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Designing an Energy Saving Mechanisms for Hybrid Routing Protocols in Manet

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Abstract: In Mobile ad-hoc Network, routing is the challenging task due to load balance, traffic and network size, node mobility. Loads on the nodes appear in two aspects: energy consumption and traffic consumption. Unbalanced energy consumption leads to network partition, node failure and decrease network lifetime. The energy efficient routing based on load balancing scheme can spread out data transmission and is free from overburden of nodes. It can be achieved through creating alternatives for effective utilization of available resources. To keep the network long lifetime and network alive, energy conserving operation is the key technique based on using load balancing techniques. In this paper, we deliberately designed Adaptive Fidelity Zone routing protocol (AFZRP) to integrate the energy balancing with the zone routing protocols. The parameter per node energy consumption and packet delivery ratio is compared with the both the routing protocols using NS-2.34 Simulation tool.

Keywords: MANET, Routing Overhead, End-to-End Delay, load balance, Adaptive Fidelity Zone Routing, IZRP.

1. INTRODUCTION

Ad hoc network do not rely on existing infrastructure, they can be rapidly deployed to provide robust communication in a variety of hostile environment. Routing algorithms for MANET's require high efficiency because of limited resources in a mobile node such as battery power, memory capacity and network bandwidth. Hence, routing in MANET is extremely challenging task. Due to node mobility, the network topology changes frequently, then optimized route will probably unavailable after short period. This may result in frequent update of route to the network by flooding the control packets that consumes precious network resources. Therefore discovering and maintaining the route in MANET environment is complex [1].

There are different issues in MANET. Several routing protocols were designed for such an environment. The routing protocols can be classified into proactive, reactive, hybrid protocols. Proactive or table-driven protocols try to maintain routes to all the nodes in the network at all times .Examples are Destination Sequenced Distance (DSDV) [7], Optimized Link State Routing (OLSR), Wireless Routing Protocol (WRP) and Reactive or on-demand protocols attempt to find a route to the destination, only when the source has to send the packet to destination. Hybrid protocols are combined with the pros of proactive and reactive protocols.

Long network lifetime of routing path in a network is a very challenging task because energy of the nodes depends on the model, size, and capacity of battery [2]. The limitation on power consumption imposed by radio wireless radio result in a node transmission range that is typically small. Due to node activities such as transmission, reception, overhearing result in depletion of energy in batteries continuously. Energy depletion of intermediate nodes can result in changes to the network topology. However, this can be minimized through an efficient selection of high energy intermediate nodes.

Rest of the paper is organized in the following manner: Section II describes the related work that includes energy consumption of node. In Section III we propose our node selection method in AFZRP. In

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section IV we summarize the results with the extensive simulation scenarios. Section V concludes the paper.

2. ENERGY CONSUMPTION OF NODE

Node in MANET serves as router/host generating, consuming or forwarding information [3]. These nodes are powered by batteries. The depletion of battery power in a routing path will shorten the network lifetime. It is necessary to use the available energy efficiently to extend the lifetime of the nodes [4-5]. Proposing an energy efficient routing scheme is one way of achieving heavily optimized path in MANET.

Normally, Nodes consumes energy while transmitting beacon signals to detect neighbor node and it consumes while transmitting data to another node. When the intermediate node actively participates in the communication consumes more energy than an idle node. Thus, the nodes residual energy is important for a node to successfully complete data transfer. Hence routing protocol that considers the node's residual energy will perform better than the protocols that do not.

3. SURVEY ON RELATED WORK

In recent years, many researchers focus to develop several power aware routing to extend the lifetime of networks [6]. This led to designed Enhanced Transmission power control Mechanism (ETPCM)[7] which calculates the required transmission power of the node. This calculation for all nodes will increase delay. And also it is difficult to find the signal strength of non-neighbor nodes. The author in [8] estimates the residual energy of individual nodes and maintains this to select the path for routing process. In some cases the routing may result in path damage since they select the node with low battery. The author in [9] has utilized alternate zones of various power levels to reduce the consumption of transmission in reactive mechanism in case of absence of peripheral nodes. Here, peripheral nodes are not found so it creates the alternate path. Hence it require re-establishment of routes and routing update would be necessary so it takes more time to routes recovery and accomplish packet delivery process when alternate zones are created. The author in [10] proposed a novel approach based on span which eliminates multiple retransmission of request by coordinator node and overhearing process.

4. ADAPTIVE FIDELITY ZONE ROUTING PROTOCTOL

Zone Routing Protocol is an example for Hybrid routing protocol which is suitable for large scale networks. It consists of both Proactive (IARP) and reactive (IERP) mechanism. Each node in this network covers a Zone of Radius r as shown in fig 1. When the destination is in routing zone then it invokes proactive

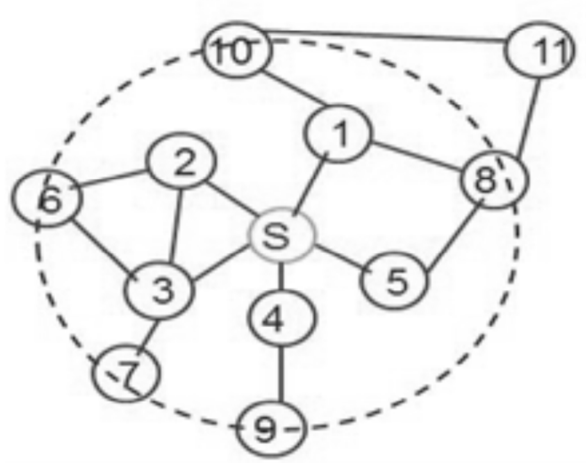


Figure 1: Routing zone with radius r = 2.

mechanism (IARP) and also when the destination is covered beyond the routing zone it invokes Reactive mechanism (IERP). Each node in this network maintains routing table by periodically broadcasting beacon messages to its neighbors with the help of Neighbor Discovery Protocol (NDP). Broadcasting of multiple queries leads to redundancy. Such redundancy can be eliminated by using suitable query control mechanism. It drops the query to the particular node which has been already covered by that query with same sequence.

Consider the network in fig-1, node S is the source node and the node S has the data packet to send to node 11. The radius of the zone is r=2 hops. By using the routing table provided by IARP the source node checks the destination whether it is present within its zone region. Since it does not find the destination in its routing table it forwards the query using IERP to the peripheral nodes 10, 8, 6, 7, 9 in fig 1. Each peripheral node checks the destination in its routing table. Now the nodes 6, 7, and 9 do not find the destination in its routing table so it repeats the border casting process. The node 10, 8 found the destination in its routing table since both the node has to send the same packet to the destination 11. It leads to more traffic. Finds the energy level both the node. The node that has the high probability of energy will be selected to forward the packet to destination 11. This is adopted by making peripheral nodes to sleep and wake up when the event occurs.

4.1. Proposed Energy Saving Techniques

Here we have designed an energy conservation algorithm for ZRP which focuses to diminish consumption of unwanted energy by scheduling and effective utilization of transmission power. The scheduling involves every node involves in three mode sleep, active, ideal mode. Time assigning them is Ts, Ti, Ta, to peripheral nodes in order to conserve the energy as much as possible. In accordance with AFZRP technique every peripheral node in ZRP are operated with effective sleep schedule approach as shown in fig 2. Whenever event occurs ie. Arrival of packet, receiving any request, makes the node wake up from sleep mode. As soon as a node finds that request from its neighbor during its idle period (Ti) it switches over to Active mode. In case if it finds no request or no message from its neighbors it immediately processes the request by entering in to sleep mode (Ts)

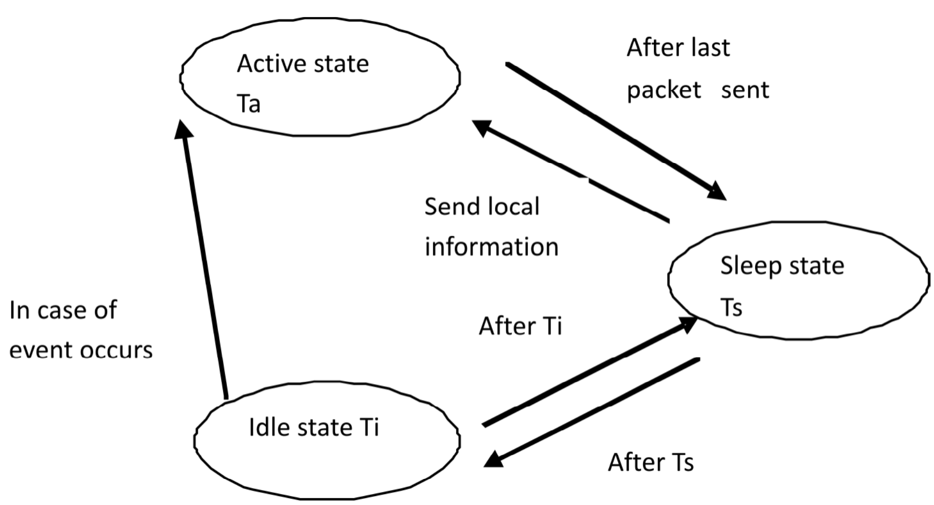


Figure 2: Sleep diagram of peripheral node

Ti = It is the time over which the node idle for any request

Ts = It is the time over which the node is in Sleep mode.

Ta = It is the time over which the node participates in Active Packet Delivery Process

In order to ensure the successful delivery of data packets, repeated transmission of requests to n+1 times would be necessary. It makes a node will reply for any one of the n+1 request when it is in sleep mode. This may slightly increase overhead in the network. Once the node wakes up it will not give much impact on latency and overhead. At time TA the node put into sleep mode should reduce power consumption Power A to Power S. When event occurs at time TE then node goes from sleep mode active mode for any packet delivery process. At the time TE to the start process becomes Energy overhead of the node.

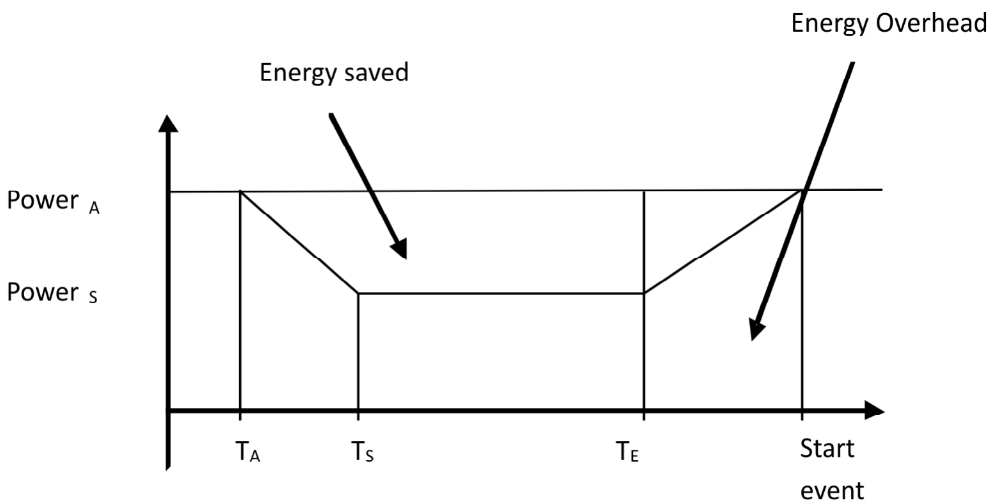


Figure 3: Energy saving in sleep mode

$$\text{Energy Saving} =(T_E-T_A)\ \text{Power}_A-(T_s-T_A)\ (\text{Power}_A+\text{Power}_S)/2 + (T_E-T_A-(T_S-T_A)\text{Power}_S \longrightarrow \qquad 1$$

Simulation parameters

Parameter	*Value*
Number of Nodes	20,30,40,50,60.
Grid Area	800*800
Initial Energy	100J
Traffic Model	CBR
Transmitter Power	0.2J
Receiver Power	0.1J
Data Packet Size	2000 bits
Antenna Type	Omni directional Antenna
MAC Type	IEEE 802.11
Antenna Model	Two Ray Model
Simulation Time	200 sec
Idle time (Tl)	1s
Sleep time (Ts)	3s
Active time (Ta)	20s
Idle Power	0.0005J
Routing Protocol	AFZRP, ZRP
Simulation Tool	NS-2.34

Consider a network consist of 11 nodes of radius 2 hops as shown in Fig 1. This shows how the nodes are responsible for three mode approach. In this node S is Source and node 11 is destination. When the source S has the data to deliver to the destination, node S checks the destination in its routing table and it found that the destination node is not covered by the source Zone region so it follows IERP. Node S broadcast request to its peripheral nodes (nodes 6, 7, 8, 9, 10) directly by using BRP (Border cast Resolution Protocol). As soon as the peripheral node 7 finds the destination in its routing table, it sends reply back to the source node S. The nodes S, 1, 2, 3, 4 and 5 are involved in process of route discovery and the remaining nodes are not participated in this process so it goes to sleep mode or low power mode. These nodes conserve their energy by switching into sleep mode when no event occurs.

ALGORITHM:

Step 1: Create dynamic topology with the mobility of the node.

Step 2: Routing zone has to form with the radius r=2

Step 3: If the destination is available in the routing zone then it invokes proactive mechanism () and if it available beyond the routing zone then it invokes reactive mechanisms ()

Step 4: Periodic broadcasting of beacon messages using Neighbor discovery routing protocol.

Step 5: If any event occurs in peripheral nodes then it wakes up and do the packet delivery process otherwise peripheral nodes are in sleep mode.

Step 6: proactive mechanism ()-Destination is in routing zone

- Routing table Maintenance and packet delivery process.

Step 7: Reactive mechanisms () –Destination is beyond the routing zone.

- Broadcasting of request to its peripherals using BRP and makes the node wake up
- Upon Reception of Request Checking of destination in its routing table and repeat it until it finds destination.
- Once the Destination is found the reply will be send back to source and use transmission power control technique.

6. RESULT

6.1. Energy Consumption

In mobile ad hoc Network Energy is the scare resource that is available that make use of it effectively is the challenging task that decides the life time of the network that it also contributes to the remaining QOS parameters. The graph shown in fig 7 shows that Adaptive Fidelity Zone Routing Protocol utilizes less

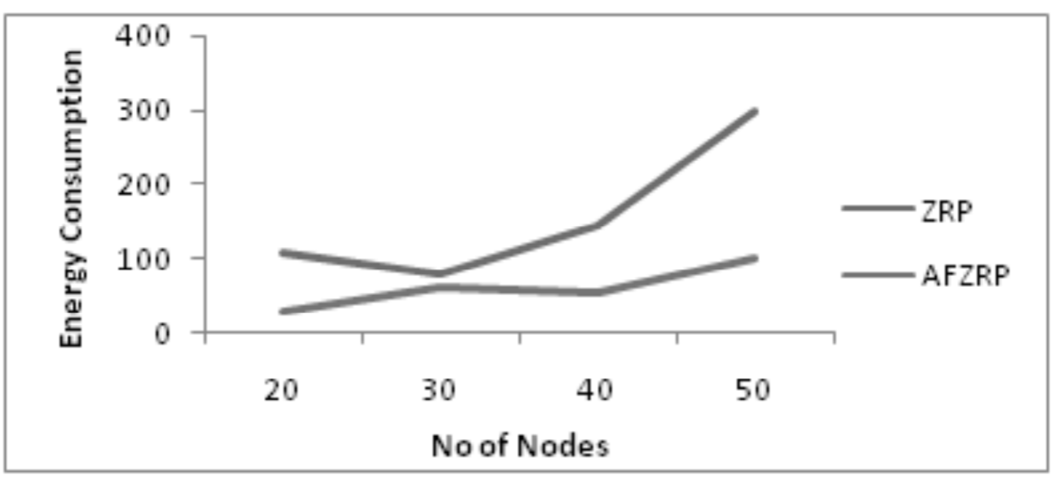
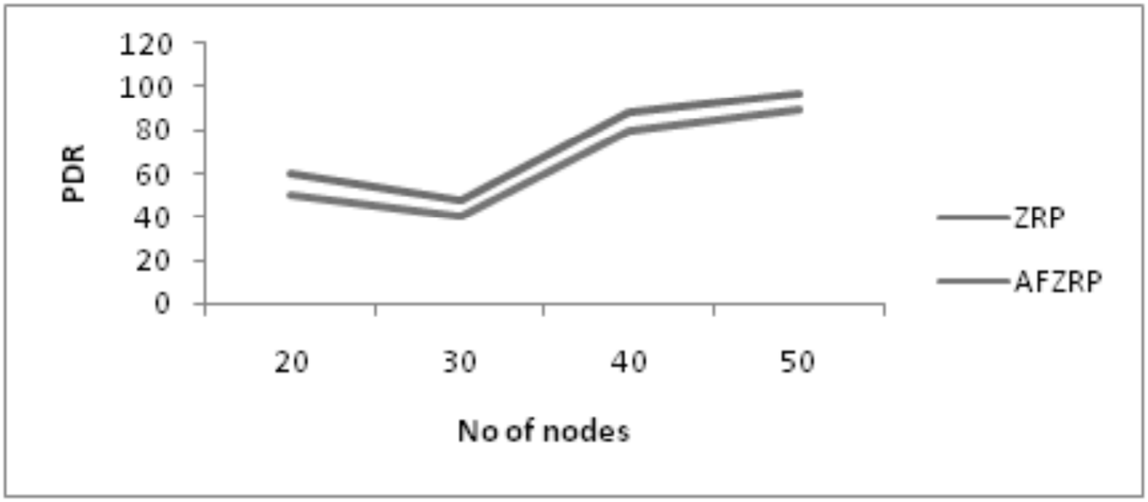


Figure 4: Energy Comparison between ZRP and AFZRP



amount of energy when compared with the Zone Routing Protocol. AFZRP conserves maximum amount of energy by putting the peripheral nodes into sleep mode when it is idle and extend its energy conservation during Active mode. As the number of nodes increases, utilization of energy also increases gradually but the conservation of energy in AZRP is more than basic Zone Routing Protocol.

6.2. PDR

Looking at the Packet Delivery Ratio shown in fig 5, pure ZRP maintains its PDR as an average of 60% and 45% in low and high density of nodes respectively. The adaptive fidelity Zone Routing Protocol has the PDR of 55 % and 40% under low and high density of nodes respectively. It is nothing surprises that reduction of PDR when we use Power saving techniques. Whenever the event occurs then only the node wake up a and does the packet delivery ration from sleep mode to active mode it takes time this is the reason behind packet delivery ratio.

7. FUTURE WORK

This paper designed novel way which mainly deals with conservation of Energy saving. The basic reason behind the issues of this paper such as reduction in Packet Delivery Ratio and increase in control overhead is receiving node could be in sleep mode when the event flow occurs. This increase in overhead is due to multiple retransmission take place because some packets may be dropped. This drawback can be rectified when it comes to practical by using Radio frequency tag to all the nodes in the network. The Radio Frequency tag helps to wake up the nodes from sleep mode when the event occurs. This helps to deliver the data packets without any loss and also it reduces multiple re transmission of requests.

8. CONCLUSIONS

In this paper we have deliberately designed a novel approach which conserves the energy of the mobile nodes as much as possible by following sleep mode approach. The simulation results were shown that Adaptive Zone Routing Protocol has better performance which can conserve 105% of energy under low density of nodes and 48% of energy under high density of nodes. It ensures that modified ZRP is effectively suitable for wide range of applications.

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