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A New Approach of Fault Node Recovery in Wireless Sensor Network

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Abstract—**Wireless sensor network is one of the most essential small and large scale communication technologies. This would be used for various scientific and the engineering applications for sensing the events and the real world surrounding data. Therefore the information gathering and transmission in typical places are the primary aim of sensor network design. Meanwhile if the sensor nodes are mobile and able to communicate in ad hoc manner it adds advantage on information distribution. In this paper mobile sensor nodes and their performance is estimated. Additionally contribution is placed to find fault node discovery and recovery technique.Basically the mobile sensor nodes are communicating by relay techniques therefore first required to discover route among source and destination. After route discovery data transmission is taken place. In this context mobile scenario nodes can move in any direction thus the probability of path loss; path break or node faults can be occurred. Additionally in routing technique maintenance phases can also perform the route repairs but these processes are slow down the performance of network. In order to preserve the performance in terms of energy and routing overhead a new technique is required to find.Therefore two consequent paths for source and destination are discovered first then after the data transmission is performed. If the primary selected route is damaged then the secondary path is utilized for communication. The implementation of the proposed concept is performed using NS2 simulator. The performance of the proposed simulation is estimated in terms of end to end delay, routing overhead, packet delivery ratio, energy consumption and throughput. The result shows the performance is improved by implementing the proposed concept.**

Keywords— **NS2, AODV, fault node, route recovery, path repairing.**

I. INTRODUCTION

A wireless sensor network is a distributed real-time system. Unfortunately yet very little work is applied in these new system and always a new solutions are often essential in all areas of the system [1]. The main cause is that the set of assumptions underlying earlier work has changed dramatically. Most of the earlier distributed systems research works on the following assumption like the systems are wired; powers is unlimited, not works on real-time, with a fixed set of resources, have user interfaces such as screens and mice, treat each node of the system as very significant and are location independent. In contrast, the designing of a wireless sensor network should be formulated with keeping following terms in consideration such as the systems is completely ad-hoc and works with wireless channel, have scarce power, are real-time, utilize the sensors and actuators as interfaces, with dynamically changing sets of resources, aggregate behaviour is also important there and location is very critical. Various wireless sensor networks also exploit negligible capability devices which places a further strain on the ability to use precedent solutions.

In this proposed work the wireless sensor networks are investigated for finding the optimum solution for mobility management and performance loss issues during the mobility. Wireless sensor networks with mobility can adds advantages during the monitoring and surveillance applications but due to mobility the path breaks are occurred and performance issues are arise. Thus in order to provide the solution during faults in wireless sensor networks a new solution is proposed and implemented. This chapter provides the brief overview of the proposed work and the included sub-domains of the study.

II. PROPOSED WORK

Wireless sensor networks are basically a static network technology that is fixed for gathering information from environment or different surroundings. Therefore these networks are configured with a tree or mesh network topology. These configurations enable long battery preservation, efficient aggregation and efficient communication. But due to mobility network topologies are not more stable and intermediate nodes moves in random manner. Therefore in WSN due to mobility performance losses are observed. Route discovery, data delivery and route maintenance in mobile networks are responsibility of routing protocols. Therefore improvement on routing protocols is required.

Basically there are two techniques are available in AODV routing protocol source repair and link repair for mobility management. In source repair the routing protocol not able to recover the primary route then new route discovered and again RREQ and RREP messages are exchanged. This results additional control messages are injected in network and network traffic increases. On the other hand during link repair the AODV routing protocol tries to repair the primary route if route is repaired then communication is on flow.

During communication the source and destination are communicate through multi-hop configurations. Due to this when a source node want to send data to any other sensor node the path discovery is required. In this context after

path discovery routing algorithm decide shortest path first and start transmission. If any intermediate node leaves their place then path break condition is occurred and normal communication is interrupted. This fault is repaired using route maintenance in traditional routing protocols.

Therefore, continuous mobility, connectivity and availability is major issue in network, due to this routing performance is affected. If the existing route is repaired then the performance can preserved. Thus required to enhance the route repair technique by which new path is obtained in less amount of time this will results efficient route recovery and fault node recovery. To find an optimum solution required to develop solution using the following strategy.

1. **Discover a two nearer path between source and destination:** during initiation of communication the route discovery processed is initiated, during this source broadcast RREQ packets and when it reaches to destination then it replay with RREP packets. The first arrived route reply is considered as the shortest path and data is transmitted. Here a new concept is added during the route selection two routes are selected.
2. **First path is master and second is slave:** in this step both the path is labelled as master and slave. The first shortest path is denoted as master and the next is termed as slave. The slave path is a supporting path that is preserved for future use in critical conditions.
3. **The path segmentation:** the selected path is segmented in small parts. The segmentation of these path helps for finding the fault router and immediate path break condition is noticed.
4. **Passing additional information to the next hop:** some additional routing information is added to the next hop router it is basically a flag value which is set to 1 when the next hop of router is un-reachable. Thus host get the error and discover braked segment of network route.
5. **Recovery of fault segment:** as the router is detecting where path break occurred, the slave path is utilized to repair primary path. This may help in recovering the current path which is damaged.

That can be understood by an example, suppose in network two nodes want to communicate and source route initiate the route discovery. The source node waits for route reply message, when reply messages are arrived on source, routing table make some entries of available routes, these entries are possible path between source and destination.

Therefore if N number of path is routing table exist then only two paths P1 and P2 is selected which are optimum path in routing table. Suppose path P1 contains h1 hop in path and P2 contains h2 hops in path. Than in each route h1 and h2 segments are prepared. In addition of that each router contains a flag value which is by default set to 0, if the nodes next hop is not in radio range or not responding then the concerned router updates their flag to 1. When a source router detects the routing path contains a flag set value to 1 then it consumes the secondary path for continuous communication.

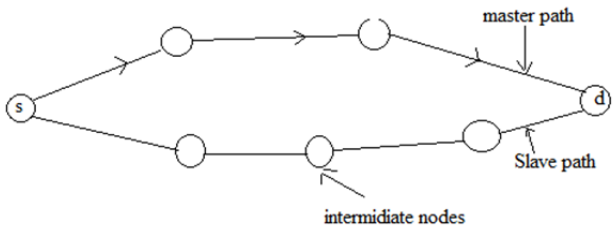

Figure 1 route discovery

III. SIMULATION SETUP

In this section provides the desired network configuration for simulation of proposed location estimation and simulation.

Simulation properties	Values
Antenna model	Omni Antenna
Dimension	750 X 550
Radio-propagation	Two Ray Ground
Channel Type	Wireless Channel
No of Mobile Nodes	15
Routing protocol	AODV
Time of simulation	10.0 Sec.

Table 1 simulation setup

In order to simulate the effect of proposed routing protocol over the traditional routing protocol two basic scenarios are desired to implement.

1. **Simulation of traditional routing protocol:** in first animation available routing strategy [1] is implemented and simulated. After that required to evaluate simulation based routing performance of network. The obtained performance is extracted using generated trace by the simulator.
2. **Simulation of proposed routing protocol:** in this module the proposed routing algorithm is implemented using similar network configuration and the performance of routing protocol is extracted in similar ways. And comparative performance is provided.

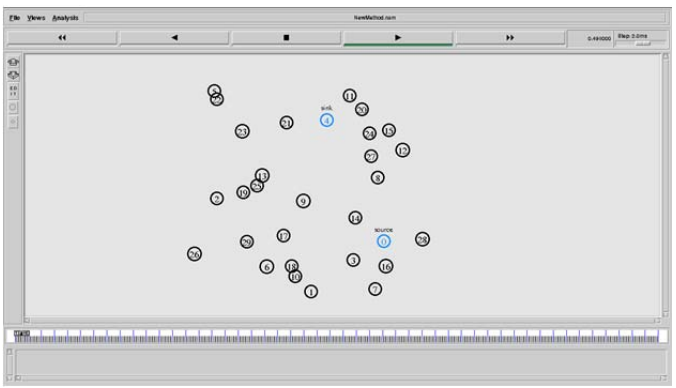

Figure 2 proposed simulation

IV. RESULTS ANALYSIS

This chapter provides the understanding of the performance evaluation and comparison of performance for both the algorithms which are implemented for demonstration. The performance parameters and their estimated outcomes are discussed in this chapter in detail.

5.1 Throughput

Network throughput is the average rate of successful message delivery over a communication channel.

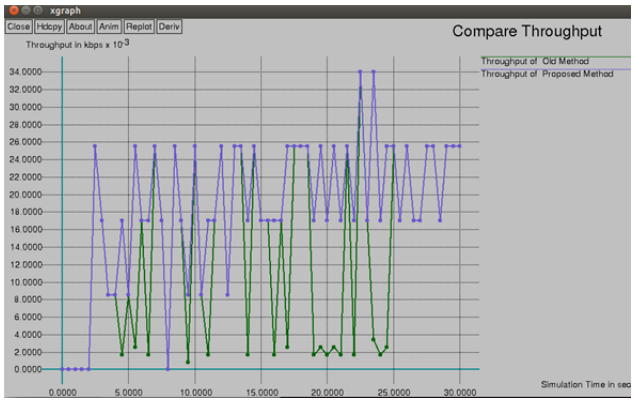

Figure 3 throughput

This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

The throughput of both the techniques previous or traditional and proposed algorithm is provided using figure 3. In this diagram the blue line shows the performance of network during implementation of the proposed routing algorithm and the green line shows the performance of traditional routing. In order to show the performance X axis shows the simulation time in terms of milliseconds and the Y axis shows the obtained throughput in terms of KBPS. According to the obtained results the performance of the proposed routing technique in terms of throughput is much better than the traditional routing technique.

5.2 Packet delivery ratio

The total number of packets sent by source device and successfully received packets ratio is responsible for PDR packet delivery ratio. That may include RREP and RREQ packets too. The packet delivery ratio is estimated using the below given formula.

$$Packet\ delivery\ ratio = \frac{total\ recived\ packets}{Total\ transmitted\ packets} X100$$

Figure 4 shows the performance of both the implemented routing protocols in terms of packet delivery ratio. In this diagram the X axis shows the simulation time and the Y axis contains the percentage successfully delivered data on target host. In order to represent the performance of both the algorithm green line is used for traditional method and the blue line is used for proposed technique. In this context the results shows the performance of the proposed routing protocol in terms of packet delivery ratio is optimum as compared to the traditional technique.

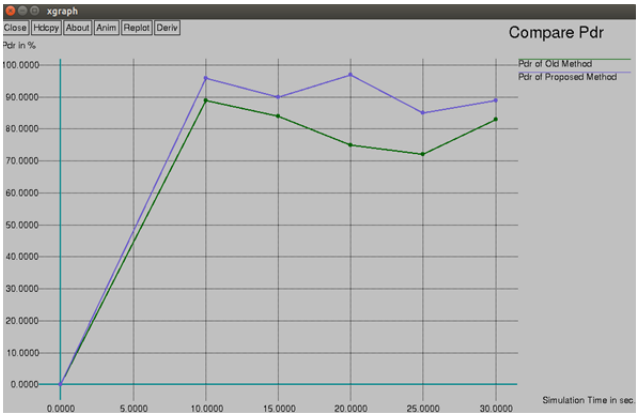

Figure 4 packet delivery ratio

5.3 Routing overhead

During the routing activity the additional packets are injected in network, the additional packets which are injected is known as the routing overhead. The figure 5 shows the amount of routing overhead for both the implemented routing techniques, for representing the proposed methodology the performance is given using blue line and the performance of traditional technique is given using green line.

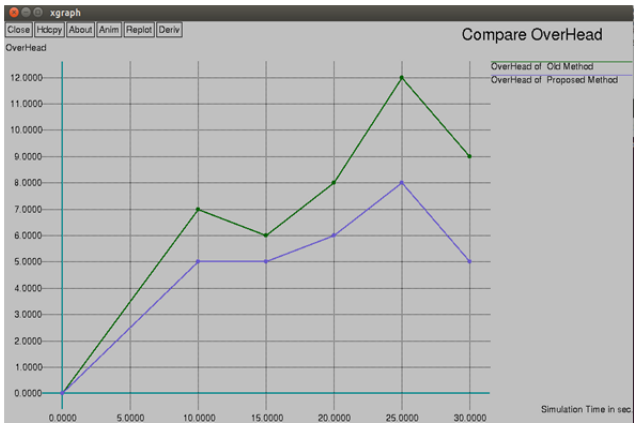

Figure 5 routing overhead

In this diagram the X axis shows the simulation time in terms of seconds and the routing overhead in terms of number of packets are given in Y axis. According to the obtained performance the proposed routing algorithm introduces the less amount of additional packets in network thus the routing overhead of the proposed technique is fewer as compared to the traditional technique.

5.4 Energy consumption

In wireless sensor network almost computational units and communication units are built with sensor devices. Therefore the devices consume high energy. Each device contains some initial energy in battery, and consumes with packet forwarding, routing and receiving. During this an amount of energy is consumed is known as power consumption of network.

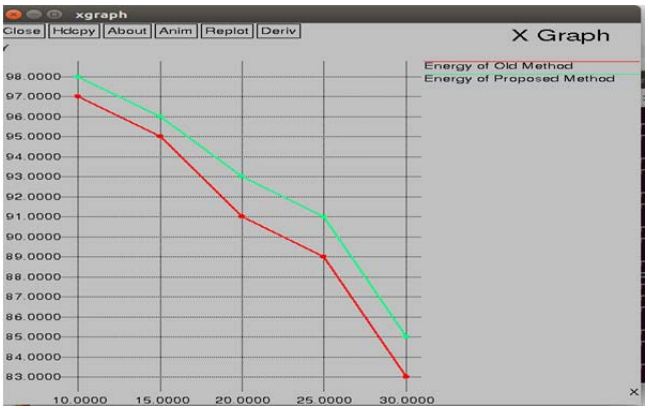

Figure 6 energy consumption

The comparative energy consumption of both the techniques are given using the figure 6 in this diagram the X axis shows the simulation time in terms of seconds and the Y axis shows the energy drop of both the algorithms. Furthermore the red line shows the performance of the traditional approach and the green line shows the performance of proposed method. According to the obtained results the energy consumption of the proposed routing technique is less as compared to the traditional technique.

5.5 End to end delay

End to end delay provide the information about the additional time consumed during the transmission of data. In order to simulate effectiveness of the presented routing protocol that is compared with traditional routing protocol performance. The comparative end to end delay between proposed and traditional cryptographic approach is given using figure 7.

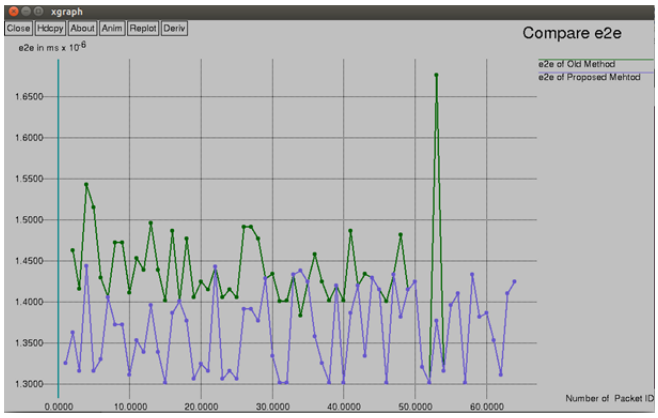

Figure 7 end to end delay

According to the obtained results as given in figure 7 the performance of the proposed routing technique (blue line) shows the less end to end delay as compared to the traditional routing approach (green line). For demonstrating the performance of both the algorithms the X axis contains the packet ID and the Y axis shows the end to end delay in terms of milliseconds. The results show the effectiveness of the routing technique over the traditional technique.

IV. Conclusions

.The wireless communication is a precious gift for human additionally the mobility added wireless communication enable more domains of applications. In this presented study the wireless sensor network is in key role thus the entire investigation and network design is performed for wireless sensor network demonstration. Due to the mobility added wireless sensor network the routing issues occurred frequently thus the performance losses is arises. Thus the proposed work is intended to find a novel approach of mobility management and fault node recovery techniques.

In order to find the optimum technique of fault node recovery a number of research articles and algorithms are studied and after evaluation a new technique is proposed. The proposed technique is based on the backup route management scheme. In this technique after route discovery two different routes are selected where first is termed as the master route and second is known as the salve. The source router sends information by the first route or master route and if the route is damaged then the back route is utilized for continuous communication.

The given concept is implemented through the NS2 (network simulator 2) where three routing algorithms are default available namely AODV, DSR and DSDV. Among them the AODV found more suitable for implementing the desired concept. Thus the AODV routing protocol is modified using the proposed concept and a new protocol is established. The simulation of the proposed routing is prepared and then using the generated trace files the performance is evaluated. The obtained performance is summarized using the below given table 2.

S. No.	Parameters	Proposed technique	Traditional
1	Throughput	High	Low
2	Packet delivery ratio	High	Low
3	End to end delay	Low	High
4	Routing overhead	Low	High
5	Energy consumption	Low	High

Table 2 performance summary

According to the evaluated results the performance of the proposed technique founds efficient as well as less resource consuming. Thus the proposed technique finds much optimum as compared to the traditional one.

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