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Reliability Evaluation on Wireless Sensor Network

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Abstract - Reliability on Wireless Sensor Network (WSN) will provide fault tolerant network and find out the failures which are occurred at various levels. The main task of sensor is to monitor the area, by collecting the data and transmit the data to sink node. Fault occurred in sensors due to low cost and limited energy. Reliability requirements and drawbacks are depends on the resources utilized by the WSN. Routing protocols are used to transfers data to the sink node from sensors without error and to provide reliability against sinkhole and node clone attack. In this paper we study the reliability enhancement by routing protocols to transfer a data, a hardware spare that replaces sensors when failed and modeling reliability in WSN and compare the performance also.

Keywords - Wireless Sensor Networks, Reliability, Routing, Fault tolerance.

I. INTRODUCTION

A wireless sensor network is a collection of large number of sensor nodes scattered over the region or inside the target which is to be detected, monitored or tracked. Each sensor node consists of processing capability, memory, Radio Frequency transceivers, a power source, and various motors for moving or controlling a system [1].Wireless sensors are used in various fields including environmental medical, military, transportation, entertainment and smart spaces [2]. To collect the data efficiently sensors require reliable network without loss of data from the nodes.

Sensors have a direct contact with environment. While sensing, processing or reporting the data to the sink, errors introduced in some of the sensor measurement. So in order to improve data integrity and detection reliability [3], the faulty sensor's data have to be detected and filtered out, while data without fault are aggregated and sent. Even when the object or event is reliably detected, error occurred due to poor quality communication link. Network based reliability can be improved by selecting a suitable routing protocol. Also even if the devices and links are working properly, sometimes the target or sink node may not get detected due to limited coverage and connectivity and inefficient placement of sensors. The objective of this paper is to evaluate reliability in routing protocols when a data will be send by sensors, and find the hardware support for reliability and modeling reliability.

II. LITERATURE REVIEW

In this paper we surveyed reliability on Wireless Sensor etwork on the basis of three criteria:

- Reliability provided by the routing protocol.
- Hardware support on reliability(Spare)
- Reliability Modeling

A. Routing protocols proposed for Reliability (Fault occurred in link and sensors)

Jianlin, koichi Ishibashi 2014[4] proposed reliable routing protocol(RRP) in large scale wireless sensor network. RRP discovers multiple bidirectional routes between sensors and sink node. To guarantee the complete routing topology buildup sink node initiates route construction with an imaginary node as destination. It achieves load balance by sending data packets via route with lighter workload. It can be optimized for lightweight routing. Ning Cao, Rusell Higgs Grecory 2014[5] proposed Nearest Closer protocol for WSN. The main idea of this paper is distance between the receiver sensor node and the sink node is shorter than distance between the transmitter sensor and the sink node. To implement this each node has to know its own position, its neighbor position within its transmission range and position of sink node. Then they investigated the relationship among density, lifetime and reliability. Based on the result they introduced parameters for tracking application in sensor network.

Ghufran Ullah,Abdul Hanan 2014[6] proposed an Efficient Delay aware routing protocol(EDARP) it enhances the quality of service parameters to satisfy the end to end delay and reliability requirements to real time WSN applications. EDARP is compared with several protocols and result shows that EDARP has got better performance in terms of end to end delay and reliability. This protocol is suitable for smaller number of hops. Bejoy.B.J, Dr.B.Paramasivan 2012[7] proposed transport protocol for WSN. Clusters are formed to minimizing energy dissipation. The node has to maintain the neighbor list to forward data and any changes in local topology can cause a node to update its neighbor list. If a node notices that its neighbor list has changed. It can suddenly re-advertise all of its data. Therefore it provides reliable transport in mobility condition.

Yuping Zhou, Zhenjie Huang, Juan Wang 2014[8] proposed a Global deterministic linear propagation verification protocol (GDL). This protocol detects node clone attack in WSN. Location information of the node is propagated and stored along horizontal and vertical direction. Extension of GDL scheme is randomized parallel multiple cells linear propagation verification protocol. Omid Naderi, Mahdi Shahedi 2014[9] estimates area in the network where a sink hole attack has occurred there by considering an energy consumption model in network. They apply trust based routing for providing a high quality of security by selection based on packet trust requirement. So the routing protocol classifies the traffic packet according to their requested security and the routes the packet related to each class through the path that fulfills the security requirements of them. Amir Ehsani Zonouz, Vinod M. Vokkarane, 2014[10] modeled the reliability of two different types of sensor nodes: Energy

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Harvesting Sensor nodes EHSNs and Battery Powered Sensor nodes BPSNs. They presented a Wireless Link failure models for each type of sensor nodes by considering the parameters like battery life-time, shadowing, noise and location uncertainty on wireless link reliability. Based on the node and link reliability models, they compared performance of different routing protocols in terms of the average end-to-end path reliability. A new cost function also defined to facilitate a fair and comprehensive comparison among these routing algorithms. Jian ZHU, Hai ZHAO,JIuqiang XU 2009[11] proposed an energy balanced reliable routing metric in WSNs. In this paper, an optimization model for WSNs lifetime is firstly advanced. Then the shortage of expected transmission (ETX) based routing metric is solved with the help of optimization model. Finally, an energy balanced routing metric is advanced. This metric cannot only ensure the reliable communication, but also balance the network's load, and prolong the network's lifetime.

Vincent D.Park, M.Scott Corson 1997[12] proposed an adaptive distributed routing algorithm that is well suited for operation in wireless networks. It quickly creates and maintains loop free multipath routing to destination. It rapidly adapts the topological change, and has the ability to detect network partitions and erase all invalid routes within a finite time.

Table. I Reliability provided by routing protocols

Protocol Name	Functions
Reliable Routing Protocol(RRP)	Large Scale Wireless Sensor Network
Efficient Delay Aware Routing Protocol(EDARP)	Smaller Number of Hops
Transport Protocol	Clustered Wireless Sensor Network
Global Deterministic Linear Propagation Verification Protocol(GDL)	To Eliminate Node Clone Attack
Trust Based Routing	To Find Sink hole Attack

B. Hardware supported to provide Reliability

Yongxian song, Ting Chen 2012[13] adopts a bionic hardware to implement bionic reconfiguration of wireless sensor network node, so as to the nodes have able to change their structure and behavior autonomously and dynamically, in the case of the part hardware are failure and the node can realize bionic self-healing. Markov state diagram and probability analysis are adopted to realize solutions of functional model for reliability, establish the relationship between reliability and characteristics parameter for sink node. D.Bein,V.Jolly, B.Kumar 2002[14] provide a reliability if a different types of sensors failed it will be replaced by spares using Markov model. They compared the model in terms of reliability, cost and Minimum-Time-To-Fail (MTTF)

C. Reliability Modeling and Analysis

Chaonan Wang, Liudong Xing ,Vinod M. 2014[15] proposed reliability and lifetime models for WSN under three scenario defined by existing MAC protocols: traditional MAC,.S-MAC and T-MAC. The numerical study shows that T-MAC offers long lifetime among the others. Traditional MAC and S-MAC, lifetime is constant and reliability is jumping from 1 to0 when the battery depletes. But specific result depends on parameters selected. Ing-Ray Chen, Yating Wang 2012 [16] analyzes the reliability of homogeneous WSN executing a distributed code attestation protocol with neighbor. This paper identifies how often attestation should be performed as well as how many neighbor sensor should serve as code verifier to maximize system lifetime without compromising performance. Yunhuai Liu, Yanmin Zhu and Lionel Ni 2007 [17] proposed a in middle recovery mechanism that fills the gap between the traditional per-hop recovery and end-to-end recovery mechanisms. This paper implements proliferation routing. It can increase the end-to-end transmission success rate up to 70% compared with hop-based routing and flooding. They investigated three problems long transmission, self congestion phenomena and bad link propagation.

Majid ghaderi, Don Towsely and Jim Kurose 2008[18] this paper quantifies the reliability gain of network coding for reliable multicasting in Wireless networks. It defines the expected number of transmission per packet as a performance metric for reliability and derives an expression that characterizes the performance of network coding. Jie Cai, Xiaoyu Song, Jinyuan Wang and Ming Gu 2014[19] studied the wireless link reliability for fading channels. The node energy availability for the source and relay nodes is investigated in terms of the limited node energy. Network reliability and mean time to failure are derived. Finally, the initial node energy allocation scheme is proposed to balance the lifetime of each sensor node, thus reducing the total energy consumption

III. RESEARCH GAP

WSN reliability depends on combination of hardware, software and wireless link between sensors and sink. In this paper we surveyed routing protocols, hardware and reliability modeling. According to the **survey on routing protocol**, there are number of protocols provide reliability based on some parameters. Each one of them will be best if we satisfy the constraints of the protocol. Depends on the number of sensors and distance between them, protocol will work efficiently. For example, Global deterministic linear propagation verification protocol (GDL), Will detect the node clone attack it will not find out the sink hole attack. To tolerate a fault occurred in sensors or link during a data transfer we suggest Hill climbing Algorithm is best one. It will find the entire route from sensor to sink but it choose best path from initial node to final node. It can return a valid solution even if it is interrupted at any time before it ends. But it will not used to find out the node clone attack or sink hole attack. According to the Hardware support, bionic reconfiguration of wireless sensor network node will be a best one when compared with the spare replacing. But both of them will follow Markov model. Reliability modeling analyzes number of mechanisms based fading channels, multicasting and middle recovery.

IV. CONCLUSION

Various protocol, hardware operations and functional aspects of a reliable WSN are analyzed in this paper. Many of the

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works are available to improve the reliability for communication between the sensors of WSN by modifying the existing routing and transport protocols. On analyzing the reliability of sensors, it is shown that the reliability can efficiently improved by adopting fault tolerance in the various levels especially target detection i.e., Sink node and data aggregation/fusion techniques. It is understood that all reliability techniques concentrate in energy efficiency and are aimed to improve the life time of the WSN.

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