MINIMUM ENERGY CONSUMPTION IN ROUTING OF MOBILE AD HOC NETWORK

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Abstract: In this paper, Modification of Dynamic Source Routing for MANET is implemented. This protocol will reduce energy consumption in MANET , maintaining connectivity in the network and reduce the overhead of Basic DSR. The final result is that energy spent in transmitting overhead packets is reduced. Th reduction allows more energy in transmitting data packets. The Dynamic Source Routing (DSR) protocol is altered to implement the modified protocol.

1. Introduction:

In Mobile Ad Hoc Networks (MANET) there is a need of providing messages to a group of mobile nodes. If the mobile nodes are not within the transmissionr anges,will communicate using multi hop fashion. Hence the availability of each node is equally important to the operation of the network. The failure of single node can greatly affect the overall performance of the network. The energy source of a mobile node is usually a battery, and battery drainage is one of the major reasons for node failures. In order to utilize the limited energy source effectively and extend the lifetime of the network, Modified DSR routing protocols have been proposed for MANET that uses different approaches to save energy.

Many Routing Protocols have been proposed in MANET to achive energy conservation.These protocols use different approach to save energy. These Protocols are broadly classified as i) Transmit Power Control approach[3],[4][5],[6]ii) Load Distribution approach[7][8][3].

Routing protocols need to scale to networks with thousands of nodes.Typical examples of large adhoc networks are technical festivals in universities and military communication networks (which involve hundreds to thousands of devices). Maintaining routes in large networks becomes cumbersome due to longer path lengths between node pairs. Longer the paths, more the number of nodes on the path and more is the possibility of route breaks because, any single node failure disconnects the source from destination.

The limitations of existing ad hoc routing protocols in supporting Scalability is Proactive routing protocols are based on either link-state or distance-vector routing schemes. These protocols compute routes to all the nodes in the network, and maintain them in background by periodically exchanging routing updates.

Hierarchical routing protocols reduce the overhead generated by periodic updates, using clustering. Hierarchical state routing (HSR) groups nodes into clusters based on their geographical proximity, and a node in the cluster is elected as cluster-head to represent that cluster. On-demand routing protocols are credited to be adaptive to the dynamic environment of adhoc networks, due to their low routing overhead and quick response to route disconnections.

choice of the shortest route causes excessive use of sources such as energy and bandwidth[1].Recently, cooperative communication has been taken as a promising technique and through the cooperation of users quality of service (QoS) can be improved in wireless networks [2]

2. Overview of Modified Dynamic Source Routing :

The Modified protocol is derived from the Dynamic Source Routing (DSR) protocol by modifying the control messages of DSR protocol. The Protocol works in two phases:

- Route discovery
- Link-by-link power adjustment.

During the discovery process, different power levels are used to identify routes that can return low energy routes in data transmission. During this process, a source node first tries to discover a path using a low power level. If that source cannot discover a route using that low power level (i.e. transmission radius of 125m), it will switch to a higher power

level (i.e. transmission radius of 250 m). Using two power levels in the route discovery reduces the route discovery time and also reduces overhead. In the Modified protocol, once routes are discovered by using any of the two power levels, the transmit power levels of the nodes along those routes are adjusted link-by-link to the minimum required levels. With this adjustment, the nodes transmit a packet to other nodes at the minimum power level that can reach the next hop. This also leads to across-layer design, where network layer control packets, such as a request packet, are used to determine the transmission radius of a node. Moreover, route reply packets are used for determining the minimum transmission power link-by- link.

It is shown by simulations that the Modofied reduces energy consumptions in the network compared to the DSR.

Hierarchical Modified DSR: The Hierarchical modified is similar to the basic Dynamic Source Routing (DSR), but designed to minimize the energy use in transmission. The hierarchical approach limits the number of routing control packets, and the minimum energy approach limits the energy use in the Hierarchical DSR protocol. Simulation results show that the Hierarchical DSR can reduce overhead as well as save energy using minimum transmit power. The overall result is that the Hierarchcial DSR protocol can send more data packets the destination by using the same amount of initial energy compared to the basic DSR protocol.

3. Overall description:

Modified Dynamic Source Routing: The Modified Dynamic Source Routing protocol is a basic modified form of the DSR protocol. The modifications are made to the DSR route discovery mechanism to allow for energy awareness and efficient operation of the protocol. This protocol consists of two basic mechanisms:

- multiple power level route discovery,
- link-by-link power adjustment.

Route request packets are used to discover a route that is more energy efficient and route reply packets are used to adjust transmit power link-by-link. The route discovery mechanism in the Modified protocol uses several power levels in the route discovery process. The nodes try to obtain a route to the destination by initially transmitting at low power levels. If they are not successful at this level, they increase their transmit power level and try again. This process continues until one of the power levels returns a successful discovery. In the implementation phase, two power levels are utilized; one is low and the other one is high power levels.

Mohammed Tarique and Kemal E. Tepe (2009) [6] have proposed Minimum Energy Dynamic Source Routing (MEDSR) and Hierarchical HMEDSR (HMEDSR). Their performances were investigated via computer simulations.

Quansheng Guan et.al [9] have introduces physical layer cooperative communications comprised with topology control to improve the network capacity of MANETs.

Root discovery: Cheng and Heinzelman have [7] (2008) disputed that many routes in ad hoc networks are short lived, triggering frequent route discovery processes, which in turn report for extra control overhead and packet latency.

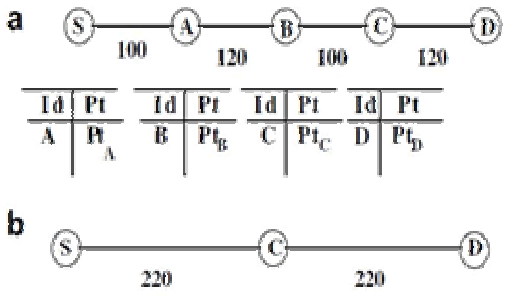
The route discovery process of the Modified protocol using low power level is depicted in Fig 1, where the source node S has some packets to send to the destination node D. Node S initiates a route discovery process by broadcasting a request message at low power level (i.e.range of 125 m). The route request packet of the DSR protocol has been modified to carry power level information in the packet header. When the next hop node A receives the request packet, it determines whether it is the destination or not. Since A is not the destination, it adds its address to the request packet and forwards the request packet to its neighbor at the same power level at which it received the packet from source S.

This process goes on until the request packet reaches the destination node D. After receiving the request message, node D replies back after copying the routing information accumulated in the request packet into the route reply packet. The

route reply packet of DSR has also been modified to carry power level information, and that field has a copy of the power level information contained in the request packet. Suppose node C receives that reply packet, and measures the received power level, Precv. Since the route reply packet contains the transmit power level information, Ptx, of node D. Node C can estimate the required minimum transmit power to reach node D by taking the difference.

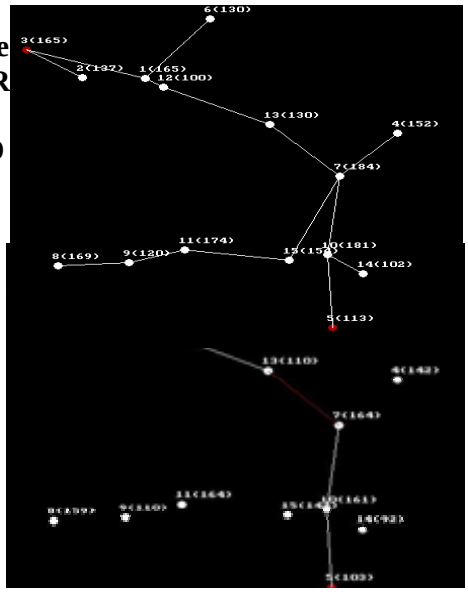
Pmin=Ptx – Precv + Pth + Pmargin

Pth in IEEE 802.11 Wireless Local Area Network (WLAN) card is 3.652 X 10-10Watt. After the adjustment, node C determines the required transmit power to reach node D and stores this minimum transit power in a power table. While transmitting packets, each node uses its power table to determine the minimum transmit power to reach the next hop along the route and uses this power level to forward the packet to the next hop. In that scenario, since the link distances between two nodes are less than 125 m, the source node is able to discover the route. But there are some cases where a source cannot discover a route at the low transmit powerlevel as illustrated in fig 1 b. In that case,the source node switches to a high power level route discovery.The distance between nodes is 220 m. In the Modified DRS protocol, if a source cannot find a route by sending three route request packets, it assumes that it cannot reach the destination with the low power level, and will then attempt to find a route with a high power level.



Route Discovery Fig.1 with a) Low Power b) High Power

Modified DSR ROOT DISCOVERY: In the Modified DSR protocol, if a source cannot find a route by sending three route request packets, it assumes that it cannot reach the destination with the low power level, and will then attempt to find a route with a high power level.



Modified DSR PACKET TRANSMISSION

4. The Hierarchical Modified Dynamic Source Routing (HDSR) protocol:

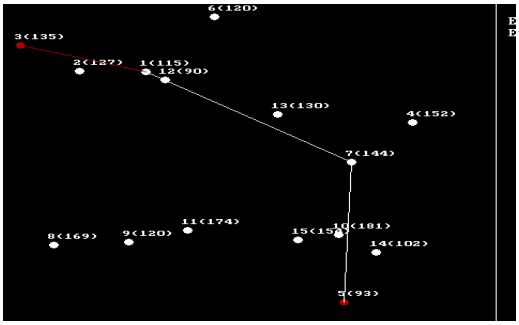
The Hierarchical DSR protocol is a combination of both the Hierarchical Dynamic Source Routing and the Modified Dynamic Source Routing protocols. In this a source node initiates a route discovery, first with a low power level.If this is unsuccessful, it tries again with a high power level. But how these route discovery packets are handled by neighboring nodes is different. In the Hierarchical Modified DSR, after receiving a request packet,an intermediate node initiates a forwarding node selection mechanism. In that mechanism, the node goes into a back-off time, as in the Modified DSR protocol, as opposed to transmitting the request packet immediately, as in the Modified DSR protocol.

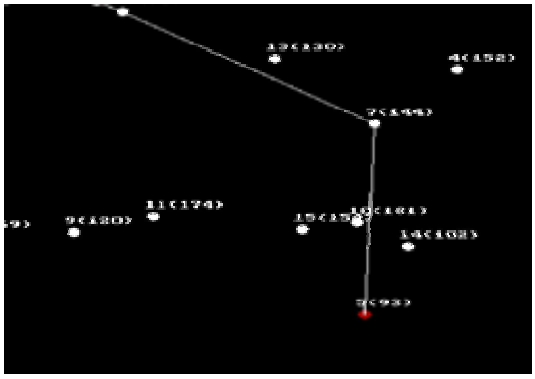
The back-off time will be smaller for those nodes that have higher energy levels. Hence, nodes that havehigh energy are more likely to become forwarding nodes and are more likely to participate in the network operation.

Thus, the overall network life time is increased by reducing the number of

'dead' nodes in the network. The node whose back-off time is the smallest will time out first, and then it will rebroadcast the request packet. The nodes that are still in the back-off phase will hear this communication and they will stop their timers and save the remaining time period for future use. This process continues until a route is found to the destination. If a route discovery fails to return a route, the source initiates a new route discovery. At this time, nodes that did not broadcast the request packets previously will broadcast the request according to how much time is left in their timers.

Hierarchical Modified DSR Route Discovery

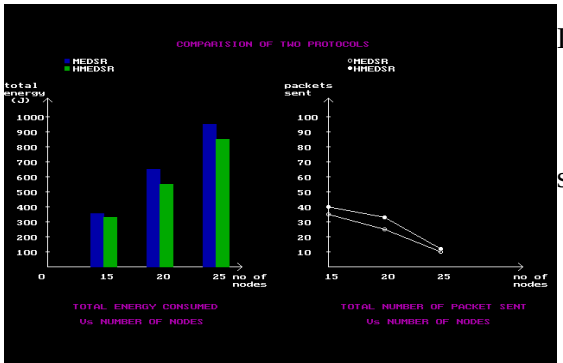




Hierarchical Modified DSR Packet Transmission

5. COMPARISON OF PROTOCOLS:

Comparision of Modified DSR and Hierarchical MDSR



6. CONCLUSION:

The two new protocols are sudied: Modified Dynamic Source Routing (MDSR) and Hierarchical Modified DSR (HMDSR) working and their performances are identified through computer simulations. Modified DSR was found to improve energy efficiency and network lifetime, as compared to the simple DSR protocol, especially in dense networks. However, the energy efficiency drops with increasing network size due to routing overhead and MAC layer packets. A considerable portion of the total energy is dissipated by the overhead packets in these networks. In order to limit this overhead and improve MEDSR, HMEDSR is introduced.The HMEDSR protocol eliminates unnecessary overhead packets, and improves considerably the performance of MEDSR. Both the HMEDSR and MEDSR provide a great improvement over the DSR for energy efficient operation in MANET. It is shown that the total energy consumption by different types of packets is always less using the MEDSR protocol. The energy savings increase with the network size. Since overhead of the MEDSR protocol has been further reduced by using the HMEDSR, even more energy saving can be realized by using the HMEDSR protocol instead of DSR in MANET networks.

References:

1. P. Dhaval, R. Arpit, "Power Aware Routing Protocol to Extend Life-Time of MANET", International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 10, 2012.

2. F Richard Yu, Helen Tang, Shengrong Bu and Du Zheng, "Security and quality of service (QoS) co-design in cooperative mobile

ad hoc networks", EURASIP Journal on Wireless Communications and Networking, Vol.188,pp.1-14, 2013.

3. Doshi S.,Bhandare S,Brown T.X " An on-demand minimum energy routing protocols for Wireless adhoc Network", ACM SIGMOBILE Mobile Computing & Communication Review Vol6,Issue 2, Pages50-66.

4. Banarjee S,Misra "Minimum Energy path for reliable communication in Multihop Wireless Network"in proceedings of the ACM Annual workshop on Adhoc networking and Computing june 2002,pages 146-156.

5. Narayanaswamy S,Kawdia V, Srinivas RS., Kumar PR "power control in adhoc Networks:Theory,Architecuture,Algorith ms and Implementation of the Compow protocols" in proceedings of the european Wireless conference-next generatation of wireless networks;Technologies, protocols,services and applications Feb2002 pages-156-162.

6. Mohammed Tarique and Kemal E. Tepe, "Minimum energy hierarchical dynamic source routing for Mobile Ad Hoc Networks", Elsevier- Ad Hoc Networks, Vol.7, pp.1125-1135, 2009

7. Z. Cheng, W. Heinzelman, "Discovering long lifetime routes in mobile ad hoc networks",ELSEVIER- Ad Hoc Networks, Vol.6 (5), pp. 661–674, 2008

8. Quansheng Guan, Shengming Jiang, F. Richard Yu, and Victor C.M. Leung, "Topology Control in Mobile Ad Hoc Networks with Cooperative Communications", IEEE Wireless Communications, Vol.19, pp.74 – 79, 2012

9. Quansheng Guan, Shengming Jiang, F. Richard Yu, and Victor C.M. Leung, "Topology Control in Mobile Ad Hoc Networks with Cooperative Communications", IEEE Wireless Communications, Vol.19, pp.74– 79, 2012