A Survey on Multipath Routing Protocol for Wireless Sensor Networks.

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Abstract—**a group of numerous wireless Sensor devices or nodes without infrastructure are known as wireless Sensor network. In which each nodes are help to other nodes for data transmission in the network, sensor nodes having limited residual energy. Due to wireless property devices are able to move in the entire network. Due to this property it is also known as wireless Mobile sensor network. In wireless sensor network data communication can be done very easily as well as fast but security, network traffic and nodes energy are the major issues in wireless sensor network. Due to connectionless property there are many challenges occurred in wireless sensor networks which is very dangerous for whole network. In this paper we are survey about various routing protocol for wireless sensor network which help to improve network performance as well as efficiency.**

Keywords: - Wireless communication, **wireless sensor network, residual energy, network security**.

I. INTRODUCTION

Wireless sensor network consist of tightly coupled sensor nodes, which have limited residual energy, computational capability and bandwidth. Each sensor node performs Sensing, Communicating and Computing. The sensor nodes are also participating for data transmission for other nodes; due to this they lost their residual energy. Ones a sensor node sense a data, it can processes it and sent to the destination through the conventional path. There are generally few different types of routing protocol for wireless sensor network i.e. simple network routing and hierarchical network routing and location-based routing. Applications of sensor network are in the field of Military operations, Fire detection, Health Monitoring, Traffic control system etc. Now a day's application of Wireless sensor Networks is rapidly growing day by day due to that few problems always exist in the system which affect system cost and performance. Routing algorithm play major role in wireless sensor networks. The greatest routing algorithm helps to improve overall performance of the systems like residual energy, efficiency, reliability, time complexity, fault tolerance and other service.

II. Wireless Sensor Network Topologies

a. Star Topologies

It is a communication topology. In which each node is connected directly to a gateway and nodes are not allowed to send messages to each other. The network size must be depends on the number of connections made to the hub.

b. Tree Topologies

It is also Known as cascaded star topology. In which, each node is connected to a node that is positioned superior in the tree, and then to the gateway. The tree topology error detection becomes very easy.

c. Mesh Topologies

In Mesh topologies, data transmission can be done easily from one node to another, within its radio transmission range. In mesh topologies if a node what to send data packet to another node which is not in its range then data transmission can be done using an intermediate node. Mesh network is very expensive.
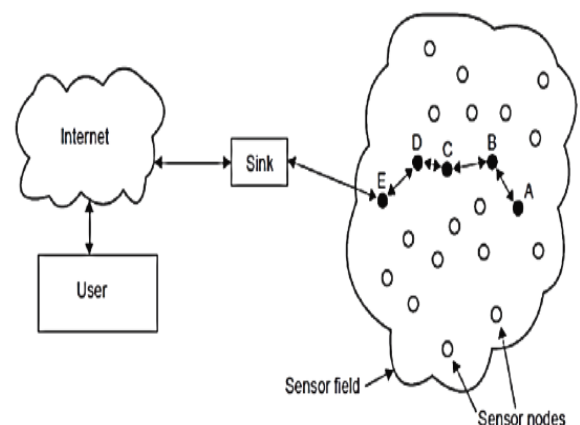

Figure 1: Wireless Sensor Network.

III. Types of Wireless Sensor Network

d. Mobile WSNs.

e. Terrestrial WSNs

f. Underwater WSNs

g. Multimedia WSNs

h. Underground WSNs

IV. Characteristics of Wireless Sensor network

a. Flexibility

b. Data Communication

c. Quick Response

d. Mobility

e. Reliable

V. Security issues in WSN

In wireless sensor networks security play a major role. These are few issues are as follows:

a. Sensor Node Authentication: one of the major problems in WSN. Some time malicious nodes are also present in the networks and either they drop or modified data packet.

b. Data Duplication: Due to data duplication many problem arises like network conjunction, node work for same packet etc.

c. Data Privacy: In any wireless network data security is one of the major challenges.

d. Data Consistency: delivered data must be error free and can be transmit by authenticated path of the network.

VI. EVOLUTION

In 2002, Hongmei Deng, Wei Li, and Dharma P. Agrawal, Routing Security in Wireless Ad Hoc Networks in which a mobile ad hoc network consists of a collection of wireless mobile nodes that are capable of communicating with each other without the use of a network infrastructure or any centralized administration. MANET is an emerging research area with practical applications. However, wireless MANET is particularly vulnerable due to its fundamental characteristics, such as open medium, dynamic topology, distributed cooperation, and constrained capability. Routing plays an important role in the security of the entire network. In general, routing security in wireless MANETs appears to be a problem that is not trivial to solve. In this article they study the routing security issues of MANETs, and analyze in detail one type of attack — the "black hole" problem — that can easily be employed against the MANETs. They also proposed a solution for the black hole problem for ad hoc on-demand distance vector routing protocol.

In 2005, Daniele Puccinelli and Martin Haenggi studied about Wireless Sensor Networks: Applications and Challenges of Ubiquitous Sensing in which Sensor networks offer a powerful combination of distributed sensing, computing and communication. They lend themselves to countless applications and, at the same time, offer numerous challenges due to their peculiarities, primary the stringent energy constraints to which sensing nodes are typically subjected. The distinguishing traits of sensor networks have a direct impact on the hardware design of the nodes at at least four levels: power source, processor, communication hardware, and sensors. Various hardware platforms have already been designed to test the many ideas spawned by the research community and to implement applications to virtually all fields of science and technology. They are convinced that CAS will be able to provide a substantial contribution to the development of this exciting field.

In 2006, Ye Ming Lu and Vincent W. S. Wong about an energy efficient multipath routing protocol for wireless sensor networks in which the energy consumption is a key design criterion for the routing protocols in wireless sensor networks. Some of the conventional single path routing schemes may not be optimal to maximize the network lifetime and connectivity. In this paper, they proposed a distributed, scalable and localized multipath search protocol to discover multiple node-disjoint paths between the sink and source nodes. They also proposed a load balancing algorithm to distribute the traffic over the multiple paths discovered. They compare our proposed scheme with the directed diffusion, directed transmission, N-to-1 multipath routing, and the energy-aware routing protocols. Simulation results show that their proposed scheme has a higher node energy efficiency, lower average delay and control overhead than those protocols.

In 2008 Zoran S. Bojkovic, Bojan M. Bakmaz, and Miodrag R. Bakmaz deals with some security issues over wireless sensor networks (WSNs). A survey of recent trends in general security requirements, typical security threats, intrusion detection system, key distribution schemes and target localization is presented. In order to facilitate applications that require packet delivery from one or more senders to multiple receivers, provisioning security in group communications is pointed out as a critical and challenging goal. Presented issues are crucial for future implementation of WSN.

In 2010, Shio Kumar Singh, M P Singh and D K Singh, Routing Protocols in Wireless Sensor Networks – A Survey, in which Advances in wireless sensor network (WSN) technology has provided the availability of small and low-cost sensor nodes with capability of sensing various types of physical and environmental conditions, data processing, and wireless communication. Variety of sensing capabilities results in profusion of application areas. However, the characteristics of wireless sensor networks require more effective methods for data forwarding and

processing. In WSN, the sensor nodes have a limited transmission range, and their processing and storage capabilities as well as their energy resources are also limited. Routing protocols for wireless sensor networks are responsible for maintaining the routes in the network and have to ensure reliable multi-hop communication under these conditions. In this paper, they give a survey of routing protocols for Wireless Sensor Network and compare their strengths and limitations.

In 2011, R. Devisri and R.J.Archchana Devy, Reliable and Power Relaxation Multipath Routing Protocol for Wireless Sensor Networks, Routing in sensor network is very challenging task for wireless sensor networks. Generally the ideal sensor networks should provide reliable, power consumption, multipath routing, less delay efficient path discovery and long lifetime node. Therefore in this paper, relax multipath routing protocol is proposed for wireless sensor network successfully. The proposed relax protocol utilizes the LWFEC technique by adding the data redundancy. The relax protocol increase the protocol reliability and is able to recover from the path failure.

In 2012, S. Saqaeeyan and M. Roshanzadeh, Improved Multi-Path and Multi-Speed Routing Protocol in Wireless Sensor Networks, in which they proposed a optimum routing protocol, in some of Quality of Service achieved improvements in the field of reliability in data sending to destination and load balancing in wireless sensor network. In our proposed protocol, to ensure that a data packet correctly send to the destination, it used of an improved hybrid method based on multipath data sending. The routing decisions in this method are by considering the remaining energy of nodes that are in neighbors of sender nodes. Simulation results shows that release rate of data packets in this method is reduced and reliability in data sending to destination is increased. Also, the energy efficiency of sensor nodes effectively improved and thus increase the overall lifetime of wireless sensor networks.

In 2013, Yash Arora and Himangi Pande, Energy Saving Multipath Routing Protocol for Wireless Sensor Networks, The Wireless sensor networks have many characteristics such as limited energy resources, low bandwidth and unreliable links. Due to these characteristics there are many challenges in the design of sensor networks. Routing in WSN is very challenging task. Multipath establishes several path for data transmission rather than single path. Due to this data delivery is high. They proposed energy saving multipath routing protocol (ESMRP). ESMRP make use of load balancing algorithm to transfer the data. ESMRP calculates node strength to discover its next best hop. Our protocol uses two versions, in the first version, data is transmitted through single path, if some path failure occurs or discovered path node strength goes below 15% of alternative path node strength then it will switch to next alternative path. In the second version of ESMRP, message is split into various segments and some correction codes are added to these segments. After that these segments are transmitted across multiple paths. Simulation results shows that the proposed

protocol is more energy saving than previous protocol in providing efficient resource utilization.

In 2013,Guimin Huang, Wujin Tao, Pingshan Liu and Siyun Liu, Multipath ring Routing in Wireless Sensor Networks ,In the past years, the routing problems of wireless sensor network (WSN) have attracted great interest, and many routing protocols for WSN have being proposed. However, these routing protocols pay little attention to the transmission reliability. Therefore, this paper proposes a new multipath ring routing algorithm for WSNs. The proposed algorithm utilizes ring level to separate sensor nodes into several sections, which can improve the reliability of the data transmission. Using the multipath ring routing data delivery improves as an average of 27.58% to leach routing and 113.06% to directing routing.

In 2014, Swati Lipsa, An Empirical Study of Multipath Routing Protocols in Wireless Sensor Networks, Wireless Sensor Networks (WSNs) consist of thousands of tiny nodes having limited sensing, computation, and communicating capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy consumption is an essential parameter to be considered. Since wireless sensor network protocols are application specific, the focus has been given to the routing protocols that might differ depending on the application and network architecture. In this piece of work, the study of various routing protocols for Wireless Sensor Networks presents a broad outlook of existing routing protocols for Wireless Sensor Network applications. Routing protocols for wireless sensor networks are responsible for maintaining the path from source to destination and have to ensure reliable multi-hop communication in a harsh environment. Further, the aim is to identify the various types of multipath routing protocols and to analyze the strength and limitations involved in it.

In 2015, Suraj Sharma and Sanjay Kumar Jena, Cluster based Multipath Routing Protocol for Wireless Sensor Networks in which Wireless Sensor Network (WSN) consists of low power sensor nodes. Energy is the main constraint associated with the sensor nodes. In this paper, they proposed a cluster based multipath routing protocol, which uses the clustering and multipath techniques to reduce energy consumption and increase the reliability. The basic idea is to reduce the load of the sensor node by giving more responsibility to the base station (sink). They have implemented and compared the protocol with existing protocols and found that it is more energy efficient and reliable.

In 2015, K Renuka and G. Murali, providing security for multipath routing protocol in wireless sensor networks, Wireless Sensor Network (WSN) is a combined group of sensors form a network. WSN will monitor the changes in physical conditions and it will forward the data via multi hop network. Sensors are dynamic in nature so the lifetime of sensors and providing security for the data transmitted by the nodes are the major problems faced by the Wireless Sensor

Networks (WSN). Ad hoc On-demand Multipath Distance Vector (AOMDV) routing protocol is used for generating multiple paths between source and destination. Route discovery and route maintenance are main services of AOMDV. By having, Multipath routing protocol increases the lifetime of the sensors by distributing the traffic load among all the paths instead of single path in a network. The malicious node introduces many attacks on WSN because the network is dynamic in nature. The Warm Hole attack is one of the threat in which it will deviates the original path by introducing a tunnel between source and destination. Secure and authentic Multipath Routing Protocol in WSN is a major challenge and should be proposed which overcomes Warm Hole attack and maintain secure data transmission in the network. Elliptic curve cryptosystem (ECC) is used to prevent the attack and improve the performance of a sensor network by sharing secret keys among nodes in the network. By using Hop by Hop authentication scheme, the authentic message will be transmitted between source and destination in the Wireless Sensor Network. Performance evaluation will be done by using measures such as packet delivery ratio, end-to-end delay and throughput.

In 2017, N. Vijayarani and and A. Senthilkumar, Multipath Routing Protocols in Wireless Sensor Networks: A Retrospective Review, To review the basic principles of Multi-path Routing Protocols (MRPs) design and its performance metrics. To discuss the assortment of MRPs overview for Wireless Sensor Networks (WSNs) based on its arrangement and delivery. Methods/Statistical Analysis: The enhanced reliability, load balance and security promote the multi- path routing as an appropriate tool in the domain of Wireless Sensor Networks (WSNs). In order to obtain simultaneous data transfer with reduced delay period, critical review is made based on the performance metrics, taxonomy of MRPs, and qualitative comparison. Findings: From the discussions, it can be concluded that most of the protocols achieved better load balance with improved performance. Coding based MRPs can perform with better reliability when compared to other protocols. Application/Improvements: The survey of earlier reports led to the decisions that the energy-efficient, reduced transmission delay with multiple pairs is the details to be studied in the domain of MRPs.

VII. CONCLUSION & FURTHER DEVELOPMENT

Now a day's wireless technologies are fastest growing technology, people's are using many wireless systems because of its effectiveness and quick response The various multipath routing protocols for wireless sensor network has been in these papers, they are also discussed about the problems during data transmission in the wireless network.

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