Survey on Efficient Routing Models In Wireless Sensor Network

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***Abstract*— Wireless sensor network is most interesting and promising area of over the past few years and it the hot research area in the world. In the wireless sensor network efficient routing process can improve the data gathering and data abstraction process. So we need to study the different routing models. Here, this survey paper is mainly focus on the different routing models and compare the routing models. Based on these routing models we can improve the network lifetime and secure data transmissions. The advantages of efficient routing models are efficient data gathering, energy saving, and reducing the communication cost for data transmission.**

***Keywords*— Wireless Sensor Networks (WSNs), Clusters, Cluster Head (CH), Routing networks, nodes, sink.**

I. INTRODUCTION

Wireless sensor networks (WSNs) is one of the most interesting and promising area's over the past few years. A wireless sensor networks (WSNs) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, pollutants, at different locations. WSN are used to collect data from the environment. The networks are limited by the node battery lifetime. Sensor nodes are deployed in remote and hazardous areas, where manual monitoring is difficult. And it is difficult to charge or replace the batteries in the nodes, and like various problems.

The Applications of wireless sensor networks (WSNs) includes Military services, Forest fire detection, Environmental monitoring, Disaster relief networks, Vehicular technology, heath care services, medicine, surveillance, structural monitoring [1]. The wireless sensor networks have many advantages, they are it avoid lot of wiring, It can accommodate new devices at any time, its flexible to go through physical partitions, It can be accessed through a centralized monitor. The disadvantages are It is very easy for hackers to hack it as we can't control propagation of waves, Comparatively low speed of communications, Gets distracted by various elements like Blue-tooth, Still costly at large value.

The basic requirements of WSN are Low Power Consumption, usage, Scalability, Responsiveness, Range, Bi-Directional Communication, and Reliability. Factors influencing sensor network design are Scalability, network topology, Transmission media, and Power consumption. To avoid these to an extent, group sensors into clusters having one cluster head, which receives data from nodes and aggregate or fuse them and transmit to sink node. In wireless sensor network (WSN), introduces the concept routing data from ordinary nodes to the head of nodes; and head of nodes to the sink node.

Clustering improve network lifetime, and it is introduced in the wireless sensor network (WSN) a primary metric for evaluating the performance of a sensor network. The clustering techniques proposed for data processing typically consider many parameters, such as the distance between the nodes, and assume that nodes are more reliable in the network [3].

The wireless sensor network (WSNs) contains the problem of security of data transmission and data aggregation in the network. Efficient Routing can leads to improved security of data transmission and data aggregation. The routing approach process an important role in data gathering process. Wireless sensor networks (WSNs) are data driven network, produces large amount of information's that needed to be routed [5].

The energy efficiency is one of the major constraints in WSN. The efficient routing in the wireless sensor network is related to the efficient energy utilization techniques. The network topology may also change unpredictably due to node failure, running out of power, or adding new nodes into the network [4].

The major objective of this survey paper is to analyze different types of routing protocol models and find out an optimal protocol model for wireless sensor networks (WSNs). Efficient Routing can leads to improved security of data transmission and data aggregation. Hence, Protocols must be designed must leads to low computational power and low energy requirements in the network. Efficient routing protocol is a major design goal for Wireless Sensor Networks (WSNs). Since bandwidth and power battery are limited resources in wireless sensor networks (WSNs), thus an efficient way of utilizing these resources is necessary in the wireless sensor network (WSN).

II. LITERATURE SURVEY

In wireless sensor networks (WSNs) different routing models are exists, depending on the energy efficiency and secure data transmissions. This survey paper is mainly based on the different routing models mainly based on the cluster based wireless sensor networks, and the working of different routing

models in their proposed system models. The efficient routing methods can improve the energy efficiency, data aggregation, and secure and efficient data transmissions and network lifetime. This literature survey is mainly based on the different routing models in the wireless sensor networks.

In paper [1], describes about sensor networks made viable by the convergence of micro-electro-mechanical systems technology, wireless communications and digital electronics. Including sensing tasks and potential sensor networks applications. A review of factors influencing the design of sensor networks is provided. Then, communication architecture for sensor networks is outlined. In this paper [2], includes first break down the energy consumption for the components of a typical sensor node, and main directions to energy conservation in WSNs. They present a systematic and comprehensive taxonomy of the energy conservation schemes, in depth. Special attention has been devoted to promising solutions.

Paper [3], they discuss about the challenges in clustering a WSN, design rationale of the different clustering approaches, and classify the proposed approaches based on their objectives and design principles. In paper [4], it discuss about the multihop communications, energy concepts and limitations, and variations. In this paper [5], they discuss the state-of-the-art routing techniques in WSNs, and outline the design challenges for routing protocols in WSNs.

Paper [6], propose formal classification of sensor networks, based on their mode of functioning, as proactive and reactive networks. In paper [7], they propose a hybrid routing protocol (APTEEN) which allows for comprehensive information retrieval. And also study about the theoretical differences between the TEEN and APTEEN routing protocols. Because APTEEN protocol is advanced protocol of TEEN protocol, it includes both reactive and proactive networks.

In the paper [8], they present secure energy-efficient routing protocol (SERP) for densely deployed wireless sensor networks which aims to achieve robust security for transmitted sensor readings with an energy-efficient network backbone. In paper [9], study about data aggregation method and improve the network lifetime. Also study about energy saving methods.

Paper [10], they propose a novel Data Routing for In-Network Aggregation, called DRINA, that has some key aspects such as a reduced number of messages for setting up a routing tree, maximized number of overlapping routes, high aggregation rate, reliable data aggregation and reliable data transmission.

In paper [11], it is used for local detection and propagation in smart dust networks by efficient and robust protocols in wireless sensor networks (WSNs). Paper [12], it proposes an energy balanced data propagation in wireless sensor networks (WSNs). And also it gives energy balanced network lifetime for the system. In the paper [13], it gives detailed study of information fusion and its models. In the data aggregation and information fusion models.

Paper [14] proposes a model for clustering and energy efficient cluster head selection method for the wireless sensor networks. It is based on a circular monitoring area with a number of nodes and a sink node at the center of the network. In paper [15], proposes the energy management schemes and improves the network lifetime. In the paper [16], there are different types of routing algorithms exists including the LEECH, HEED, etc for the cluster based algorithms.

In the paper [17], they develop a LEECH algorithm; it is an application specific algorithm for the wireless micro sensor networks. It includes cluster based algorithm also. Paper [18], shows the energy models for local monitoring, so known as energy aware local monitoring [ELMO]. In paper [18] present survey on different energy efficient routing models in wireless sensor networks (WSNs). In this Paper [19], they proposes a method for local monitoring in wireless sensor networks (WSNs) and using the combined approaches including on-demand sleep-wake scheduling and guard scheduling methods. In this paper [20], it proposes the communication synchronization in an efficient manner through the relay nodes. In the Paper [21], propose the data aggregation method for reducing the energy consumption. In paper [22], proposes the data aggregation methods and about joint scheduling of tasks for the energy conservation in the wireless sensor networks.

In paper [23], they proposes a protocol called link-stability and energy aware routing protocol. This proposed approach for link stability and for minimum drain rate energy consumption in the distributed wireless sensor network (WSNs).

III. ARCHITECTURE

Wireless sensor network (WSN) are composed of different types of sensor nodes and a sink node. The nodes are deployed in large area of network, and the node deployment area is fixed for different simulations, and the nodes are selected as random numbers for each simulation. In the wireless sensor networks (WSN) the nodes are communicated by combining the nodes together, means the nodes are grouped together known as clusters, composed of cluster members and cluster heads (CHs) based on the energy consumption of each nodes in the group.

Wireless sensor networks (WSNs) are consisting of large number of sensor nodes and one or more Base Stations. The nodes in the network are connected via Wireless communication channels. Each node has capability to sense data, process the data and send it to rest of the nodes or to Base Station. These networks are limited by the node battery lifetime. Sensors are deployed in remote and hazardous areas, where manual monitoring is difficult. It is difficult to charge or replace the batteries, in the wireless sensor networks (WSNs) [1].

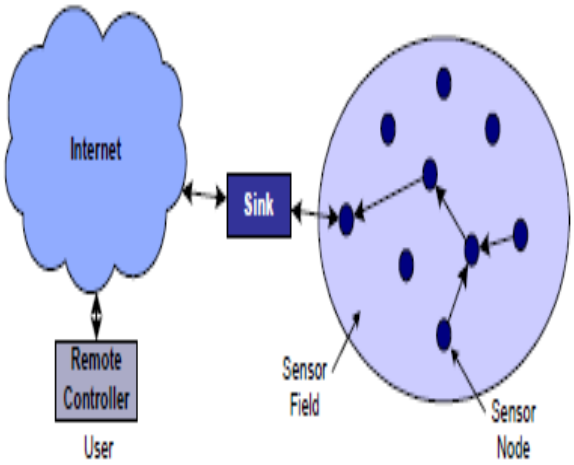

Fig. 1. architecture of the Wireless Sensor Networks (WSNs)

The wireless sensor networks (WSNs) includes many sensor nodes. The sensor node archicture is given below,

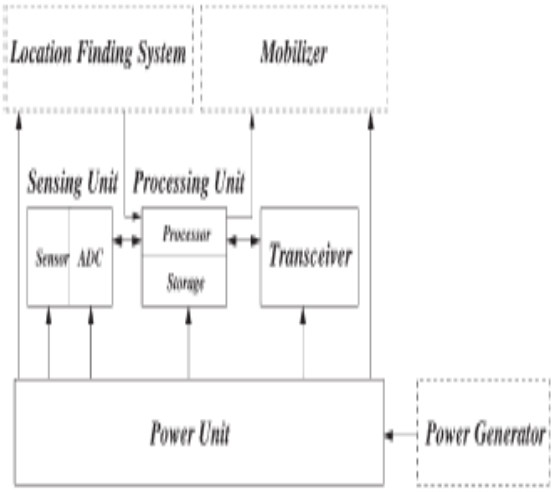

Fig. 2. components of sensor node

The large-scale deployment of wireless sensor networks (WSNs) and the need for data aggregation necessitate efficient organization of the network topology for the purpose of balancing the load and prolonging the network lifetime. Clustering has proven to be an effective approach for organizing the network into a connected hierarchy [3].

Different types of cluster communications,

- intracluster
- Intercluster

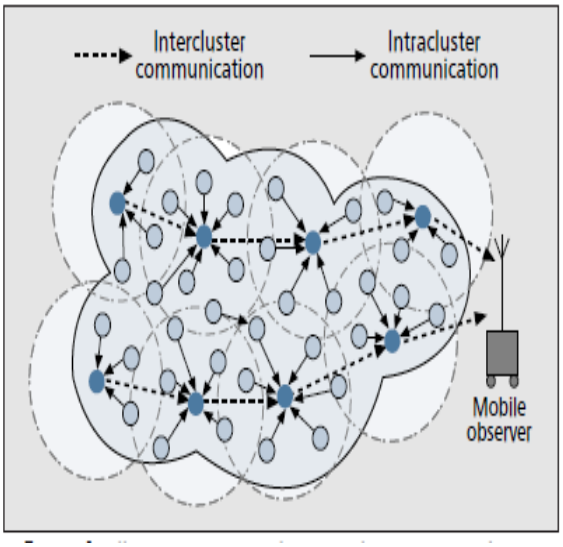

Fig. 3. Representing intercluster and intracluster communication

Challenges of cluster communications,

- how to schedule concurrent intracluster and intercluster transmissions,
- how to compute the optimal cluster size,
- How to determine the optimal frequency for CH rotation in order to maximize the network lifetime

This survey paper is mainly based on the different routing models. Efficient Routing can leads to improved security of data transmission and data aggregation. The routing approach process an important role in data gathering process. Wireless sensor networks (WSNs) are data driven network, produces large amount of information's that needed to be routed, in multihop fashion towards the sink node from the ordinary nodes. Routing data from ordinary nodes to the head of nodes and head of nodes to the sink node.

The routing is done by the sink node, which controls the communication between the ordinary nodes and head of the ordinary nodes. For routing it calculates the distance of each node to the sink node, and then according to that number it transmits data to that node. The sink node transmits data to its next hop neighbor, then that node transmits to its next hop neighbor and so on. Finally the data reaches its destination. The advantages of the routing concept are efficient data aggregation, energy saving, reduces the communication cost for data transmission.

In the wireless sensor networks (WSNs), routing approach process an important role in data gathering process [5]. Wireless sensor networks (WSNs) are data driven network, produces large amount of information's that needed to be routed. The routing architecture is given below,

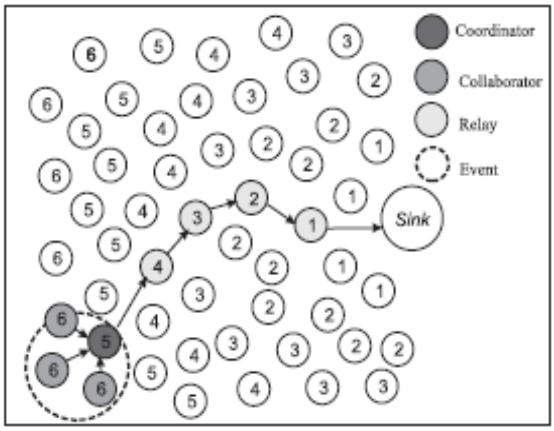

Fig. 4. Routing in the clustered wireless sensor networks

Different routing models are given below,

1. DRINA algorithm,

DRINA algorithm was extensively compared to two other known solutions: the Information Fusion-based Role Assignment (InFRA) and Shortest Path Tree (SPT) algorithms. Their results indicate clearly that the routing tree built by DRINA provides the best aggregation quality when compared to these other algorithms [10]. In the DRINA algorithm, it includes

IN-NETWORK DATA AGGREGATION
Three main timing strategies:

1. Periodic simple aggregation
2. Periodic per hop aggregation
3. Periodic per-hop adjusted aggregation

Various algorithms,

1. Tree based routing
2. Cluster based routing
3. Structure less routing

Roles of the nodes in this algorithm,

- ❖ Collaborator
- ❖ Coordinator
- ❖ Sink
- ❖ Relay

Four phases are exist in this algorithm,

1. Building the hop tree
2. Cluster formation
3. Routing formation and Hop tree update
4. Route repair mechanism

2. TEEN protocol

- Threshold Energy Efficient sensor Network protocol [6]
- Reactive Network Protocol
- The first time a parameter from the attribute set reaches its hard threshold value, the node switches on its transmitter and sends the sensed data.
- The sensed value is stored in an internal variable in the node, called the *sensed value (SV).*
- TEEN is well suited for time critical applications and is also quite efficient in terms of energy consumption and response time.
- Allows the user to control the energy consumption and accuracy to suit the application.

3. APTEEN protocol

- Adaptive Periodic Threshold-sensitive Energy Efficient Sensor Network Protocol [7].
- In this paper we have introduced Hybrid protocol APTEEN which combines the best features of both proactive and reactive networks and to provide periodic data collection as well as near real-time warnings about critical events.
- In reactive networks, if the thresholds are not reached, the nodes will not communicate and the user will never get any data from the network at all.
- The nodes in such a network not only react to time-critical situations, but also give an overall picture of the network at periodic intervals in a very energy efficient manner.
- Such a network enables the user to request past, present and future data from the network in the form of historical, one-time and persistent queries respectively.
- To overcome the drawbacks of *TEEN* we incorporated the periodic data transmission to form *APTEEN.*

4. SPIN protocol

- Sensor Protocols for Information via Negotiation [5].
- Uses negotiation and resource adaptive algorithms.
- Information process immediately using a user to query any node.
- Semantics is not specified.
- Types of messages, ADV, REQ, DATA.
- Flat routing

5. INFRA

- Information Fusion-based Role Assignment [10].
- This algorithm is used in data aggregation methods.
- It is the efficient method to improve the data transmission and data aggregation.
- Information fusion is done here.

6. SPT

- Shortest Path Tree algorithm [10].
- It is the algorithm used for tree formation
- Choose the shortest path algorithm
- Tree formation from node to sink.

7. SERP

- Secure energy efficient routing protocol [8].
- Contains different phases,
  1. tree construction and OHC initialization phase
  2. Network operation and secure data transmission phase.
  3. Optional key refreshment
  4. Repairing a broken path and OHC re-initialization
- Each level based on hop value.

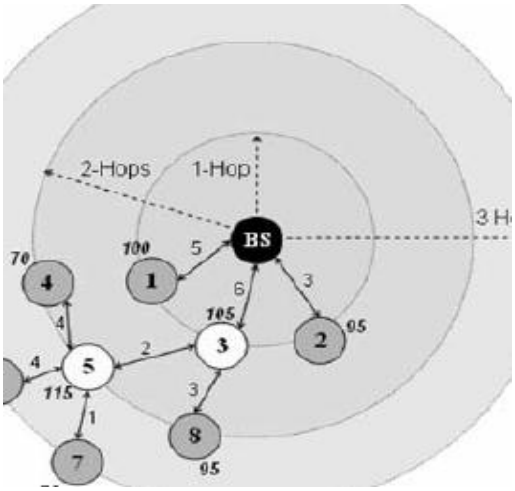

Fig. 5. Representing SERP protocol

- In this model, it is proposed as the corona based model, contains white nodes as active and gray nodes as non-forwarding status.

8. AODV
- Ad-hoc on-demand distance vector [4]
- It is an ad-hoc routing protocol
- Reduce the number of messages broadcast through the network.
- Keep complete updated information's of routing
- The process is check the rout table for valid route, if exist then forward the packet. Otherwise, execute the route discovery process by route request (REQ) message.

9. DIRECTED DIFFUSION
- Data aggregation paradigm [5].
- Data centric and application aware methods.
- In-network data aggregation by eliminate redundancy, minimize number of transmissions.
- Saving network energy and lifetime.
- Unlike traditional end-to-end routing in the network, DC routing finds routes from multiple sources to a single destination that allows in-network consolidation of redundant data in the network.
- Working,
  - i. Sending interest
  - ii. Building gradients
  - iii. Data dissemination
- Flat routing.

10. LEECH
- Low energy adaptive clustering hierarchy [5].
- Hierarchical routing.
- Cluster based protocol
- Uses TDMA/CDMA/MAC to reduce inter-cluster and intra-cluster collisions in the cluster networks.
- Limits energy consumption
- Cluster head collects data and aggregated the data then send to sink nodes.
- Operation in two phases,
  1. Set up phase

Arrange the nodes and cluster heads in the order.

2. Study state phase

Actual data transfer is done.

- Increase the network lifetime
- Aware about the route.

IV. CHALLLENGES OF ROUTING NETWORKS

This survey paper is mainly based on the different routing models. Efficient routing can improve the network lifetime, security and data gathering process. The main challenges of efficient routing models are given below,

- Improve the network lifetime.
- Efficient data gathering process.
- Improve the security of the network.
- Energy efficiency
- Data security
- Data Communication
- Data aggregation
- Scalability
- Coverage
- Secure data transmission
- Node deployment
- Node heterogeneity
- Connectivity
- Quality of service
- Transmission Media

V. CONCLUSIONS

Wireless sensor network (WSN) is a growing research area. In wireless sensor network (WSNs) we include energy efficiency, routing concepts, security of the network and the data to be transmitted, and network lifetime. The energy efficiency of the network is achieved through efficient routing concepts and effective security in the wireless sensor network (WSN) system. There are different routing algorithms exists, TEEN, APTEEN, SERP, INFRA, SPT, DRINA.

Routing means transmitting the data from one ordinary node to the head of that collection of nodes. The routing concept is explained by numbering the nodes, based on the distance from the sink or cluster head. Advantages of the efficient routing are efficient energy consumption, increased network lifetime, data aggregation and security. The routing includes the concept of data aggregation. Data aggregation is done before the routing; the aggregated data is transmitted from one node to another and give acknowledgement back to the node. This is done through routing. Routing structure includes message part and acknowledgement part in it. So, DRINA is the efficient algorithm as compared to other algorithms. Because it includes all the features of the algorithms like data aggregation, security, and efficient network lifetime.

Wireless sensor network (WSN) is a growing research area. The energy efficiency of the network is achieved through efficient routing concepts and effective security in the wireless sensor network (WSN) system. So, my future work is based on the research of different routing models in the cluster based wireless sensor networks (WSNs). And study more about the challenges of the routing networks in wireless communications.

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