when a route is needed by a source node, there is some finite latency while the route is discovered.

Hybrid Routing Protocol:

It is combination of both reactive and proactive protocols. Mostly hybrid routing protocols are zone based; it means the number of nodes is divided into different zones to make route discovery and maintenance more reliable for MANET. One of the protocols is Zone Routing ProtocolThe advantage of hybrid protocol is No route setup latency for short distance connections. Hybrid routing protocols are not suitable for those networks where the nodes behaviour are highly dynamic and network contains a large number of nodes

LITTERATURE REVIEW

Mansoor Ali H. et al. proposed Signal strength based link sensing in OLSR [3] protocol. Mobility causes frequent link failures in ad-hoc networks. This results in a severe degradation of performance especially in case of high mobility of nodes. This is because the routing protocols for ad-hoc networks are not equipped to handle high mobility. In this paper, we have presented a new link management algorithm to locally manage links. This new mechanism is based on signal strength measurements. The mechanism in OLSR uses Hello packets received/lost to decide to establish link or not. The problem with this approach arises when there is high mobility in which case the time to break the link and use a new path becomes significant. To overcome this, authors proposed to use signal strength to determine if the link-quality is improving or deteriorating. This combination of the two mechanisms makes the link management more robust and also helps in anticipating link breakages thereby greatly improving performance.

Hirata K. et al. proposed residual energy-based [4] OLSR protocol and named it REOLSR. The REOLSR selects MPR nodes based on not only reachability and degree but also residual energy of 1-hop neighbors. They aim to avoid selection of MPR nodes which has small residual energy and concentrating energy consumption in specific nodes. Simulation results show that the proposed scheme reduces energy consumption and enhances network throughput efficiently. Later they enhanced there technique calling it as REOLSR2. In REOLSR2, authors proposed selection of MPR on basis of residual energy till certain value of threshold and later, the MPR selection algorithm runs as default OLSR. It has been observed that the number of active nodes of the proposed scheme (REOLSR2) is larger than those of OLSR standard and REOLSR. This is because if an MPR node has small residual energy, the MPR node easily runs out of its energy during broadcasting messages.

Jacquet P., et al. [5] one of the authors of OLSR protocol itself found that selecting routing path merely on basis of shortest path is not always the best practise. Though this metric gives good performances. However, this metric has its limits in satisfying traffic needs. In fact, when the network is dense, shortest paths tend to be more solicited. Consequently, congestion is created on these paths as well as on their neighborhood. This second point is particularly important because simulations have shown that the neighborhood could be equally affected and sometimes more affected than the selected path itself. To offer good end-to-end delay to real time applications, it is better to use the delay as a metric.

PROPOSED METHODOLOGY

In order to mitigate the effect of mobility, MPR selection criteria must be focused. During MPR selection process, OLSR considers reachability and degree of the node. No. of nodes that are reachable from current node is called its “Reachability”. While No. of symmetric neighbors of current node determine its “Degree”. W-OLSR considers both of reachability and degree along with other parameters viz., residual energy, signal strength and delay.

Steps to be followed during the process:

STEP 1: MPR selection criterion:

MPR links offer a sparse partial topology containing shortest paths. As in fig below, any 2-hop neighbor n of source s have selected some neighbor of s as MPR since s is 2 neighbor of n. Indeed, any node at distance d from s must have selected as MPR some node at distance d-1 from s. Use MPR link backward to route from s to d.

STEP 2: MPR selection based on W-OLSR

At Originating Node:

In W-OLSR, firstly it sends Hello message with additional values of residual energy along with sending time of hello. As we periodically receive HELLO messages from our neighbours (by default every 2 seconds), we have enough packets to determine updated values of residual energy and sending time. These transmissions are so frequent, that it can even accommodate little “hello packet” loss.

Weighted MPR= X.Residual Energy + Y.Signal Strength + Z.Transmission delay
Where X,Y and Z are constants

At Receiving Node: At receiving node, we determine link to be bad or good by measuring residual energy, transmission delay and signal strength.

Weighted MPR = $x(E_{res}) + y(S) - z(D_t)$

Where E_{res} is residual energy, D_t is transmission delay and S is the Signal strength to transmit packet p**.**

STEP 3: Link Sensing

OLSR performs link sensing in order to retrieve updated status of it adjoining links and neighbors. With link sensing it generates Link Tuple and Neighbor Tuple. In W-OLSR, weight is added to tuple in order to get updated weight value with each transmission of hello message.

STEP 4: MPR Computation

Ultimately, MPR is computed provided weight should be greater than weight_threshold value. Thus, combined effect of these parameters will determine our link quality. Values of these will select best MPR called as **Weighted-MPR**. For MPR selection implementation in W-OLSR, it initially sends "HELLO" message with residual energy of current node along with sending time of hello packet. At receiving point, receiver node will detect signal strength of the communication link through which HELLO has arrived. Also, it will check current time at which message has arrived to receiving node. With sending time and current time, we can calculate transmission delay.

Hello Packet Sending Routine

Send Hello ()
{
hello Packet -> Residual energy = node current energy()
hello Packet-> send time = CURRENT Time
// existing OLSR code
}

Hello Packet receiving Routine

Receive OLSR packet ()
{
If (hello packet)
{
signal strength= receive signal strength
weight=(0.6(E_{res}) + 0.5(S) - 0.1(D_t))
Process Hello ();
}
}

Hello Processing Routine

Process hello ()
{
Add link tuple with weight ()
//existing OLSR code
}

MPR selection Routine

MPR selection ()
{
create neighbor set() // neighbors with max weight value is considered
create 2hop neighbor set()
// existing OLSR Code
}

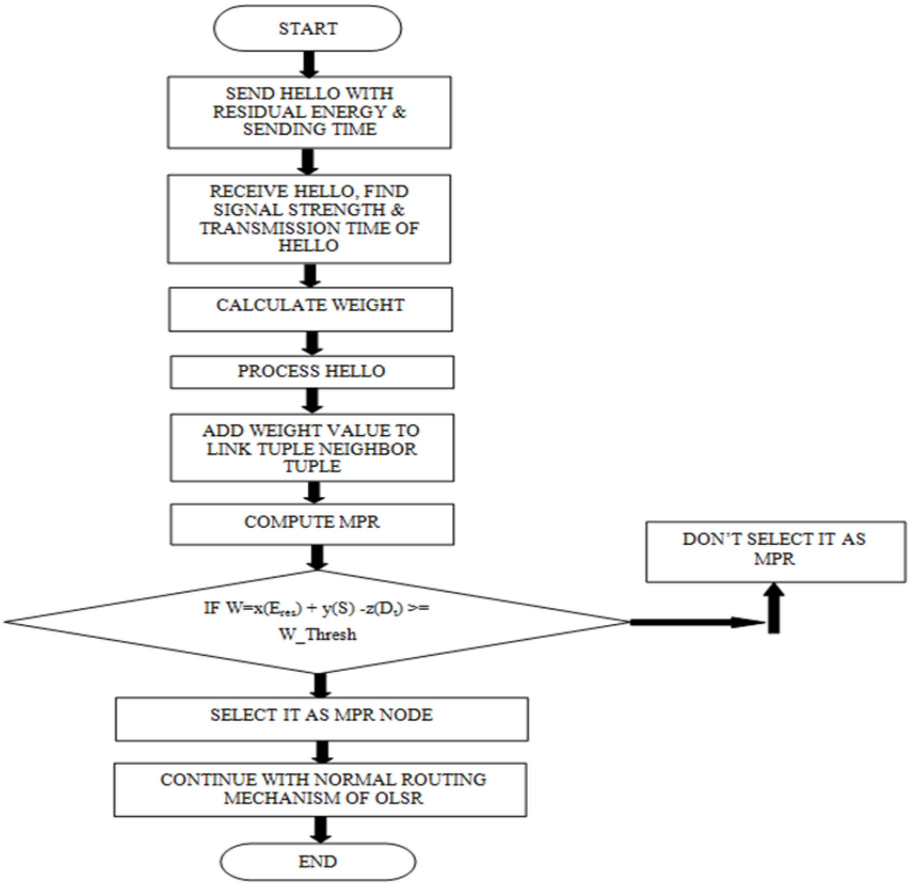

Fig 2. Flow chart of W-OLSR

RESULT AND DISCUSSION

Table 1: Simulation Parameters

Simulation Parameters	
Propagation Model	TwoRayGround
Network Type	IEEE 802.11
Mobility Model	Random Waypoint
Queue Length	50
Topology Area	1000 x1000
Number of Nodes	50
Willingness	3
Simulation Time	200s
Transmission Power	1.2 Watt
Receiving Power	0.6 Watt

Average end to end delay Vs Mobility

The mpr selection procedure has become more complicated and the time taken for selecting the mpr node is a higher than that of the normal selection procedure which leads to a higher end to end delay. But when the mobility of the nodes in less and once the mpr is selected W-OLSR is able to perform better than OLSR.

Normalized overhead Vs Mobility

Normalized overhead is the ratio of control packet and data packets in the network. As the mpr selection is more stable in W-OLSR than in OLSR, the routing packets or other control packet need is decreased and hence the overhead in the network decreases by a considerable ratio than that of OLSR.

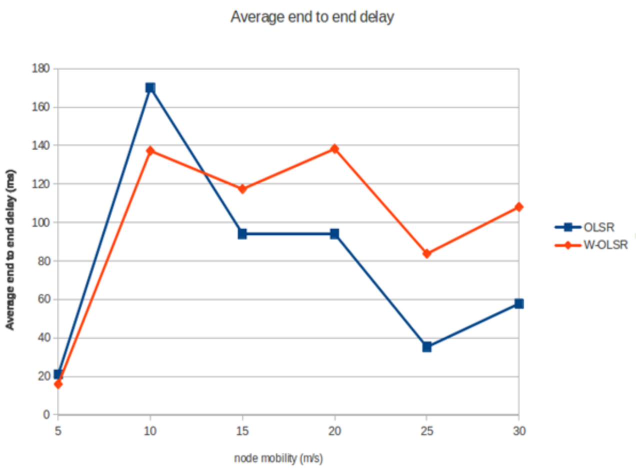

Fig 3: Average end to end delay Vs Mobility

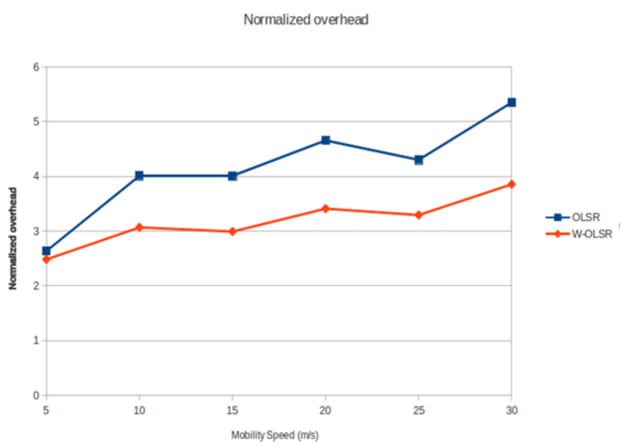

Fig 4: Normalized overhead Vs Mobility

Packet Delivery Ratio Vs Mobility

Packet delivery ratio is the ratio of packet received at destination with the total number of packets sent by the source. Since, MPR is selected with consideration of signal strength, it won't select link with poor quality. And thus W-OLSR gives higher packet delivery ratio in comparison to default OLSR.

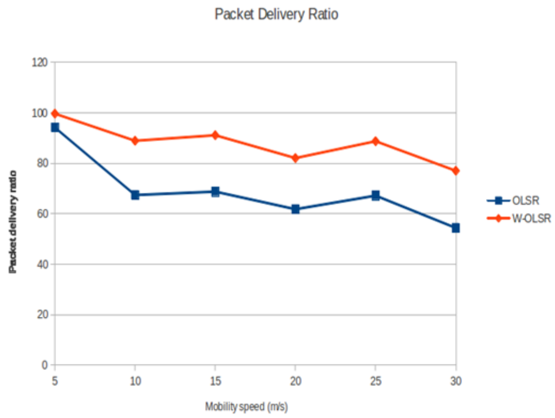

Fig 5: Packet Delivery Ratio Vs Mobility

Throughput Vs Mobility

Throughput of W-OLSR increases with increase in mobility because the mpr is more stable and the route break frequency is decreased due to more stable routing. The result shows that W-OLSR can be much beneficial in highly mobile scenarios.

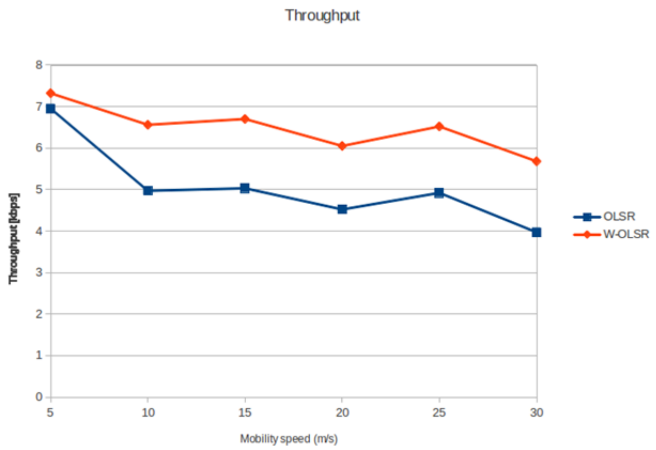

Fig 6: Throughput Vs Mobility

CONCLUSION

OLSR is one of the protocols which have lost major research attention. So, we have undertaken OLSR in order to enhance its efficiency during higher mobility in network. OLSR shortlists certain nodes called as "MPR", which further relays packets in network. This MPR selection is based merely upon connectivity and reachability. Thus to enhance it, we have proposed a new MPR- Selection mechanism with which it can select healthier link thus giving boon to network throughput even under more mobile networks. A weighted MPR approach not only focuses on its mobility but also considers transmission delay and residual energy of nodes. Thus improving our network throughput

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