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A Survey on Communication Link Fault Tolerance for Wireless Sensor Networks

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ABSTRACT: This paper describes how the path fragments are rectifying during the transmission time and how the energy are handled in wireless sensor networks are explored. Wireless sensor networks are used to monitoring the application like chemical sensing, fire detection, weather condition. In this homogenous application some problems may occur during the data transmission time. There are various techniques that are available to rectifying path fragments problem and reduce the energy consumption during data transmission as well as continuous monitoring. The various algorithms mainly focused to solve the path fragments with lowest possible energy and end to end transmitting delay. The fault tolerances are classified based on the different kinds of fault which occur in WSN that are discussed in detail. In this paper present a survey on fault during the data transmitting time and how that are detect and recovery from that fault in WSNs in theoretical point of view research.

KEYWORDS: fault tolerance, wireless senor networks, energy, path fragments

I. INTRODUCTION

Sensor networks are highly distributed networks of small, lightweight wireless node, deployed in large numbers to monitor the environment or system. Each node of the sensor networks consist of three subsystems there are Sensor subsystem, Processing subsystem, Communication subsystem. Sensor subsystem are used for senses the environment, processing subsystem are used for performs local computations on the sensed data and Communication subsystem are used for responsible for message exchange with neighboring sensor nodes. The advantages of sensor networks are robust, reliable, accurate and fault-tolerant. Two important operations in a sensor networks Data dissemination. this is used for the propagation of data/queries throughout the network, Data gathering is used for the collection of observed data from the individual sensor nodes to a sink. The different types of sensors are Seismic, thermal, visual, infrared.

Recent technology improvements that have been developed in small size nodes, low-cost, battery power devices, which are capable of local processing and efficient wireless communication. Such nodes are called as sensor nodes. These sensor nodes are efficient in computing in various applications, such as office building, industrial plants, and reading temperature of a particular region. Each sensor will be having a limited lifetime and hence the processing of data may loss some sensed data due to battery power, collision while communicating between the nodes and having multipath links to reach the destination. Hence in order to place a sensor node in the environment, we must first analyze how many sensor nodes are required in the terrain (within the region). We can place the sensor nodes randomly in the environment or we can use a Grid based approach to place the sensor node.

A sensor node is can be made up of four basic components. They are as follows (a) *Sensing unit* a sensor used to sense the environment conditions like temperature, pressure, etc. The sensed parameters are converted into digital form using ADC (Analog Digital Converter). (b) *Processor unit* includes a processor such microcontroller and memory. (c) *Transceiver unit* includes wireless transmitter and receiver sections. (d) *Power unit* uses batteries that provide necessary power to remaining units. Each sensor node is operated by battery power and hence we cannot replace or recharge the battery once it has been deployed in the environment. Where the entire sensor can change their battery power according to environment aspects, when the sensor node is active state, the battery power will be 75-100% battery and it will be sensing the environment and it will be transmitting the sensed data to the destination. When

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the sensor node is in the inactive state, the battery power will be 10-40% of battery and it will sending only connectivity messages (Hello message) to the other neighbouring nodes into maintain connectivity.

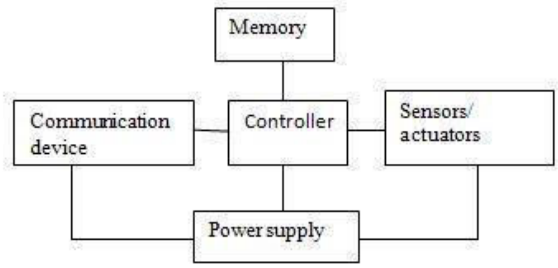

Fig 1 sensor node architecture

The number of nodes in sensor network can be several orders of magnitude large than the number of nodes in an ad hoc network. Sensor nodes are more easy to failure and energy drain, and their battery sources are usually not replaceable or rechargeable. Sensor network will be having the knowledge to find the location of a high accuracy of sensing data in the particular environment; hence we will be using Location Finding System. The Mobilize will be an optional in the sensor node, since for some task the sensor node should be moved from one place to another to find the sensing data which is related to the application. The power unit for the sensor can either be a solar power cells or battery power cells, the more sensing data transmission the more battery it consumes. Sensor nodes may not have unique global identifiers (ID), so unique addressing is not always feasible in sensor networks.

II. KEY CONCEPTS

A. Sensor networks

A sensor network is composed of a large number of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. The number of nodes in a sensor network can be several orders of magnitude higher than the nodes in an ad hoc network. Sensor nodes are densely deployed. Sensor nodes are limited in power, computational capacities and memory. Sensor nodes are prone to failures. The topology of a sensor network changes frequently. Sensor nodes mainly use broadcast, most ad hoc networks are based on p2p. Sensor nodes may not have global ID. In Military applications Monitoring friendly forces, equipment and ammunition, Reconnaissance of opposing forces and terrain Battlefield surveillance, Battle damage assessment, Nuclear, biological and chemical attack detection. In Environmental applications Forest fire detection, Biocomplexity mapping of the environment, Flood detection, Precision agriculture. In Health applications Tele-monitoring of human physiological data, tracking and monitoring patients and doctors inside a hospital, Drug administration in hospitals.

B.Fault tolerance

Fault tolerance is the ability to sustain sensor network functionalities without any interruption due to sensor node failures. The fault tolerance level depends on the application of the sensor networks. Those levels are physical layer, hard ware, system software, middle ware, and application [3]. The physical layer is used for make the communication between two nodes. That is handling the modulation demodulation, and encoding-decoding. Mainly that is used to minimize the cost and maximize the energy efficiency. In this layer some fault occurs like communication problem on physically. Second one is hardware level, which contain computation engine, storage subsystem and power supply. In this layer the some faults may occurs like malfunction and energy problem in battery and storage capacity. Third one is system software, which contains operating system and utility program. That mainly used for communication path in

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routing and rerouting using the protocols. It is support distributed and simultaneous execution of the algorithm. Several protocols are used for coordinate the distributed actions. Next one is the middleware, which contains the various actions like data aggregation, data filtering and sensor fusion. These tasks are related to the sensor reading. In heterogeneous application that can substitute the readings of one type of the sensors with the readings of another type of sensor under the low overhead. Another one is how many sensors of each type should be placed on a particular node and on which positions. Last one is application, in this level also fault tolerance can be addressed. Main advantage in this level that can be used to address fault in any type of resource.

C.Energy consumption

Sensor nodes are ability to monitor a wide variety of ambient conditions such as temperature, pressure, mechanical stress level on attached objects etc. sensor nodes are having limited battery power. Some techniques are used to reduce the energy level in wireless sensor networks. Power saving mode are used to turning the transceiver off may not always be efficient. Operation in a power-saving mode is energy-efficient only if the time spent in that mode is greater than a certain threshold. Multi hops are also used in energy efficient communication using several shorts hops.

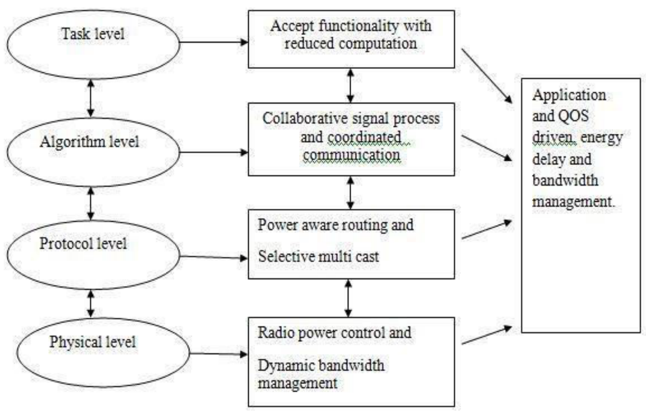

Fig 2 energy save ideas

Energy efficient are used in node level and network level. In node level dynamic power management is to shut down the several component of the sensor node when no events take place. In Dynamic voltage scaling (DVS) the processor has a tome-varying computational load, hence the voltage supplied to it can be scaled to meet only the instantaneous processing requirement. The real-time task scheduler should actively support DVS by predicting the computation and communication loads. In network level the computation-communication trade-off determines how much local computation is to be performed at each node and what level of aggregated data should be communicated to neighbor node or BSs. Traffic distribution and topology management algorithms use the redundancy in the number of sensor nodes to use alternate routes so that energy consumption all over the network is nearly uniform.

III. COMPARATIVE STUDY

This section includes a study on some of the techniques and its efficiency in improving the system performance and fault tolerance.

A. Secure and efficient disjoint multipath constraint

Secure and efficient disjoint multipath construction [1], ensure the good performance fault tolerance in wireless sensor networks. Two approaches are used in these techniques which are SMRP and SEIF. First, approach of multipath routing, called SMRP (Sub-branch Multi-path Routing Protocol), derived from node disjoint paths that enhances significantly the network lifetime comparing to the existing solutions. Furthermore, the message exchange between sensors is very optimal since our scheme requires only one message per node to establish a reliable routing topology. Second approach developed an efficient and lightweight security scheme, named SEIF (Secure and Efficient Intrusion-Fault tolerant protocol) based on the above multi-path protocol. SEIF differs from existing intrusion-fault tolerant solutions by providing a totally distributed and in-network execution, which does not require referring to the base station for both route building and security checks.

B. Adaptive algorithm for fault tolerance rerouting

Adaptive algorithm for fault tolerance rerouting [4], ensure the rerouting fault tolerance in wireless sensor networks. routing in sensor networks has focused upon methods for constructing the best route, or routes, from data source to sink before sending the data. To propose an algorithm that works with this chosen route to increase the probability of data reaching the sink node in the presence of communication failures. This is done using an algorithm that watches radio activity to detect when faults occur and then takes actions at the point of failure to re-route the data through a different node without starting over on an alternative path from the source. To increase the percentage of data received at the source node without increasing the energy consumption of the network beyond a reasonable level.

Route broadcasts some query packets to other nodes to form a directed tree graph of nodes with the root at the BS. This tree is formed using a simple shortest-path-**first methodology. Whoever a given node's parent is in the tree will**

forward its data on in the network until it reaches the BS. Problems can arise in this scheme when for some reason the parent is unable to forward the message. It could be that the parent node experiences a transient or even permanent failure. It could also be that another radio broadcast in the network collides with the message or just occasional data loss on a generally good radio link.

A distributed algorithm for rerouting messages in the face of transmission failure in wireless sensor networks. Results were obtained from a TinyOS based mote hardware test and a number of TOSSIM simulation runs. to have seen that to can use parameters, such as the number of retries, to tune the algorithm to provide a high success rate while still being energy-efficient in both benign and hostile environments. We compared the affect on energy and success rate due to increasing the DSF. We provided results based on node depth to show that the algorithm benefits nodes further out in the network, where it is more needed, as much as those near the BS.

C. Stateless protocol for real time communication

Stateless protocol for real time communication [5], ensure the good performance in sensor networks. SPEED is used in this approach. Many excellent protocols have been developed for ad hoc networks. However, ad hoc sensor networks have additional requirements that were not specifically addressed. These include real-time requirements and nodes which are severely constrained in computing power, bandwidth, and memory. SPEED maintains a desired delivery speed across the network through a novel combination of feedback control and non-deterministic QoS-aware geographic forwarding. This combination of MAC and network layer adaptation improves the end-to-end delay and provides good response to congestion and voids. In simulations on GloMoSim and implementation on Berkeley motes demonstrate SPEEDís improved performance compared to DSR, AODV, GF, SPEED-S and SPEED-T. To develop a new protocol that meets the requirements of ad hoc sensor networks in real-time situations. SPEED also utilizes geographic location to make localized routing decisions. The difference is that SPEED is designed to handle congestion and provide a soft real-time communication service, which are not the main goals of previous location-based routing protocols. Moreover, SPEED provides an alternative solution to handle voids against approaches based on planar graph traversal and limited flooding

D. Direct diffusion

Direct diffusion for wireless sensor networks [6], ensure the good performance in fault tolerance in wireless sensor

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networks. Directed diffusion consists of several elements: interests, data messages, gradients, and reinforcements. An interest message is a query or an interrogation which specifies what a user wants. Each interest contains a description of a sensing task that is supported by a sensor network for acquiring data. Typically, data in sensor networks is the collected or processed information of a physical phenomenon. Such data can be an event which is a short description of the sensed phenomenon. In directed diffusion, data is named using attribute-value pairs. A sensing task (or a subtask

thereof) is disseminated throughout the sensor network as an interest for named data. This dissemination sets up gradients **within the network designed to "draw" events (**i.e., data matching the interest). Specifically, a gradient is

direction state created in each node that receives an interest. The gradient direction is set toward the neighboring node from which the interest is received. Events start flowing towards the originators of interests along multiple gradient paths. The sensor network reinforces one, or a small number of these paths.

E. Energy efficient routing with delay guarantee

Energy efficient routing with delay guarantee [2], ensure the efficient energy in sensor networks. Linear programming and routing protocol are used to ensure the energy efficient in this wireless sensor networks. The LP solution is then approximated by an iterative algorithm based on least cost path routing, in which each step is implemented efficiently in a distributed manner. Second part of the paper incorporates delay guarantee into energy efficient routing by limiting the length of the routing paths from each sensor node to the collection node. routing protocol for sensor networks with the goal of maximizing the time duration until the first node dies. To show that the lifetime can be estimated by the minimum lifetime of the nodes over the network since the time from the disconnectedness of 5% to 50% of the nodes from AP is very small and the quality of data at the AP decreases as a result of the death of the nodes. the energy efficient routing to provide a delay guarantee by limiting the length of the routing paths from each sensor node to the AP. The decrease in battery lifetime as a result of decreasing the maximum allowed delay is shown to be considerable for non-uniform distribution of the nodes and uneven packet generation patterns across the network.

F. Maximizing network lifetime based on transmission range adjustment

Maximizing network lifetime based on transmission range adjustment [7], ensure to increase the network lifetime based on transmission range adjustment using CETT and DETL. These two algorithms are used to obtain the transmission range list for different node distributions. CETT is an algorithm of searching approximate optimal spanning transmission trees with maximal network lifetime from inner corona to outmost step by step. The algorithm DETL is based on the factors which affect lifetime of each corona. The transmission range and received nodes of each corona are the two factors affecting the network lifetime. If a corona has locally maximal per node energy consuming rate (ECR), i.e. it will have locally minimal lifetime, it need adjust its transmission range or received nodes in order to prolong its lifetime. A centralized algorithm and a distributed algorithm for assigning the transmission ranges of sensors in each corona for different node distributions. The two algorithms can not only reduce the searching complexity but also obtain results approximated to the optimal solution. In energy model data receiving and transmitting and processing with low power consumption in wireless sensor networks. These algorithms are used to reduce the power adjusting the transmission range in sensor networks. Spanning transmission tree is used for energy efficient in sensor networks. This method is compared with other algorithm that is more efficient and reliable to increase the network lifetime based on transmission range adjustment in wireless sensor networks. Corona model are used for adjusting the transmission range for saving the energy to increase the lifetime of the network in wireless sensor networks. These methods are used to reduce the searching complicity and obtain the optimal solution in the sensor networks.

IV. CONCLUSION

In this paper some of the techniques and algorithms are survey related to the communication loss and energy consumption in wireless sensor networks. A comparative study has been made regarding the merits and demerits of all the techniques. Link and path and energy consumption are the common problem in the wireless sensor network. Routing methods are used to solve the path fault and link problem in the sensor networks. For Saving the energy also some techniques are used. Various methods are studied related to this path and energy problem that are help to solve the problem and increase the performance in the wireless sensor the networks.

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