DESIGN OF AN ENHANCED NEW MULTIPATH ROUTING APPROACH FOR ENERGY EFFICIENT IN WIRELESS SENSOR NETWORKS

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ABSTRACT

A wireless sensor network is a collection of sensors that can transfer information obtained from a monitored field over wireless networks. The data is routed via many nodes and connects to other networks such as wireless Ethernet via a gateway.Wireless Sensor Networks (WSNs) are self-configured, infrastructure-free wireless networks that detect physical or environmental factors such as temperature, sound, vibration, pressure, mobility, or pollution and collaboratively transmit their data via the network to a central location or sink. The main aim of this study is to discuss the New Multipath Routing Approach for Energy Efficient in Wireless Sensor Networks. In this work the recommended Multipath routing scheme consists of 3 measures as multipath construction phase, maintenance of optimum energy road and also the energy usage design to enhance the energy efficiency in the sensor networks.The study work involves enhanced multipath routing-based routing, authentication as well as scheduling-based approach to create the wireless sensor networks safer with the least energy usage. A new Multipath Routing Approach (NMRA) is actually created for raising the energy efficiency in wireless sensor networks. The multipath routing is built to attain higher throughput as well as load balancing

Keywords - *Wireless sensor network, multipath routing, energy efficient, optimum energy etc.*

1. INTRODUCTION

The improvement of wireless sensor networks (WSNs) has as of late opened up another and fascinating zone for the production of new sorts of uses. WSNs comprise of countless detecting nodes that screen their condition, process data if essential (utilizing microprocessors) and send/get handled data to/from other detecting nodes. These detecting nodes, dispersed in the earth, are associated with a sink node – in concentrated networks – or to other detecting nodes by means of a network. In brought together networks, the sink gathers sensor data to be utilized by the end client. By and large, the sink is likewise fit for actuating detecting nodes by means of broadcasting, by sending network arrangement and control data. Similarly, as with different networks, there are three basic plan challenges that very impact the availability and profitability of the whole network: (1) utilizing network protocols to limit control and data packets, (2) choosing the best topology by situating nodes in the correct spots, and (3) conveying a steering calculation that adequately goes data through the network from the starting point node to goal node/nodes.

WSNs comprises of various sensor nodes extending out of a few of tens to thousands that are set up together to monitor as well as sense the information regarding the place. The style of WSNs is program reliant. Due to the diversity at the application environments of the use of theirs, the layout of protocols and algorithms for WSNs must give some thought to elements such as for instance the location of deployment, the apps layout goals, price, and hardware system constraints. Apart from this the tiny dimensions of the sensor nodes imposes restrictions on the different energy as processing, mind & energy abilities. Therefore, to be able to extend the lifespan of the WSNs efficient use of the available resources; particularly the energy resource is actually unavoidable.

1.1 Wireless Sensor Networks

Wireless Sensor Networks are usually composed of a lot of distributed sensor nodes that organize themselves into a multi-hop wireless network. Several of the main problems in wireless sensor networks are actually energy usage, lack of authentication data integrity as well as instability of load link between sensor nodes which brings down the acceptance of the sensor network

Wireless Sensor Networks (WSN) has received worldwide interest in the latest years as a result of the developments within the wireless communication, information technologies as well as electronics discipline. It's an in vital sensing technology in which small, compact and autonomous gadgets known as motes or sensor nodes deployed in a remote place to identify phenomena, gather as well as process information and transmit sensed information to the users. The development of low cost, low power, multifunctional sensor has gotten increasing focus from different industries. Motes or sensor nodes in WSNs are actually easy sized and therefore are able to sensing, processing and collecting information while talking with various other connected nodes of the network, through Radio Frequency (RF) channel.

1.2 Elements of WSN

A typical wireless sensor network can be divided into two elements. They are:

- Sensor Node
- Network Architecture

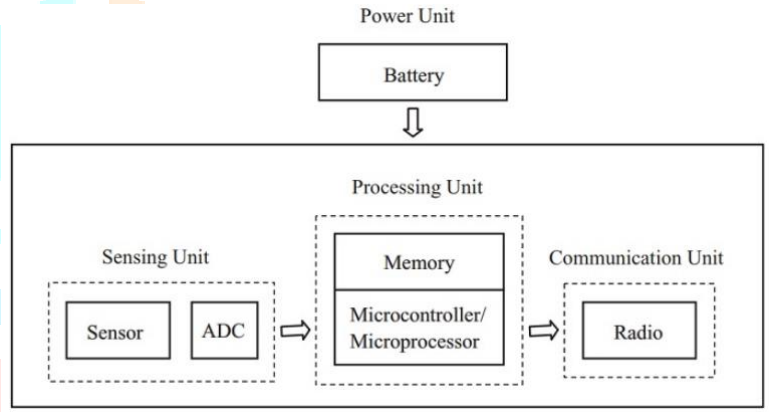

Figure 1: Element structure of WSN

1.3 WSN Architecture

The OSI model is usually followed in the WSNs architecture. Basically, the WSN architecture has 5 primary layers specifically the actual physical layer, data link layer, network layer, transport layer and application layer. Apart from these layers you will find 3 cross level planes to blame for the coordination of the whole sensors nodes and controlling the general effectiveness of the network. They're the power management plane, the mobility management plane as well as the job management plane. The WSN OSI architecture is actually provided in Figure 2.

The power management plane coordinates the usage of energy. The mobility management airplane is actually to blame for the tracking of node mobility as the task management airplane schedules the sensing procedure. These cross level optimizations augment in conserving other resources and the energy.

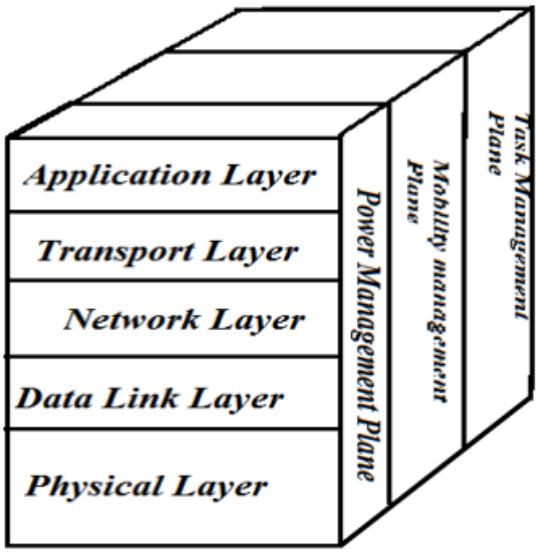

Figure 2: WSN OSI Architecture

The sensor nodes differ in efficiency and size and are actually created especially on the application prerequisite as they're designated for certain application scenarios.

1.4 Energy Consumption in WSN

WSN sensors, usually used in non-accessible atmosphere, are actually powered using little batteries coupled with methods for power harvesting; replacing batteries isn't an alternative. Relying on a battery not just limits the sensor's lifetime but also makes efficient design as well as management of WSNs a serious challenge. The limitation of energy supply, nonetheless, has inspired a great deal of the study on WSNs at all levels of the protocol stack.

Network architectures, like Internet as well as OSI, are generally purposeful designs organized as levels in which a layer offers services to the layer above (e.g. the application layer provides services to the end users). A network is usually evaluated in phrases of the quality of the service parameters of its, like delay, throughput, jitter, accessibility, reliability as well as security. Nevertheless, with regards to energy consumption (EC), one typically encounters difficulty, as optimization as well as evaluation of the network as an extensive design which takes the EC into consideration rarely prevails. In general, scientists concentrate on the standard network architecture and attempt to minimize a certain element of a single layer, with the hope that the general EC of the network is actually reduced with no regard for various elements or even layers. This's not a best scenario, in which one doesn't understand the way a single component works in the complete energy photograph of a whole wireless sensor network. Nearly all present energy minimization models target on sending as well as receiving data, while remaining parameters are ignored. The power use design focused on the price of sending as well as receiving data and deduced the top limit of the energy efficiency of single hop distance. This particular method considers an intermediate node among destination as well as source so that the retransmission will help save the energy. Some other methods assess the energy efficiency of wireless sensor networks by utilizing the power usage version.

Since wireless networks have difficulties and specs diverse, the standard network architecture can't satisfy them. The cross layer plan was produced to offer flexible network architecture for wireless networks. The crucial thought in cross layer style is actually allowing enhanced info sharing in addition to dependence among the various levels of the protocol stack. It's argued that by doing so, greater performance gains could be received in wireless networks, and also the ensuing protocols are a lot more suited to employment on wireless networks as compared to protocols created in the absolutely layered approach. Wide instances of cross layer design include, say, look of 2 or maybe more layers jointly, or maybe passing of parameters between levels throughout run time, etc.; but there's no criteria to figure out which layers must be combined to make the ideal outcome for the complete EC.

2. LITERATURE REVIEW

Samara et al., (2020) A Wireless Sensor Network (WSN) is actually a set of small nodes which have low energy levels and also have become an important element of the contemporary communication infrastructure and extremely important on academia and industry. Energy is actually essential in WSN, and hence the layout of WSN of the study society is actually based on energy efficiency, as well as node energy use is an excellent challenge to improve WSN's lifetime.

N., Padmapriya et al., (2020) A wireless sensor network (WSN) is actually a gathering of sensor hubs which powerfully self-sort themselves into a wireless system without the usage of any prior framework. Among the serious problems in WSNs is actually the energy usage, whereby the device lifetime is actually governed by this particular aspect. Energy-efficient routing is considered probably the most assessment errand. Sensor organizes for the majority of part work within dynamic and perplexing circumstances and directing winds up repeated assignment to continue as the ca measure increments. This particular chapter portrays the framework of wireless sensor network the analysis as well as research of various investigation functions determined with energy efficient routing in wireless sensor networks.

Sharma, Vidushi&Pughat, Anuradha (2017) The advancements in low power electronic products integrated with wireless communication abilities are one of current facets of investigation in the area of Wireless Sensor Networks (WSNs). One of the leading challenges in WSNs is uniform and least energy dissipation while enhancing the lifetime of the network. This's the original book that introduces the cost-effective wireless sensor network methods as well as protocols.

Semente et al., (2015) Due to increasing number of controllers, actuators and sensors in typical instrumentation methods, cabling connection complexity has additionally developed, improving time as well as maintenance cost. Being a result, the usage of IEEE 802.15.4 standard in Wireless Sensors Networks (WSN) has additionally improved, allowing faster maintenance time, and also format changes. In certain apps, in which there aren't any reliable sources of energy, the issue of energy use is crucial, as for environmental monitoring, mobile applications, agricultural industry as well as automation of engine oil wells. This particular chapter additionally provides a usage estimation technique to be utilized in WSN models tasks which enables the engineer to determine the network attributes as a set of performance needs and also suggests additional advancements in this specific place.

Parmar et al., (2014) Wireless sensor networks can be broadly used in numerous applications. Sensor networks still have troubles in conveying data from one sensor node to various another node. Routing algorithms are actually created for wireless sensor networks. With this paper, several of them are talked about. These protocols continue to have a number of troubles in sensor networks. WSNS as well as ad hoc networks resemble one another as both hinge on hop-to-hop routing. And so, protocols created for ad hoc networks can also be used in numerous sensor apps. Moto of this particular paper is actually giving a concept that some other protocols which had been created for MANETs could be totally utilized in WSNs, by having angle-based mechanism, as discussed in ADSR.

3. PROPOSED METHODOLOGY

Inside WSN, sensors are structured randomly. Routing in the wireless sensor networks is actually a challenging assignment. This particular assignment might result in a selection of routing protocols which properly utilize the limited resources offered at the sensor nodes. All the routing protocols are going to attempt to search for the perfect energy path. To figure out the answer track quickly, a reduction of energy load as well as time is actually necessary. At this point, the brand-new Multipath Routing Approach (NMRA) is actually suggested for raising the energy efficiency in WSNs. It consists of 3 phases. In the very first phase, the multipath routing is actually built. In the 2nd phase, the perfect energy path is actually established and in the third phase, the energy usage design is actually designed. By simulating the results, the proposed NMRA accomplishes much better shipping ratio, enhanced network lifetime, less and faster energy usage while different the selection of nodes in phrases of mobility as opposed to the current plan Smart Boundary Yao Gabriel Graph (SBYaoGG)

This work involves enhanced multipath routing-based routing, authentication as well as scheduling-based approach to create the wireless sensor networks safer with the least energy usage. A new Multipath Routing Approach (NMRA) is actually created for raising the energy efficiency in wireless sensor networks. The multipath routing is built to

attain higher throughput as well as load balancing.

The recommended Multipath routing scheme consists of 3 measures as multipath construction phase, maintenance of optimum energy load and also the energy usage design to enhance the energy efficiency in the sensor networks.

3.1 Multipath Construction Phase

Several paths may additionally be used at the same time to raise information transmission reliability. You will find 2 various techniques to supply efficient information transmission via concurrent multipath routing. The very first strategy is based on transmitting several copies of an original information packet over various paths to guarantee package recovery from a number of path problems. Erasure coding is yet another method utilized by several of the present protocols to provide desired reliability need of various programs. Depending on the utilized coding method, each resource node provides several more info to the initial information packets and then distributes the generated information packets over numerous paths. In order to reconstruct authentic packets, a particular number of transmitted information packets from each source node must be obtained by the sink node. Appropriately, if a couple of numbers of paths failed to provide some information packets to the sink node, the reliability of information transmission may be assured by reconstructing information packets from the sink node.the energy usage will be sent out as well as the lifetime of network is actually prolonged. The main tasks in that phase are developing the routing road as well as neighbor table creation. The sink node broadcasts the route request package to find out the one hop nodes / level one node. Route Request Control Messages are actually used to recognize the nodes in amounts that are different. Immediately after a route request email is actually delivered by the sink node, the hop count records the amount of hops that travelled as a result of the sink.

3.2 The Format of Route Request Control Message

The Source ID has the node ID of the information destination, sequence number discipline, hop count discipline, energy threshold discipline, signal strength threshold as well as sink ID. Sequence Number area is actually a package sequence. The hop count discipline is actually the amount of hops out of the sink node that is utilized to determine the nodes in levels that are different, by accounting the number of hops from the sink node. Nodes which can get the radio signal of sink are actually described as one hop / level one node. Energy threshold discipline offers the minimum needed energy level for a node to be selected for the information transmission. Signal Strength threshold is actually indicating the minimum distance that the node has to be put to receive all of the data's transmitted to that node. Sink ID suggests the ID of the sink which broadcasts the route demand packet.

3.3 Maintenance of Optimal Energy Path

The present research as well as development problem is actually developing low power interaction with low cost on node processing and self-organizing connectivity/ protocol. An additional vital problem is the demand of the lengthy temporal functioning for the sensing node even with a (typically) minimal power cord or maybe battery power.Low energy usage is actually a crucial element in ensuring long operating horizons for non-power-fed methods (some methods may really be power fed and/or depend on various other energy sources).

The idea of optimum energy path is utilized to appraise the least energy usage. The primary goal is actually maintaining the information packet flow in the wireless sensor network unobstructed. The meaning of the sensor network design is provided as follows.

Let us believe a certain network $N(\Psi,\Theta)$ is actually made up of Ψ as well as Θ, in which Ψ is actually the set of nodes and Θ is actually the set of links. Because of the characteristic of multi hop transmission, sensor network might have numerous paths from supply node s to destination node d. Thus, Let Π (s,d) denote the set of all the possible paths beginning from s to d. As outlined by these definitions, it's known that Π (s,d) is actually the subset of Λ.

Let π presents a generic route, as well as $\pi i(s, d)$ belongs to the i th path in a trip from supply node s to destination node d. Also,Let $\Phi(\pi)$ be a generic price functionality related to a designated path. $\Phi(\pi)$ is usually the postpone time $\theta(\pi)$ for a package which transfers by way of a path π, or maybe the amount of hops $\varepsilon(\pi)$, including a hybrid feature mixed both of them. If it has the identical price for 2 or maybe more paths, consider them as Φ-equivalent. Since each node in the WSN functions as a router that actually works independently, many connection matrices are actually identified as well as kept in each node to help

carrying out the energy efficient routing purpose.

3.4 Packet Loss in Wireless SensorNetworks

The packet loss as a result of congestion is an essential issue in coping with the sensor networks. A queue forms in a buffer until the media link wireless n broadband router can transmit them on the way of theirs. With this strategy, it's viewed that buffer overflow takes place every time a queue exceeds its buffer limit i.e. tail drop queues. Arbitrary Early Discard (AED) systems trigger packet drop prior to the buffer is actually complete.

3.5 Energy Consumption Model

The energy usage of idling is definitely invested by the nodes to stay away from collisions, and that is the performance of MAC level. The energy usage in MAC level doesn't impact the energy analysis of network level. The entire energy usage is viewed when the energy usage of sending as well as getting a package multiplied by the entire transmission times. The driving energy ETX (k, d) as well as the receiving energy ERX (k) come to be the focus. In wireless networks, provided that the nodes are actually used to the transmission range of the transmitting nodes, they get these packets at no cost still when these packets don't belong to the tasks of theirs. This particular phenomenon is actually viewed as the broadcasting characteristic of wireless networks. Thus, the entire energy consumption is

$$EMULT = (ETX(k,d)) + N \times (E_{RX}(k)) \times NR \quad (1)$$

Wherever N is actually the amount of nodes of a cluster, NR is actually the transmission times of the network, k is actually the packet size, and d is actually the transmission radius.

In order to streamline the conversation, it's assumed that all of the sensor nodes have exactly the same transmission radius. The relationship among energy use, packet size k, and transmission radius d for one node is

$$E_{TX}(k,d) = k \times E_{txElec} + k \times \delta\, amp \times d\gamma + E_{start} \quad (2)$$

Where E_{txElec} is the energy of sending one bit data. It is the path loss factor whose value is constant in a typical condition. δamp is the value of signal amplifier, and E_{start} is the energy consumption of starting transmission. On the other hand, the energy consumption of receivingis

$$E_{RX}(k) = k \times E_{rxElec} + E_{star} \quad (3)$$

E_{rxElec} is the energy consumption of receiving one bit data.

$$E_{rxElec} = E_{txElec} = E_{elec} \quad (4)$$

From Equations (1), (2), (3) and (4) the outcome of complete energy usage is attained. In the analysis, energy usage of encoding just decoding throughout network coding operations is neglected, as well as the causes are actually accounted beneath.

For starters, the primary job of encoding is obtaining new linear combos of authentic packets.

Next, the operations of encoding as well as decoding are derived from a limited area on which all of the businesses including addition as well as multiplication are actually closed, and there's no floating-point functioning of sensor nodes.

In comparison, the energy usage of sending as well as getting as well as the energy usage throughout network coding operations is actually lower.

4. DATA ANALYSIS

Network Simulator (NS2.34) is actually utilized to simulate the proposed algorithm. NS2.34 is among the most effective simulation equipment readily available for Wireless Sensor Networks.

It can easily be quickly applied in the created protocols by utilizing the OTCL coding and also by writing the C Program. The device will help to confirm the concept analytically.

In the simulation, 200 mobile nodes move in a 1200-meter x 1200-meter square region for sixty seconds simulation period. Every node has exactly the same transmission range of 250 meters. The simulation options as well as parameters are summarized in Table1.

Mainly the performance is evaluated according to the following metrics.

End-to-end delay: End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination.

Data Availability Ratio: It is defined as making the copies of data items shared by several users in a particular point of time.

Throughput: It is defined as the number of packets received at a particular point of time.

In simulation results, the proposed algorithm (NMRA) is compared with Smart Boundary Yao Gabriel Graph (SBYaoGG) scheme in presence of the energy consumption.

Table 1 Simulation Settings and Parameters of Proposed NMRA Scheme

No. of Nodes	200
Area Size	1200 X 1200
MAC	802.11
Radio Range	250m
Simulation Time	60 sec
Traffic Source	CBR
Packet Size	512 bytes
Mobility Model	Random Way Point
Transmitter Amplifier	150 pJ/bit/m^2
Package rate	5 pkt/s
Protocol	DSR

Table 2 Comparison Results of Proposed NMRA Scheme and Existing Scheme

Performance Metrics	NMRA	SBYaoGG
Energy Consumption (Joules)	700-580	1300-800
Network Lifetime (Secs)	223.56-440.33	100.45-347.89
Overhead (pkts)	0.32-0.75	0.88-1.34
End to End delay (msec)	0.42-0.85	0.678-1.15
Data Availability (pkts)	950-4800	500-2300

Figure 3 shows the results of average residual energy by varying the time from 10 to 50ms. From the results, it shows that NMRA scheme has minimal energy consumption than the existing scheme SBYaoGG.

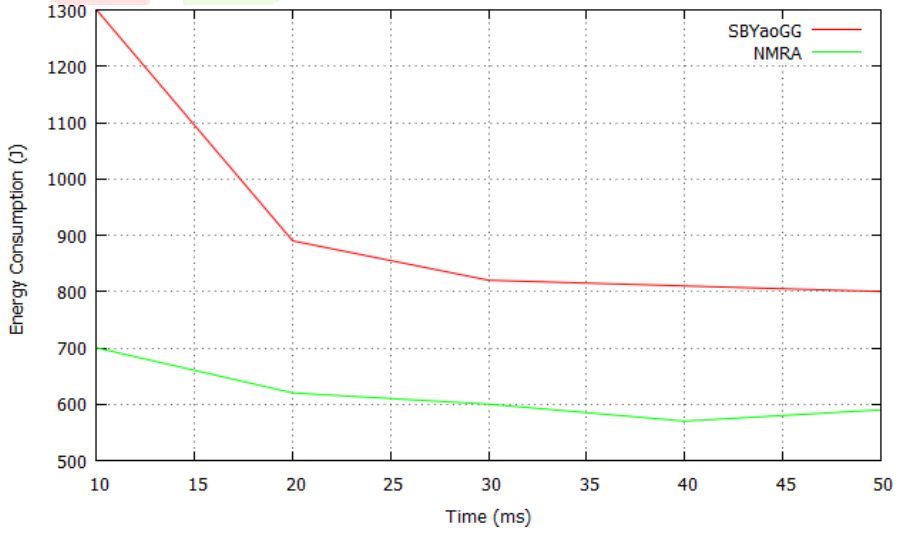

Figure 3 Time Vs Energy Consumption using NMRA Scheme

Figure 4 presents the network lifetime comparison for NMRA and SBYaoGG scheme. The Network life time of NMRA is high when compared with existing scheme SBYaoGG.

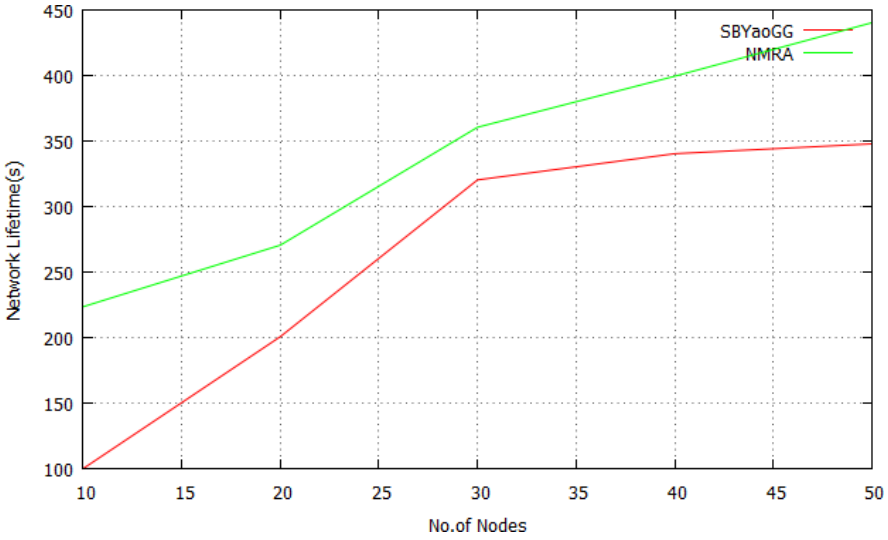

Figure 4 Increasing the Network Lifetime using NMRA Scheme

Figure 5 presents the comparison of data availability. The data availability ratio of NMRA is higher than the existing scheme SBYaoGG.

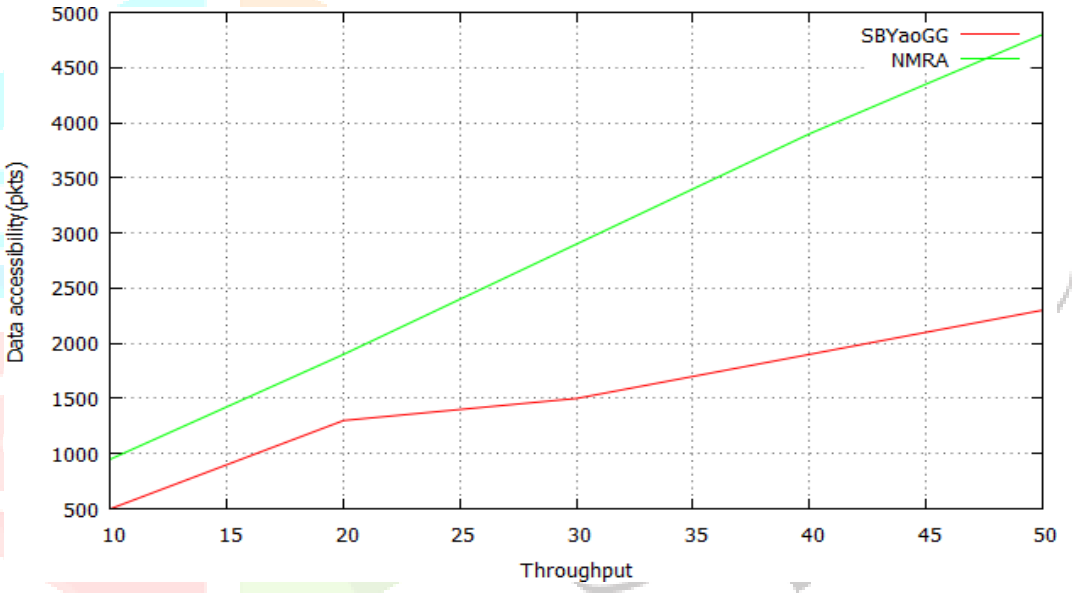

Figure 5: Throughput Vs Data Accessibility using NMRA Scheme

Figure 6 shows the results of Time Vs End to End delay. The NMRA scheme has slightly lower delay than the existing scheme SBYaoGG because of authentication routines.

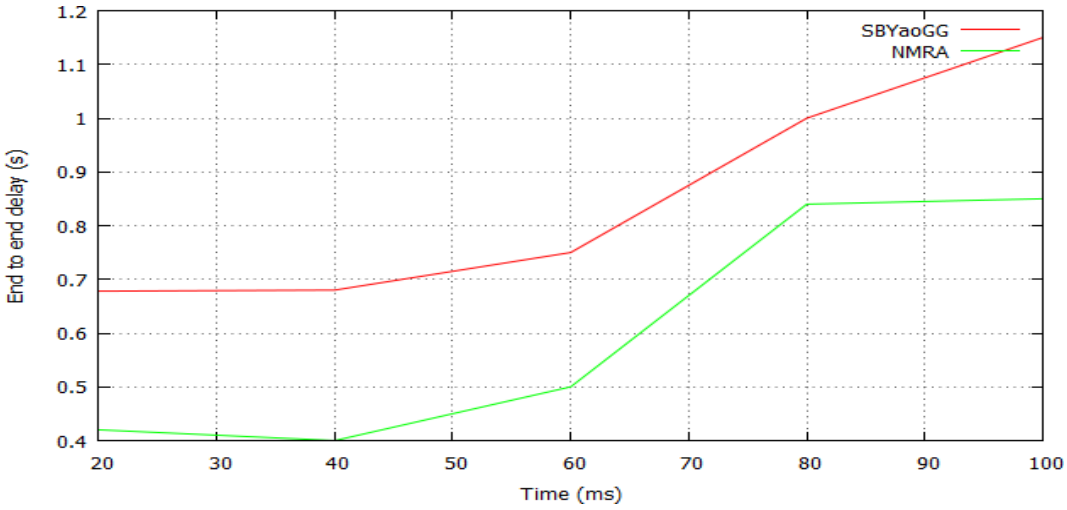

Figure 6: Time Vs End to End Delay using NMRA Scheme

Figure 7 presents the comparison of delay while varying the mobility from 20 to 100ms. The delay of NMRA is lower than the existing scheme SBYaoGG.

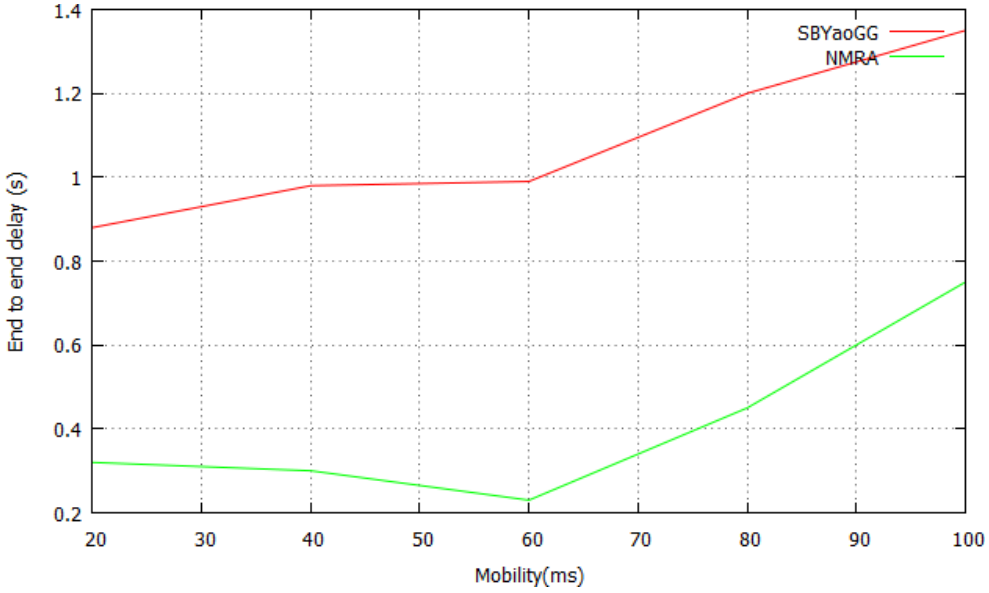

Figure 7: Mobility Vs End to End Delay using NMRA Scheme

5. CONCLUSION

The significance of WSNs is actually prominent in the latest years as a result of the enormous applications they're engaged in. WSNs is actually being utilized for many important uses including remote environmental monitoring, target tracking, habitat monitoring, medical and agricultural applications, surveillance program etc. The smaller, cheaper, and smart sensor nodes are actually built with wireless interfaces to speak with each other to create a network.

This study works with multipath routing with enhanced program to enhance the energy efficiency of wireless sensor nodes. The proposed New Multipath Routing Approach attains energy version, maintenance of optimum energy route, multipath construction phase to create a great balance between network life times, throughput as well as energy usage to the sensor nodes. The simulation device is utilized to show the overall performance of suggested scheme. In the following chapter, residual energy based multipath routing program have been proposed.

Future scope

The other concerns of wireless sensor networks including localization, targetization, security, and so on, are usually emerging areas of investigation. A security mechanism that will require energy that is very low or maybe self-harvesting nodes may be created for protected routing. Furthermore, the layout of effective routing protocol for real time programs, enhancing the Quality of Service (QoS) could be considered.

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