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PEGASIS: A Cluster Based Topology for Performance Evaluation in Wireless Sensor Network Environment

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Abstract: *Wireless sensor network is a network comprising of different number of small nodes conveyed in the remote zones to play out the undertaking of detecting, calculation and information sending. These sensor nodes continue getting depleted in the energy at whatever point the information transmission stage comes into action. To accomplish a more drawn out lifetime these nodes are managed a different steering strategy which makes the correspondence amongst nodes and Base Station considerably more temperate regarding energy utilization. In this paper, a study of chain based topology being named as Power proficient Gathering in Sensor Information System (PEGASIS) has been reviewed. PEGASIS protocol is especially symbolic in little region organize. In the wake of concentrate different variations of PEGASIS, the research gap is being conveyed under the spotlight keeping in mind the end goal to improve organize lifetime.*

Keywords: *WSN, Routing Protocols, PEGASIS, LEACH and Power Consumption.*

1. INTRODUCTION

The Wireless Sensor Network (WSN), a specialized network, consists of two main components: 1. Sensor Nodes and 2. Base Station. The nodes monitor various environmental conditions (temperature, pressure, sound) and share (wirelessly) the information obtained with either the base station or amongst various nodes. WSN is foreseen to be appropriate solutions to many applications in fields of defence, industry monitoring, health monitoring, etc. Specific, data-centric protocols are the need of these sensor networks. The protocols should be able to collect data and optimize the energy consumption. The sensor nodes are programmed for monitoring or collecting data from the technologies. Development of tiny, low cost, low power, multi-functional smart sensor nodes have been made possible owing to the recent technological advancements in the fields of WSN, Wireless communication techniques and Micro-electro-mechanical systems (MEMS). The features of wireless sensor networks are listed below:

- *Varying network size*: The size of a sensor network can vary in size (1-100 nodes)
- *Low cost*: Sensor nodes should be inexpensive so that they can be used in large numbers
- *Long lifetime network*: Efficient protocols have to be designed and implemented so that the network can last as long as possible.
- *Self-organization*: Sensor nodes should be able to form a network automatically without any external configuration.
- *Cooperation/Data aggregation*: Sensor nodes should be able to aggregate data in a meaningful way would improve network efficiency.

The architecture of WSN is shown in Fig.1. It is shown that data collected from the sensing region is forwarded to the sink through the nodes and thereafter it is forwarded to the user via internet [1]. The sensor nodes are wirelessly connected to each other.

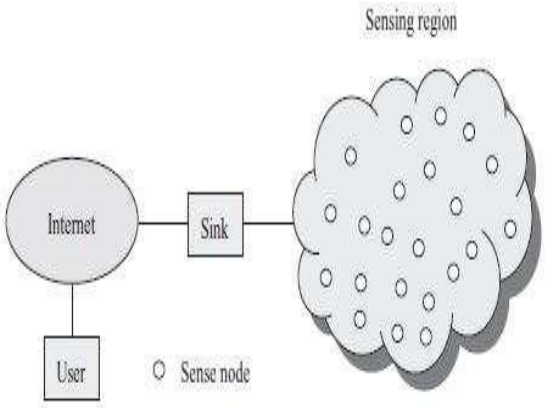

Figure 1: Architecture of Wireless Sensor Network

It's the routing which decides which node has to pass data to the other node in a particular determined path. So, routing becomes an essential element for energy saving and making the network operating for longer period of time [2-3]. Routing is basically of three types as shown in Fig.2. PEGASIS [4] is covered under hierarchical routing as different levels are formed through which data is forwarded to the Base Station.

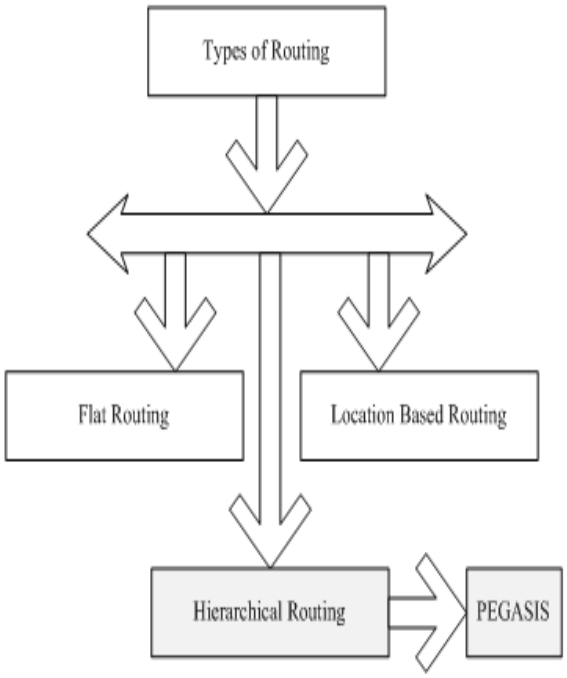

Figure 2: Types of Routing in WSN

2. DESIGN CONSTRAINT FOR ROUTING IN WIRELESS SENSOR NETWORKS

Due to the reduced computing, radio and battery resources of sensors, routing protocols in wireless sensor networks are expected to fulfill the following requirements:

- ✓ Autonomy: The assumption of a dedicated unit that controls the radio and routing resources does not stand in wireless sensor networks as it could be an easy point of attack. Since there will not be any centralized entity to make the routing decision, the routing procedures are transferred to the network nodes.
- ✓ Energy Efficiency: Routing protocols should prolong network lifetime while maintaining a good grade of connectivity to allow the communication between nodes. It is important to note that the battery replacement in the sensors is infeasible since most of the sensors are randomly placed. Under some circumstances, the sensors are not even reachable. For instance, in wireless underground sensor networks, some devices are buried to make them able to sense the soil.
- ✓ Scalability: Wireless sensor networks are composed of hundreds of nodes so routing protocols should work with this amount of nodes.
- ✓ Resilience: Sensors may unpredictably stop operating due to environmental reasons or to the battery consumption. Routing protocols should cope with this eventuality so when a current-in-use node fails, an alternative route could be discovered.
- ✓ Device Heterogeneity: Although most of the civil applications of wireless sensor network rely on homogenous nodes, the introduction of different kinds of sensors could report significant benefits. The use of nodes with different processors, transceivers, power units or sensing components may improve the characteristics of the network.

3. PEGASIS BASED PROTOCOL

Still PEGASIS had certain deficiencies. The below describes protocols are various PEGASIS based protocols that are designed to overcome those deficiencies. Each protocol takes into consideration unique factors and proposes its different version. Figure 3 shows the various PEGASIS based protocols.

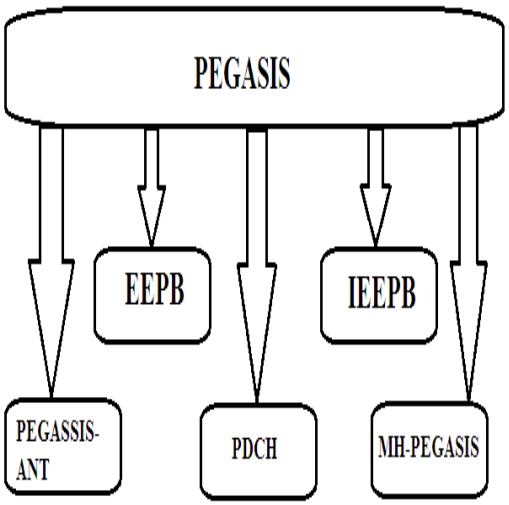

Figure 3: Various PEGASIS Based Protocols

It is an improved version of LEACH [5]. Rather than forming clusters, it is based on forming chains of sensor nodes. One node is mainly responsible for routing the aggregated information to the sink. Every node aggregates the collected information with its own information, and then passes the aggregated data to the next ring. The key idea in using PEGASIS is that it uses all the nodes to transmit or receive with its closest neighbor nodes. This is achieved by the formation of a chain as shown in the Figure 3 below. All the nodes which collect the data fuse it with the data received by the neighbor node and transmit it to the next nearest neighbor. In this way all the nodes receive and fuse their data, and pass it to the next neighbor in a chain format till they all reach the base station. Every node in the network takes turns as a leader of the chain and the one responsible to transmit the whole fused data collected by the chain of nodes to the base station.

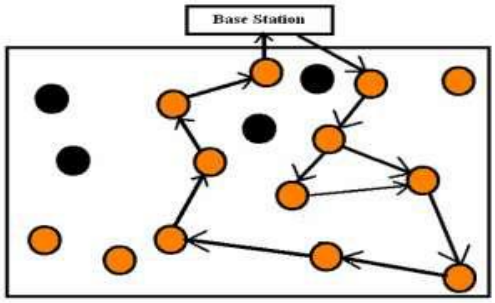

Figure 4: PEGASIS Chain Based Protocol

There are few disadvantages of this protocol such as:

a) PEGASIS assumes that each sensor node is capable of communicating with the BS directly. In practical cases, sensor nodes use multi-hop communication to reach the BS.
b) PEGASIS assumes that all sensor nodes have the equal level of energy and are likely to die at the same time.
c) PEGASIS introduces excessive delay for distant nodes on the chain.
d) The single leader can become a bottleneck for Application Field.
e) PEGASIS is greedy chain protocol which leads to lessen the overhead caused due to many cluster heads.
f) When a sensor node dies, chain is reconstructed to bypass the dead node.
g) Head node receives all the aggregated data and sends to the base station.
h) This protocol is most suited for surveillance application such as motion detection and knowing its characteristics.

4. PEGASIS STATE OF THE ART DEVELOPMENT

PEGASIS has given a breakthrough in the technological advancements by providing a flexibility in which this protocol can be implemented. There are following variants of PEGASIS protocols which use chain based method for the network lifetime improvement.

Mohsin Raza Jafri, et al. [6] recommended a multi-chain model of PEGASIS along with induction of sink mobility to maximize the network lifetime in this paper. Their considerations are supportive in diminishing the delay in data delivery and distances between the connected nodes through shorter chains. Sink mobility not only decreases load on the chain leaders in opening rounds, but also shorten the stress on unused nodes at the end of network lifetime. They also propose an algorithm for fixed path sink mobility in their design. Sink mobility has major gain on static sink in enhancing the network lifetime.

Ouadoudi Zytoune and Driss Aboutajdine [7] presented a new algorithm for gathering the data in WSN based on chain forming using greedy algorithm. It targets on equally circulate the energy load over the whole network nodes. To advert fast node dying, the leader role is better distributed over nodes. It is based on their required energies to transmit to the sink. Thus, the unified network nodes would have the same lifetime and then as result, the network lifetime would be protracted. The proposed technique allows balancing the transmission energy correctly over the whole network nodes,

which leads to network lifetime extension. The simulation results show the improvement provided by this technique compared to the well-known protocol for chaining in wireless sensor networks.

Samia A. Ali and Shreen k. Refaay [8] proposed an efficient routing protocol called CCBRP (Chain-Chain based routing protocol). It achieves both minimum energy consumption and minimum delay. The CCBRP protocol mainly divides a WSN into a number of chains using Greedy algorithm and runs in two steps. In the first step, sensor nodes in each chain transmit data to their chain leader nodes in parallel. In the second step, all chain leader nodes form a chain and randomly choose a leader node then all nodes send their data to this chosen leader node. This chosen leader node fuses the data and forwards it to Base Station (BS). Experimental results demonstrate that the energy consumption of the proposed CCBRP is almost as same as for PEGASIS and 60% less than LEACH and 10% less than CCM for WSN with hundred nodes distributed in 100m x 100m area. The delay of the proposed CCBRP is the same as of LEACH and CCM but 75% less than of PEGASIS.

Tarun Gulati et. al. [9] proposed this paper on node reliability in Wireless sensor network. Each sensor is defined with limited energy. Wireless sensor node utilized into the network to monitor the physical or environmental condition such as temperature, sound, vibration at distinct location. The protocol play significant roll, which decreases the delay while offering high energy efficiency and long span of network endurance. One of such protocol is PEGASIS, it is placed on the chain architecture, every chain have only one cluster head, this cluster head is in charge with every note's receiving and sending messages who reside to this chain, the cluster head depleted large energy and the times of every round growing. In PEGASIS, it takes the advantage of sending data to it the closet neighbor, it save the battery for WSN and growing the period of the network. The proposed work in this paper is about to select the next neighboring node reliably.

Nisha Sarwade et. al. [10] presented in this paper some of the major power-efficient hierarchical routing protocols for wireless sensor network used. In a hierarchical structure, bigger energy nodes can be used to process and send the information while low energy nodes can be used to execute the sensing in the adjacency of the destination. This means that creation of clusters and assigning special tasks to cluster heads can greatly contribute to overall system scalability, period, and energy decisive. Hierarchical routing is an efficient way to lower energy consumption within a cluster and by performing data aggregation and fusion in order to decrease the number of transmitted messages to the BS. Hierarchical routing is mostly two layer routing, where the selection of cluster heads is done by one layer and the other layer is utilize for routing.

Rathna.R and Sivasubramania.A [11] presented this paper based on environmental monitoring application of wireless sensor network. Clustering and routing are the two areas which are given more attention. This work is on the attempt to reduce the power consumption of nodes, by concentrating on the radio. The Cluster based sleep/wake-up scheduling process is approved in a simulated WSN and it validates to be decisive. Network Simulator (Ns-2) is used in this work for Simulation. The WSN is simulated by applying the clustering technique to the tree topography established by Shortest Hop path Tree (SPT) and Minimum Spanning Tree (MST). The clustering of nodes in a MST gives the best results. The proposed scheduling algorithm is completely TDMA based. It helps to reduce the energy depletion by reducing the number of times; a node has to move upward, during a slot of time, to be in active mode. The underlying concept in this paper is efficient usage of energy.

Razieh Sheikhpour et. Al. [12] Proposed ECCP, a novel Energy decisive Cluster-Chain based Protocol for wireless sensor networks that targets at protracting the lifetime of network, increase stability period and balancing energy absorption among sensor nodes. ECCP conducts sensor nodes into clusters by using multiple metrics and constructs a chain among the sensor nodes within cluster so that each sensor node receives from a previous neighbor and transmits to a next neighbor. ECCP also accepts chain based data communication mechanism for transmitting data packets from the cluster heads to the BS. By chaining the nodes in each cluster and using a isolated chain for the cluster heads, ECCP offers the improvement of small transmit distances for most of the nodes and thus helps them to be operational for a longer period of time by conserving their limited energy. The performance of ECCP is comparing with LEACH, CBRP and PEGASIS. The simulation results show that ECCP is more efficient in terms of network lifetime, stability period, instability period, adjusting energy expenditure among sensor nodes.

5. CONCLUSION AND FUTURE WORK

Wireless sensor systems have intrigued much worry for both common and military applications. Illustrations comprise of environmental observing, border protection, war zone and security observation. In these applications a colossal number of sensors are required, requiring watchful design and system administration. To help scalability, gathering nodes into clusters have been prominent strategy in

WSNs. In this work, we overviewed the status of research and ordered the distinctive bunching strategies. This paper classifies the scientific categorization of cluster based routing protocols. In this work, we focus on the benefits and confinements of various cluster based routing protocol. Based on correlation between various plans, unmistakably cluster based routing protocol are helpful in execution change of wireless sensor systems. This paper will be extremely helpful for the examination gather those are occupied with the improvement, adjustment or advancement of routing algorithm for WSNs.

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