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Dynamic Power Management an Integrated Approach for Lifetime Enhancement of Wireless Sensor Network

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Abstract – Wireless Sensor Network is a resource constrained densely deployed network. The duration of the battery power has to be increased in the network to avoid frequent replacement of battery. There are many techniques under research to reduce the battery power, consumed by the network. One such technique is an integrated approach of dynamic path routing. This paper aims at implementing the dynamic power management through multipath routing – DPMM. This algorithm outperforms better than any other traditional protocols and aids in any enhancement of network lifetime.

Index Terms – WSN, Dynamic path routing, Multipath routing, network lifetime.

1. INTRODUCTION

Wireless Sensor Network is a network where the available resources are lower than any other network. This network consists of sensor nodes that are densely deployed over a specific geographical region. The data acquired through these sensor nodes will be transferred to the sink and to the base station for further use. The network schematic is given in the figure 1.

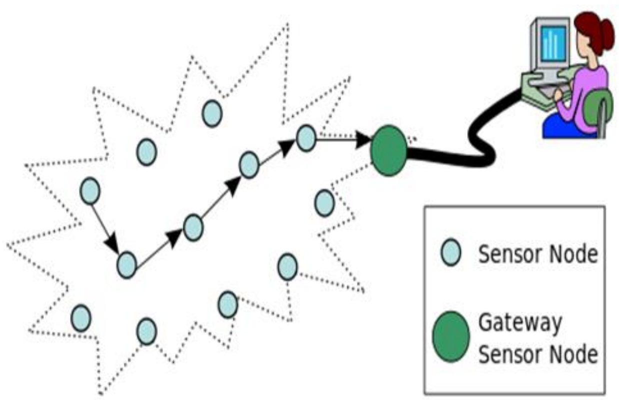

Figure 1 Architecture of Wireless Sensor Network

From Figure 1, it is identified that huge sensor nodes are deployed for the collection of sensory information. The collected information is transmitted to the gateway, which acts as a sink and then to the base station. Since the network is resource constrained, the major research challenge lies on increasing the lifetime of the network, thereby decreasing the power consumed by the network. The power consumption of the network is achieved by the design of novel algorithm and various approaches. They are, dynamic power management approach, routing techniques, congestion control etc. The few techniques of dynamic power management schemes and routing protocol through which the reduced power consumption is achieved are discussed here.

2. LITERATURE STUDIES

Sensor nodes consume power for the task such as computational task, transmission and reception of information, switching power, sensing power and overhead energy. The power consumption through these tasks is unavoidable, as these are minimum mandatory operation that a sensor node must perform. Hence, making the network to consume less power is not possible all the time, instead, it could be managed to increase lifetime. One such management technique is dynamic power management in which various methodologies are available. Figure 2 depicts various methodologies of dynamic power management schemes.

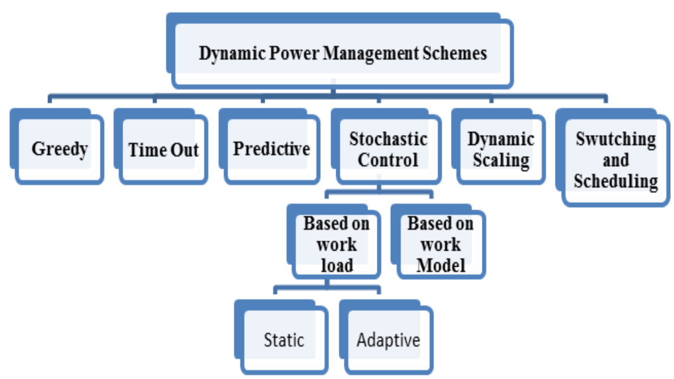

Figure 2 Various Techniques of Dynamic Power Management

Dynamic Power Management enhances the lifetime of the wireless battery powered network by making the nodes to sleep periodically. The sleep state entails minimal power consumption by a wireless device, but it also increases the average packet delay that the device encounters. The power management can also be established by varying the gating period of the system. Power management is a component that dissipates negligible power.

Design of the efficient protocol also plays a vital role in reducing power consumption. Techniques such as clustering, single hop, multi hop, multipath routing and single path routing etc are various methodologies implemented for the reduction of power consumption in a network. The base methods of cluster based routing are the clustering protocol approaches, to selection clusters and cluster heads. Finally, every CH will communicate with each other and transmits information to the sink. The methods of cluster formation and CH selection vary. Apart from cluster based routing, multipath routing will also converge to an energy efficient network.

As an integrated approach, this paper attempts to frame a protocol that initially sets up an active stochastic dynamic power management technique upon a network and upon which multipath routing is established as Dynamic Power Management through Multipath routing -DPMM.

3. METHODOLOGY

An Adaptive Stochastic control of Power Management Scheme is implemented and also to produce an integrated approach to implement power management and a routing protocol for bringing out more energy efficient network. The prediction of work load does not give a perfect trade off between latency and performance.Hence, it is always better to design a system based on work load that is adopted in real time. Stochastic techniques become essential to reduce the limitations of predictive methods.

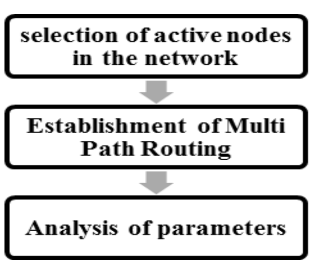

Figure 3 Flow diagram of the proposed work

It performs better and provides as the best substitution of heuristic policies. A prior knowledge is required to manage with the power of each component state and static workload. An approach that varies with the workload is called Adaptive approach and is non static. The implementation of the techniques can be done both at hardware and software. Management of power dynamically can thus be implemented at software level also rather than the hardware design. Thus, the energy efficiency of a sensor node can increase without requiring any specific power management hardware. Figure 3 shows the flow diagram of the proposed work.

4. IDENTIFICATION OF NEIGHBOURS

Initially all nodes broadcast the information of its node ID N_ID. The received nodes acknowledge with the receiver R_ID and residual energy of the node. Based on the signal strength the distance between two nodes is estimated. On estimating the distance, the neighbour table is updated with N_ID, R_ID, residual energy and distance. The selection of next hop is done based on distance and residual energy of the node. Each node is given a radius r. If the estimated distance is lesser than r, then the possibility of the node to get selected for next hop increases. Initially on trial and error basis the threshold of the residual energy is varied and attempted for various trails. Upon multiple trails the threshold of residual energy is fixed as 24% of initial energy and the algorithm is given in table 1 and the updating of neighbour table is shown in figure 4.

Table 1 Algorithm for DPMM

Algorithm DPMM	
Step 1	Assign all nodes with radius r
Step 2	Broad cast N_ID to all nodes in the network
Step 3	Receive ACK with R_ID
Step 4	Update Nieghbor table with N_ID, R_ID, Energy and Distance
Step 5	Nodes with distance less than r is selected for next hop communication
Step 6	On available multipath the shortest path is chosen for transmission

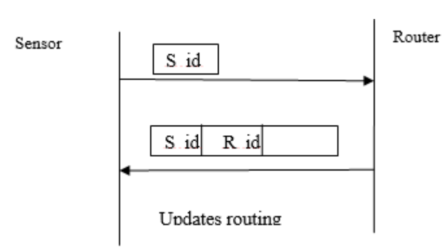

Figure 4 Neighbour table updating

5. RESULT AND DISCUSSION

The life time of cluster based and multi path routing based dynamic power management has been done and recorded for various percentage of active nodes and the same has been given in table 2 and figure 5.

TABLE 2 LIFE TIME OF THE PROTOCOL

ACTIVE NODES (%)	DPMC (No of rounds)	DPMM (No of rounds)
25	4720	4536
35	5400	4990
45	5646	5400
55	6900	6450
65	6940	6548
75	6962	6650

The packet deliver ratio and energy consumed details for DPMM technique is given in Figure 6 and 7.

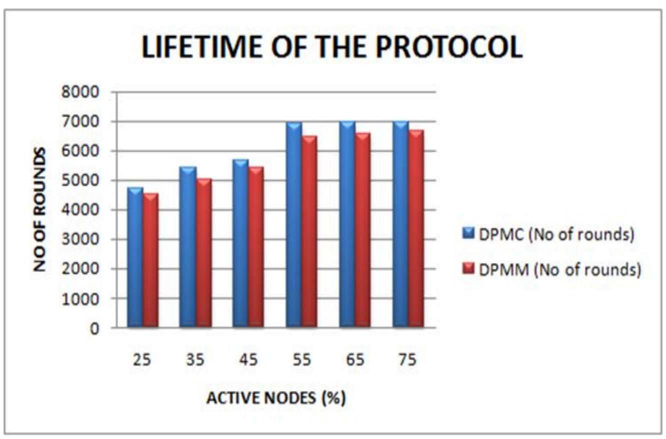

Figure 5 Life time of various protocols

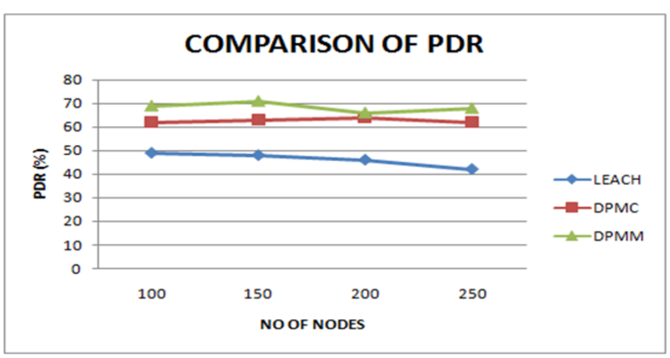

Figure 6 Comparison of Packet delivery ratio of DPMM

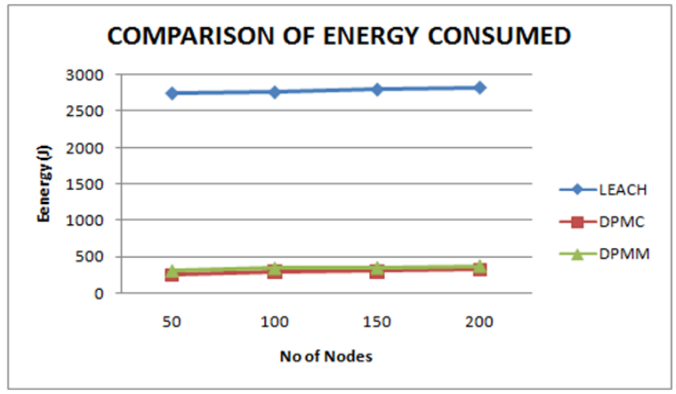

Figure 7 Energy consumed - DPMM

The average energy consumed by DPMC is 293 J and that of DPMM is 338 J. Hence the dynamic power management technique outperforms better than traditional protocols. This performance is 90% greater than the traditional WSN protocol LEACH. The average packet delivery ratio for DPMC and DPMM are 63 and 68% respectively. When compared to traditional protocol it outperforms better by a percentage of 63%.

6. CONCLUSION

The dynamic power management techniques serves better than any other protocol and also long with power management multipath routing techniques outperforms better than any other traditional protocols. An adaptive approach of power management and multipath routing implemented in the proposed work DPMM increases the lifetime of the network by an average of 90% when compared to LEACH and other traditional protocols. An average packet delivery ratio is 68%. An modified approach using soft computing techniques could be implemented to improvise the network life time.

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