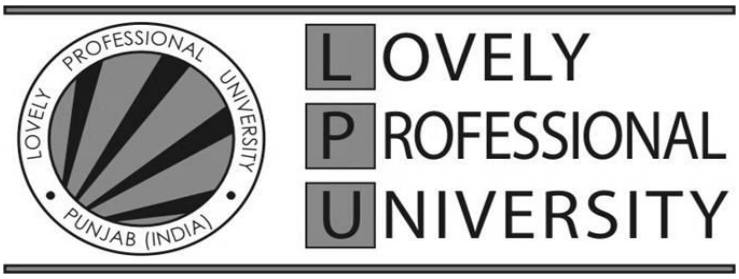

Enhancing the performance of multipath routing protocol in wireless sensor network

A Dissertation submitted

By

Anit Kumar

To

Department of

Lovely faculty of Technology and Science

In partial fulfilment of the Requirement for the

Award of the Degree of

Master of Technology

In

Computer Science and Technology

Under the guidance of

Amritpal Singh

(May 2015)

Annexure I

LOVELY PROFESSIONAL UNIVERSITY

Transforming Education Transforming India

Discipline: CSE

PROJECT/DISSERTATION TOPIC APPROVAL PERFORMA

Name of student : Anil Kumar

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PROPOSED TOPICS

1. Wireless Sensor Network
2. test suit optimization
3. image Processing

Amritpal Singh

Signature of Guide

*Guide should finally encircle one topic out of three proposed topics and put up for approval before Project Approval Committee (PAC)

*Original copy of this format after PAC approval will be retained by the student and must be attached in the Project/Dissertation synopsis and final report.

*One copy to be submitted to guide.

Student will work on security issues in Wireless Sensor Networks. I am expecting the paper to be published in this topic

APPROVAL PAC CHAIRPERSON

Signature:

11/10/14

DECLARATION

I hereby declare that the dissertation entitled, **Enhancing the performance of multipath routing protocol in wireless sensor network** submitted for the M.Tech Degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

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ABSTRACT

In recent years, multipath routing technique is recognized as an effective approach to improve quality of service in wireless sensor network (WSN). However are most of the previous protocols focused on interference, energy efficiency and load balancing etc. There is need to improve of buffer capacity and service rate of active nodes over multipath routing protocol in wireless sensor network. There is also need to evaluate the behavior of the routing protocol before path established and after path selection from source to sink. In this research work, we will improve the network performance with the help of parameters specified in objectives.

CERTIFICATE

This is to certify that **Anit Kumar** has completed M.Tech dissertation proposal titled **Enhancing the performance of multipath routing protocol in wireless sensor network** under my guidance and supervision. To the best of my knowledge, the present work is the result of his original investigation and study. No part of the dissertation proposal has ever been submitted for any other degree or diploma.

The dissertation proposal is fit for the submission and the partial fulfillment of the conditions for the award of M.Tech Computer Science & Engineering.

Date:_____ Signature of Advisor

Name:

UID

ACKNOWLEGMENT

I would like to place on record my deep sense of gratitude of Assistant Professor Amritpal Singh, School of Computer Science, Lovely Professional University, Phagwara, India for her generous guidance, help and useful suggestions. I wish to extend my thanks to Head of Department Dalwinder Singh, School of Computer Science for his constructive suggestions to improve the quality of this research work. I am extremely thankful to Head of School Amandeep Nagpal, School of Computer Science, Lovely Professional University for providing me infrastructural facilities to work within, without which this work would not have been possible.

Anit Kumar

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CHAPTER 1

INTRODUCTION

A wireless sensor network is a group of sensor nodes in sensor limited power supply reserved calculation and broadcast ability. In sensor to the limited transmission and limited broadcast capability, the sensor nodes high density, forwarding data packet the place of multi hop data transmission and forwarding. In the terms of wireless sensor network routing has been an important field in research the past few year.

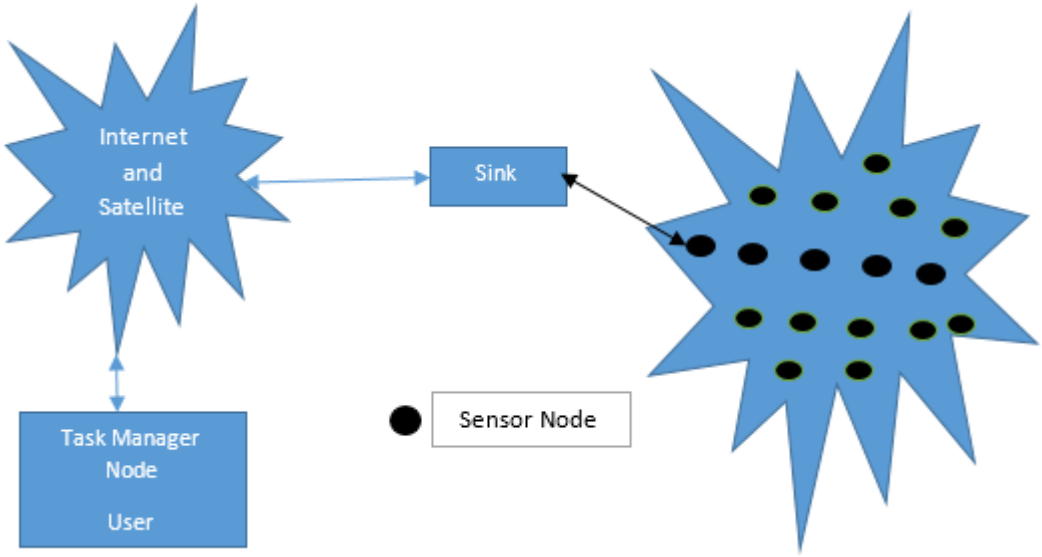

Figure 1.1 Wireless sensor networks

The sensor nodes route have non rechargeable batteries, the sensor network with effective routing actually the sensor network should be more energy saving and efficient utilization of the resource or packet this is an important area in research unease. The evolution of wireless sensor technologies and development of minimum cost in sensor nodes have led introduce of minimum power consumption in wireless sensor network. The wireless sensor many more function and easily deployment of sensor nodes. The sensor are used various application like health care, forest fire discovery, target tracking, inventory control, energy management, surveillance and investigation, and so any other application are used. Actually the main work of sensor nodes in network through gathering or collecting information send source to the sink for advance operation, but the sensor nodes imitated supply, undefined link between the sensor nodes in the combination in the many other application demand of different-2 application make it a hard work to implement and design an efficient routing algorithm in wireless sensor network.

The sensor network suitable routing algorithm for different application, the wireless sensor network has been considering the important issue, fulfil the different performance demands. In this situation different-2 routing algorithm proposed to increase the efficiency and performance demand of different application done the network layer in the wireless sensor network protocol; based in single path routing. Basically single path routing selects the source a single path which is satisfies the performance demand of the application forward and transmitting the actual load toward the sink node.

All the overall performance issue the single path strategy cope up with the limitation, in the multi path routing strategy to use the alternate path routing came into existence. In the multi path routing the name suggests there will be established multipath between sources to sink the data retched to the destination. These are totally based one individual routing strategy. Many other routing select the best path to send the data and other alternate path to use the backup if the primary path fail, to use the path concurrently to send data and so on. In the previous few year the multi path routing approach used different-2 network management purpose like as improving transmission, congestion control, fault tolerance, reliability, quality of service support (QoS) by wired and wireless network, but the different feature in wireless sensor network the new challenge the characteristics of the short range radio communication introduces and should be addressed designing the multipath routing protocol.

1.1 Wireless Sensor Network Architecture

Every sensor nodes are element in sensor network area. The wireless sensor network capability collect the information or message to send data back to the gateway nodes. The sensing data are sent to the back to the end user through a multiple hop infrastructure area less architecture through the sink. The sink node communicate end user through a satellite or internet or Wi-Fi or connected without any network type of network the sink can directly connected to the end user.

In WSNs hubs perform every the functionalities that they start likewise as course data. Supply hubs transmit their parcels to sink and just if there should arise an occurrence of moderate hubs they forward bundles got from option hubs.

The convention stack used as a piece of sensor framework involves five layers that are application layer, transport layer, data link layer, physical layer, framework layer. It similarly includes power organization plane, task organization plane and adaptability organization.

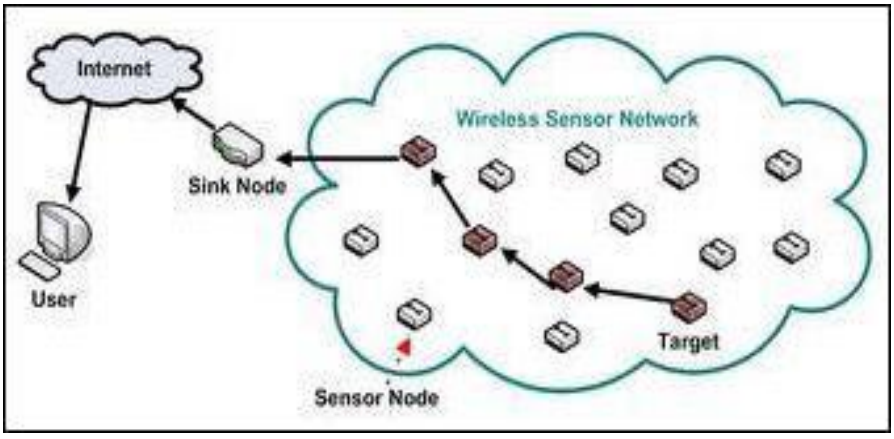

Figure 1.2 WSN architecture [3]

The power administration plane is utilized for proficient use of power of sensor node. For instance a sensor hub can kill its beneficiary in the wake of accepting message from its neighbour node. In the event that a node is having low energy then it can illuminate its neighbour nodes that it can't perform directing and can save its energy for detecting task. The mobility management plane is used to detect the mobility of nodes and also keeps track of this information so that a path back to user is always maintained.

The undertaking administration plane makes plan for the sensing undertakings given to a specific locale. All nodes in that locale where sensing errands are booked did not take part in sensing undertaking at same time and the investment of nodes can be in light of their energy levels. These administration planes are needed for productive working of network.

1.2 Wireless Sensor Network Routing

Nowadays multipath routing approach is introduced as an effective technique for improving sensor and ad hoc networks performance like less energy consumption, fault tolerance, reliability and throughput. Multipath routing is a class of routing protocols which enables every source node to discover several paths go through the destination. Searched path can be used simultaneously to distribute network traffic over several paths or the sink node only use the single path for data transmission and then switches to an alternative path when a node or link failure occurs along the active path for fault tolerance purpose. In the following we present some of the just proposed some multipath routing protocols in wireless sensor networks.

Considering the important feature of low power wireless sensor network, the wireless sensor network is much more challenging to compare the wireless network such as ad-hoc network.

First seeing the sensor node have high density, the routing protocol create must be route data over long distance, depend upon network structure and size, this are addition requirement may be fail during the energy depletion or environment factor of sensor node or hardware problem but this are issues should not important interrupt the normal operation of the network. All over as said in earlier the wireless sensor nodes are limited power supply, forwarding capability and available bandwidth, the sensor network performance totally depend upon application dependent, the wireless sensor network routing algorithm should be satisfy the quality of service demands which is network is deployed. For example the challenging of designing algorithm of environment monitoring will be different from have to be health care monitoring or target tracking. On the basic of difference between traditional wireless network and wireless sensor network, many more routing protocol are proposed in last few year, to address new challenges in routing algorithm and introduce by new feature of the wireless network AL-Karki et.al the classified wireless sensor network the exiting routing in two different part, network structure and protocol operation

In the terms of the flat routing protocol design the purpose of network structure operation with homogeneous nodes means the all nodes have Directed Diffusion, Sensor Protocol for Information via Negotiation, Same Transmission Processing Capability, and Energy Aware Routing can also added in this category. This type of protocol demonstrate low topology maintain overhead and ability of path discovery.

In other hand groups of protocol is like hierarchical routing protocol which is the proposed increase scalability of the network and make the energy efficient network through the clustering of sensor. In the terms of this protocol groups of sensor nodes and grouped of cluster and every cluster one cluster head the cluster head the responsible for the collecting the data through the cluster nodes and data processing and forwarding towards the sink. In this type of structure provide the high network scalability; in basic of clustering operation in the case of cluster head replaced execute the high signalling overhead to the sensor network. In the terms of routing algorithm such as Threshold-Sensitive Energy-Efficient Sensor Network Protocol (TEEN), Low-Energy Adaptive Clustering Hierarchy (LEACH) in this category.

Next the group of routing protocol to use for particular location of the sensor nodes for routing purposes. And use for the geographic location nodes can be found directly using the global positioning system (GPS) device and other hand the exchange information through

indirectly using strength received at each node. Then localization needs some hardware support and also use the calculation overhead, this system are not to use easily used resource inhibited wireless sensor network. Some protocol can be referred as the geographic routing protocol like Geographic Adaptive Fidelity (GAF) and Energy-Aware Routing. From the protocol operation viewpoint, some exiting protocol can be categorised into query based, Quality of service (QoS), based, multi-path, negotiation based on coherent-based protocols.

Firstly the negotiation based routing protocol design this are provide energy efficient communication, during the data transmission reduce the redundancy. Every sensor adds the collect the high level data description and performs the negotiation with neighbouring nodes redundant data and eliminate. For example SPIN protocol.

The next protocol group are Quality of service based this protocol generally work; satisfy the quality of service demands (delay, reliability, bandwidth) of the different application. The main work this type of protocol creates the trade off in between energy consumption and data quality. For example SPEED, Multipath Multi-SPEED, Sequence Assignment Routing (SAR), Delay-minimum Energy Aware Routing Protocol (DERP), this protocol are consider the quality of service aware algorithm.

The next group of routing protocol is multi path routing protocol the revolution of single path routing protocol to provide multiple path data transmission source to sink. This type of protocol like, for example Braided Multipath Routing, N-to-1 Multipath Routing Protocol.

The last group of protocol is coherent based protocol, the all of the network nodes process the same flooded data in the network, this protocol algorithm design for the coherent data processing to avoid flooding. The protocol data packets to the aggregators in order reduce to redundancy. Data aggregation and can fall under coherent data processing based protocol like as Directed Diffusion, SPIN, and SAR.

1.3 Multipath Routing in Wireless Sensor Networks

The transmission capability and restricted size of multi hop path and this is a high dynamic link in the case of single path approach rate in transmission is not able to efficient. Now a days use comes the issue resolve by the multipath routing. The mentioned before of multipath routing has demonstrated its increase the efficiency and performance of wireless sensor and ad-hoc network.

1.3.1 Reliability and Fault Tolerance

The main challenging goal in multi path routing reliable data transfer, changing network topology, time dependent and low power wireless links. The main ideas behind the multipath routing reliable data transfer and provide path flexibility. The fault tolerance comes in sensor nodes link failure and node failure and not able to send data or forward data, than the advantage from the availability of alternative path. The alternative path mechanism is it can send or forward the data to continue without any disruption even in other hand of path failure.

1.3.2 Load Balancing and Bandwidth Aggregation

In wireless sensor nodes limitation is resource, the traffic load in the case of high data amount application are disposed to congestion, and the high effect the network performance. The problem is comes, data distribution algorithm can benefit high density nodes in wireless sensor network.

1.3.3 Quality of Service Improvement

In the terms of quality of service end to end latency, network throughput and data delivery ratio the important goals of designing the multipath routing protocol for different-2 network. The quality of Service to send the critical data and large data through high volume with minimum delay and other can be promoted through non optimum path.

1.4 Basic Elements in Designing Multipath Routing Protocol

The basic element of a multipath routing protocol is basically three types which are explained in below.

1.4.1 Path Discovery

In wireless sensor network data transmission commonly completed through multi-hop data sending technique, the important assignment is route discovery to define a set of intermediate nodes that should create several path source nodes towards the sink nodes.

- Disjoint Multipath Routing: In the Disjoint Multipath Routing primary path selection the alternative path the less desirable and then have longer latency. The disjoint path create those path is alternative of the primary path. If the primary path is failure then does not affected any other those alternative paths.
- Braided Multipath Routing: the Braided Multipath routing, firstly the primary path figured or computed. In Braided Multipath every path is primary path, this is not

include the node which is best path computed. The alternative path is not necessary disjoint from the primary path.

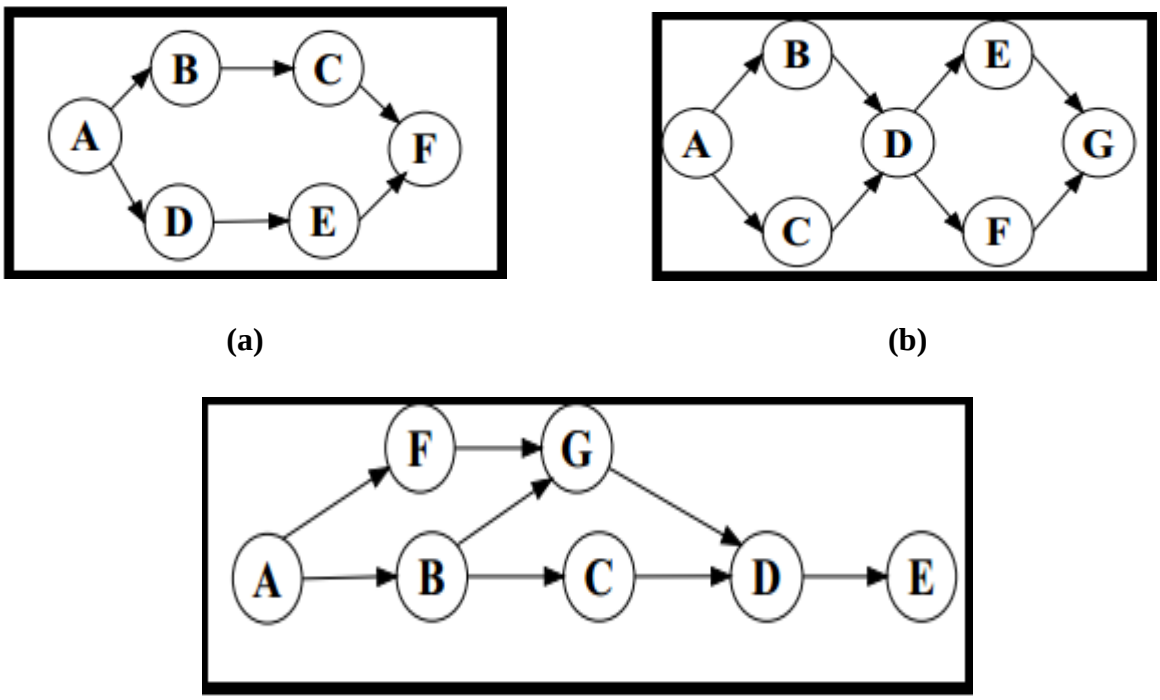

Figure 1.3 Several types of path disjointedness (a) Node-Disjoint Paths,(b)Link-Disjoint Paths and (c) Partially-Disjoint Paths.

1.4.2 Traffic Distribution

The path discovery of multiple path discovery issue, and other issue traffic distribution in multipath routing algorithm optimally split traffic the given set of path.

- Number of Path: protocol can use generally single path for the backup, or a use multiple path in round robin fashion, because at a time only one path selected at a time.
- Allocation Granularity: The allocation granularities generally use the how to deal with data distribution in between the path, important traffic allocation, specific and smallest unit information to each path.

1.4.3 Path Maintenance

In multipath routing when create that time some issue occurs for example, if one route fails or occurs many other route are fail. Than the all route fail is to search or select new path discovery than delay when new route are available. Since use the path maintenance.

1.5 Classification of the Existing Multipath Routing Protocols

Taxonomy of the Existing Multipath routing protocol is categories, alternative path, and load balancing, energy-efficient, data transmission reliability.

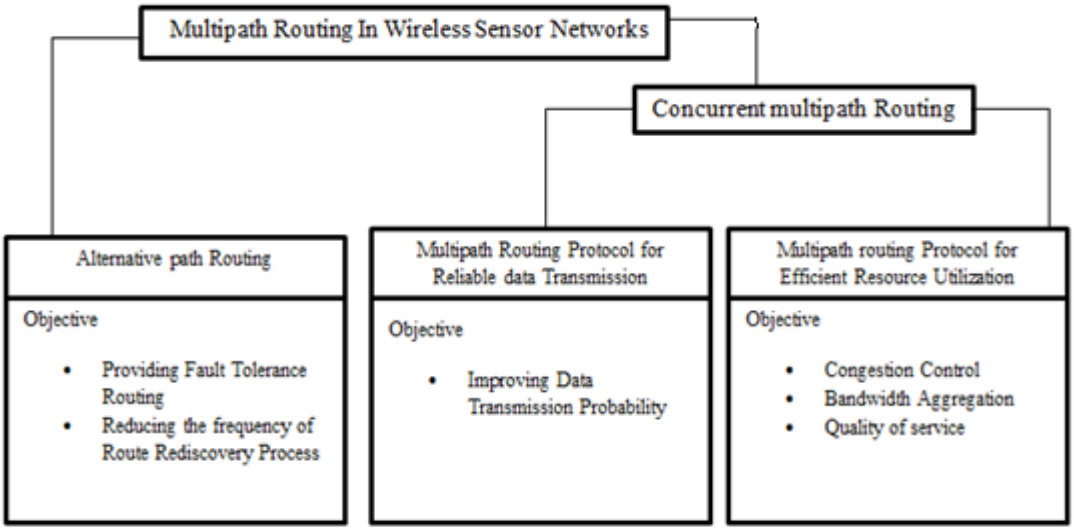

Figure 1.4 Classification of the existing multipath routing protocols in wireless sensor networks.

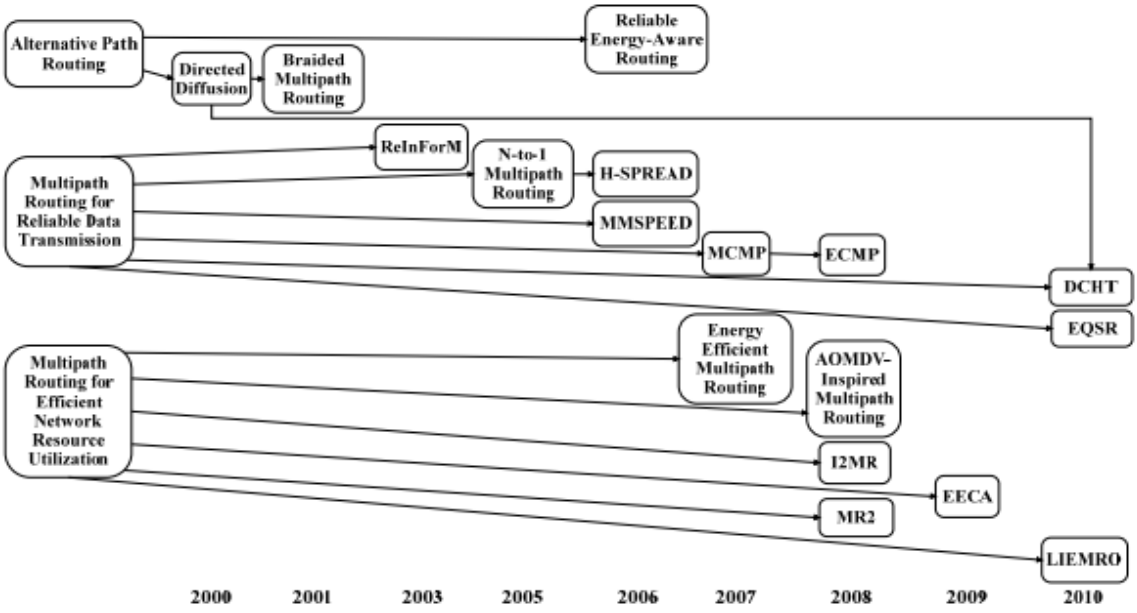

Figure 1.5 Historic design existing multipath routing.

In figure 1.4 represent the classification of the multipath routing the figure categories objective and function of the exiting protocol and figure 1.5 represent of historical design of the all above the protocol.

1.5.1 Alternative Path Routing

In table some alternative path routing protocol summarize form this categories.

Features / Protocol	Path Disjointedness	Route Maintenance	Traffic Distribution	Number of Path	Path Chooser	Improved Performance Parameters
Directed Diffusion	Partially Disjoint path	New path create in the case of active path failed	No traffic distribution	The no. of path is not limited	Path selection in sink node	1)Data transmission failed when path is failed 2)Packet rate loss when path fail
Braided Multipath Routing	Partially Disjoint path	New path create in the case of active path failed	No traffic distribution	The no. of path is not limited	Path selection in sink node	1)Data transmission failed when path is failed 2)Packet rate loss when path fail
Reliable and Energy-Aware Routing	Node-disjoint path	New path create in the case of active path failed	No traffic distribution	Number of path is two	Path selection sink and intermediate node	1)Packet rate loss when path fail

Table 1.1 some protocol summarize Alternative Path Routing

Alternative path routing protocol summarized in table 1.1 like path disjointedness, route maintenance, traffic distribution, number of path, path chooser and improved performance of the protocol in this table, the alternative path routing differnet-2 exiting protocol to work on improving performance, reliability, energy, capacity, path selection, path maintenance, security, bandwidth this all the functionality to work on the alternative path routing protocol.

1.5.2 Concurrent Multipath Routing

In the first group of multipath routing protocol, full fill the fault tolerant, were discussed and in this section in basis of reliable data transmission and resource utilization.

1.5.2.1 Reliable Data Transmission in Multipath Routing protocol

Some protocol are summarize in this table to reliable data transmission in multipath routing.

Feature / Protocols	Path Disjointedness	Route Maintenance	Traffic Distribution	Employed Reliability Mechanism	Number of Paths	Path Chooser	Improved Performance Parameter
N-to-1 Multipath Routing	Node to node disjoint	No	Every packet is splitting	Packet salvaging	Not limited	Source node Intermediate nodes	Reliability
H-SPREAD	Node to node disjoint	No	Every packet is splitting	Erasure coding	Not limited	Source node Intermediate nodes	Reliability Security
MMSPEED	Path is partially disjoint	No	Every packet is multiple copies	Copying the original packets	No of path only desired reliability	Source node Intermediate nodes	Reliability Security
MCMP	Partially Path is partially disjoint	No	Every packet is multiple copies	Copying the original packets	No of path only desired reliability	Path only intermediate node	Data delivery ratio
DCHT	Node to node disjoint	No	Two path have two copies	Erasure coding	Not limited	Source node Intermediate nodes	Delay

Table 1.2 Reliable Data Transmission protocol in multipath Routing

The multipath routing protocol summarizes some exiting protocol for use reliable data transmission to improve like path disjointedness, route maintenance, traffic distribution, number of path, path chooser and improved performance of this protocol.

1.5.2.2 Multipath Routing Protocols for Efficient Network Resource Utilization

In this table some protocol for efficient network resource utilization, to existing past few year.

Features / Protocols	Path Disjointedness	Route Maintenance	Traffic Distribution	Number of Paths	Path Chooser	Interference Avoidance Technique	Improved Performance Parameters
Energy-Efficient Multipath Routing	Node to node disjoint	Two or less than two path are active	Per-packet splitting	Not limited	Sink node Intermediate nodes	None	Network lifetime Delay
AOMDV-Inspired Multipath Routing	Link-disjoint	When every path is failed	Per-packet splitting	Not limited	Sink node	None	Network lifetime Delay
MR2	Node to node disjoint	When a path has failed	Per-packet splitting	Based on the bandwidth requirements of the target application	Sink node Intermediate nodes	Through using the broadcast nature of wireless channel	Network lifetime Throughput Data delivery ratio
LIEMRO	Node to node disjoint	Less than two path active	Per-packet splitting	Based on the end-to-end throughput of the active paths	Sink node Intermediate nodes	Through using the broadcast nature of wireless channel	Network lifetime Throughput Delay Data delivery ratio

Table 1.3 Efficient Network Resource Utilization for Multipath Routing Protocols

1.6 Applications

Wireless sensor networks are used in many different application areas.

Health care monitoring

By implanting sensors on the different part of the body we can use WSNs to check the conditions of the patient also.

Forest fire detection

Sensor nodes are nearly put in the forest and they can recognize the real beginning of the fire. Likewise the sensor nodes may contain powerful power systems, for example, sun based cells, on the grounds that the sensors can be left unwatched for quite a long time or years.

Military applications (sniper detection)

WSNs can be used to monitor the military battlefield surveillance such as in order to check the intruders or vehicle traffic etc.

Water quality monitoring

Sensor nodes are utilized to distinguish poisons in water or air and they can likewise recognize the area and kind of toxins

Industrial Machine Monitoring

WSNs can be used to monitor the machines deployed in the industries if they are working well or not.

Home applications

Sensor nodes can be utilized as a part of machines, for example, vacuums, coolers, and Video Cassette Recorders. These sensor nodes inside home apparatuses can associate with web and permit clients to deal with those machines.

Building Monitoring

WSNs can be used to check the changes in the building like the temperature monitoring and the person entering or leaving the building.

Environmental Observation

WSNs can be used to monitor the environmental changes like temperature, water level or fire. These applications oblige remote adhoc networking procedures moreover. Yet, a portion of the calculations or methods that are proposed for remote adhoc network can't be connected in remote sensor networks due to interesting highlights of sensor networks.

1.7 Components

Components of wireless sensor network are as follows:

- Radio: This is most important part of wireless sensor networks, as it consumes most of the energy of the node.

- Battery: There are basically three batteries which are normally used in sensor networks- Alkaline, Lithium and Nickel Metal Hydride.
- Micro Controller: this is the processor of the node. It helps in switching node between various modes- Wake, Power Up and Sleep Mode.
- Analog Circuit: It is the analog to digital converter.
- Sensor Interface: This senses the environmental conditions

1.8 Characteristics of Wireless Sensor Network

The parameters on which the evaluation of system can be done are – lifetime, coverage, cost, response time, sample rate, accuracy and security.

- Lifetime: denotes the average time during which the system could sense the monitoring area. Wireless Sensor networks are generally deployed in a region where the area is kept unattended for a longer period of time. So if the lifetime of the system is small then the monitoring area needs to be revisited again and again. It is essential that the system should have an average longer lifetime.
- Coverage: denotes the geographical area which is monitored by the system of wireless sensor networks. Coverage does not denote the range of the sensor nodes as using multi hop communication increases the coverage area, although the range of the network is still the same.
- Cost: denotes the cost of initial deployment and the maintenance cost. The initial cost does not pay much importance as it is one time cost. Whereas the maintenance cost should be taken care of because it is to be practiced on regular basis. In addition to the hardware and software deployment cost of the system, it should be taken care that the system is self-maintained.
- Response-Time: denotes the time after which the system will respond to a particular situation. This factor is contradictory with other factors. Since if we try to reduce the response time of the system then it will reduce the lifetime of the system. In order to reduce the response time the nodes in the system should be in active mode, which will result in the loss of energy and thus lower lifetime of the system.
- Accuracy: denotes how appropriate the system is. When monitoring the environment the output of the system should give the most appropriate value else the use of deploying the system is failed.
- Security: this is the most important factor for any system. The security of a system

can be maintained by using different privacy and authentication methods. In case the security of the system is not taken care of then the system is not safe enough to be used. The data gathered by the system may not be reliable.

- Sample-Rate: this denotes the rate at which the data is collected from all the nodes in the system and gathered at the central point. The cluster head is responsible for the collection of data from all the rest of the nodes in the cluster. It gathers the data from the nodes in the cluster and sends it collectively to the base station.

CHAPTER 2

REVIEW of LITERATURE

Heinzelman W et.al (2000), introduced LEACH protocol. LEACH is a protocol which utilizes the random rotation of local cluster head so that the nodes in the cluster have the same level of energy. Each node in the cluster will be elected as a cluster head one or the other time [29]. LEACH rearranges the dynamic cluster making it difficult to trust the node-node trust relationship. If the probability that the node is elected as a cluster head is 1/P, then the cluster head cannot be elected as cluster head at least for P rounds. If there are n cluster heads in the network and each has data to be sent to the base station then it follows TDMA approach. In TDMA each cluster is given a timestamp. If it has to send any data to the base station then cluster has to wait for its turn to come. Basic drawback is that no parameter has been used in order to elect the cluster head except the probability. The node in the cluster chooses a number between 0 and 1 randomly. If the chosen number is less than the threshold value T (n), the node will become a cluster head. So any node which has less amount of residual energy can also become a cluster head which will result into depletion of energy of the cluster. Another drawback of this system was that each node needs to send the parameter i.e. the random number to BS directly which makes the algorithm more complex. Since it uses TDMA approach to send data to the BS so it takes a longer delay in case the network is large.

Marina, M. K., & Das, S. R. (2001) is designed based on the AOMDV [10] to provide low-latency and energy-efficient data distribution in wireless sensor networks through exploiting some information from the MAC layer. In fact, the aim of this protocol is to enable every node to cull one of its next-hop neighbours towards the destination that arouses earlier than others. Since this protocol is designed predicated on AOMDV, same as the ad hoc-predicated routing protocols the all path info should be broadcast throughout the network during the path establishment process. However, in the case of reserve constraints of low-cost sensor nodes, propagating the every of path information in the network through Route Request (RREQ) packets is not feasible.

Jeroen Hoebeke, Ingrid Moerman, Bart Dhoedt and Piet Demeester (2002) in portrays that a portable specially appointed network is an accumulation of cell phones, for example, tablets, PDAs, sensors and so on and these gadgets impart through remote connection. Portable specially appointed network does not depend on altered foundation. Nodes that lie in

the scope of different nodes can impart straightforwardly and the nodes which don't lie specifically in the scope of different nodes can convey through moderate nodes and these transitional nodes go about as switches and transport the messages on the destination. Diverse positions which brings about topology change. MANETs are extremely suitable in circumstances where altered base is not accessible, excessively costly or problematic due to its self-sorting out capacity and can be conveyed effectively with least inclusion of client. There is no requirement for preplanning. MANETs are utilized as a part of numerous applications like crisis administrations (calamity recuperation, in doctor's facilities), training (virtual classrooms), diversion (multi-client recreations), sensor networks (home applications, following natural conditions).

Allam Ali et.al (2003), proposed the ZKP as the method to authenticate the node which he assumes that the node which verifies the authenticity of other node learns nothing about that node except that it is correct and that too could not be achieved if the node itself doesn't want to reveal it to other nodes [3]. He combined the ZKP with the secret key generation method in which the verifier and prove both generate a secret key which is a pair of number. He uses the mutual identifications scheme in which both the parties prove their identity to each other. He enhanced the security of the WSN using the secret key exchange method. The major drawback of this approach is the iterative approach which he has used for the mutual identification of both the parties. The steps are repeated t times which require a lot of message passing between the two parties.

Lou, W. (2005) the N-to-1 routing protocol proposed to use converge cast traffic shape of wireless sensor network to attend data transmission reliability. This protocol, every node identifies multiple path forwards the source nodes through crating a spanning tree rooted at the sink node. This Protocol, every nodes only used the single path forwarding strategy for the transmitting every data. While they additionally utilize an adaptive every hop packet saving technique provide expedition data instauration link failure. Since all the paths identified in the tree routing topology are located physically proximal to each other, parallel data transmission over the network path causes inter-path interference which in turn degrades the network performance.

Ian F.Akildiz, Tommaso Melodia, Kaushik R. Chowdhary (2006) depicted WMSNs as networks interconnected gadgets which are joined through remote connections and permit making feature and sound streams, relentless pictures, and scalar sensor information. Single level network of homogeneous feature sensors was portrayed. In this the assembled substance

is send to remote portal through multihop way. Entryway is joined with stockpiling gadget which stores information for recovery in future. Distinctive conventions for directing are portrayed that are network condition based, movement classes based and continuous gushing based. Utilizations of WMSNs are interactive media reconnaissance sensor networks, activity evasion and control frameworks, natural checking, propelled medicinal services conveyance and modern methodology control.

Huang, X., & Fang, Y. (2007) this protocol generally designed to give the soft QoS actual in term reliability and latency. Through this protocol each source node establishes multiple partially disjoint paths which can provide latency and reliability injunctive authorizations of intended application. Therefore, to achieve the reliability authoritative ordinance of individual applications, every node should toward multiple like same copies of each packet over different paths. However, this data redundancy is in difference with resource constraints of sensor networks. Since partially separate paths are conventionally located near each other, concurrent data transmission over network path causes high inter-path interference which results come in high packet loss ratio.[8]

Teo, J. Y., Ha, Y., & Tham, C. K. (2008) aims to better network throughput through transmitting every source node's traffic over zone disjoint paths which are constructed utilizing location information of nodes and employing special hardware equipment's. I2MR postulates there are several gateway nodes in the network which are accommodating as final destinations and they are linked directly to command centre utilizing non-interfering links with high-capacity. Since this protocol is designed predicated on categorical network structure with particular components, it cannot be facilely employed in many applications.

Wang, Z., Bulut, E., & Szymanski, B. K. (2009) is proposed to construct two collision free paths in every sides of state line between every source-sink pair utilizing location information of network nodes. With respect to the main process of this protocol, all the nodes should be equipped with GPS. Furthermore, every node should be cognizant about the exact location of their neighbours for making routing decisions. However, these requisites increase the network deployment cost and intensify message over-head, categorically in astronomically immense and compressed wireless sensor networks.

Ben-Othman, J., & Yahya, B. (2010) aims to slake the latency and reliability requisites of authentic-time applications. In order to consummate latency requisites of various requests, this protocol develops an accommodation variation technique through line up model to

manage authentic-time and non-authentic-time traffic. Furthermore, EQSR amends data transmission reliability through utilizing a lightweight XOR-predicated forward Error Rectification (FEC) mechanism. However, the utilized FEC mechanism imposes a consequential computational overhead to the resource constrained sensor networks for computing the error rectification codes and retrieving the pristine messages.

Marjan Radi, Behnam Dezfouli, Shukor Abd Razak, Kamalrulnizam Abu Bakar et. al. (2010) in this paper Low-Interference Energy-Efficient Multipath Routing Protocol (LIEMRO) aims to construct minimum interfering paths from every event area towards the sink. Since overhearing of the RREP packets enables nodes to update their interference levels, it does not sanction source node to establish minimum interfering paths con-currently. Furthermore, path cost function of LIEMRO estimates data transmission cost of a given path through summation of links' ETX values along that particular path [6]. However, as the ETX metric postulates the link layer provides an illimitable number of transmission end beavers over individual links; this protocol may not be able to identify efficient paths in the cases where the link layer offers constrained number of transmissions per packet distribution.

$$Next\_hop_i = \{j | \forall j \in N_i \; and \; Cost_{i,j} = Min_{j \in N_i}(Cost_{i,j})\}$$

$$Cost_{i,j} = (accETX_{i,sink}) \cdot \left(\frac{1}{resBatt_j}\right) \cdot (1 + interferenceLevel_j)$$

In Equation Ni represent to the neighbouring set of nodes i. In Equation, resBatt j is left over battery level of nodes j, interference Level j is the accomplished obstruction level at nodes j, and accETXi, sink is the gathered ETX esteem from nodes i to sink nodes through neighbouring nodes j. ETX estimation of a connection is ascertained as 1/pq, where p and q show the likelihood of effective forward furthermore regressive parcel gathering over that connection, separately. During the system introduction and neighbour disclosure stage, the aggregated ETX estimation of all the sensor nodes towards the sink nodes are ascertained through developing the ideal spreading over tree utilizing the ETX cost.

LIEMRO enhances the execution requests of table driven applications through conveying system movement over fantastic ways with least obstruction. This convention uses an element way up keep component to screen the nature of the dynamic ways during system operation and controls the infused activity rate of the ways as indicated by most recent saw ways quality. Consequently, it represents the fleeting varieties of the low-control remote

connections and conform activity conveyance likewise. Then again, like the majority of the beforehand talked about conventions.

Ming Tao, Dingzhu Lu, Junlong Yang(2010) in this paper Utilizing the accessible yet constrained assets of sensors all more productively has been the late enthusiasm for planning steering conventions for Wireless Sensor Network (WSN). Significant concern incorporates vitality, stockpiling and processing assets. In like manner, we propose a versatile vitality aware Multi-way directing convention with burden parity (AEMRP-LB). It presents an idea named bearing edge to beat the insufficiency of telecast and considers the trade-off between the remaining vitality and bounce number to establish multiple hub disjoint ways. The activity burden is adjusted over the chose ways by utilizing a weighted activity planning calculation considering their transmitting limit, and afterward AEMRP-LB utilizes the preferences of Multi-way Source Routing to report the gained information as sparing the processing and stockpiling assets of the sensors. In the scene with different Source-Sink sets, AEMRP-LB can adaptively modify the accessible lingering vitality of imparted hubs so as to make sensible utilization of them. The re-enactment results demonstrate that AEMRP-LB beats the two near plans, and the sensors devour the vitality in a more impartial manner which guarantees a more smooth debasement of administration with time.

The sensors with constrained vitality, stockpiling and registering assets bring an incredible test for outlining directing conventions in Wireless Sensor Networks and system survivability is an imperative basis for assessing effectiveness of planned conventions. In this paper, we firstly examine Radio Model, and afterward dissect two conventions: direct correspondence what's more multi-bounce directing convention on that premise, and condense a few methodologies for decreasing vitality scattering. By receiving the perspective that continually utilizing the ways with least vitality dissemination to advance vitality utilization at hub may not be ideal as far as system lifespan and keeping network and considering the constrained assets, we propose versatile energy aware Multi-way steering convention with burden equalization (AEMRP-LB) which is on-interest, circulated and responsive. It presents an idea named course edge to make the Sink and the intrigued halfway hubs send Interest to those next jump hubs which are in the privilege bearing towards source to abstain from scattering unnecessary vitality brought about by show. Also at that point it endeavours to build numerous hub disjoint ways by taking the trade-off between the bounce checks and the leftover vitality to give a solid information conveyance. AEMRP-LB then offsets the

movement over the chose ways by utilizing weighted activity planning calculation considering ways' transmitting limit and use the MSR to report

gained information. MSR greatly decreases the overhead of the stockpiling and figuring assets of the middle hubs. In the scene with various Source-Sink sets, AEMRP-LB can adaptively conform the accessible remaining vitality of the imparted hubs in order to utilize them sensibly and make them give distinctive characteristics of administrations to the Interests to diverse significance. To assess the execution of AEMRP-LB, this examination attempts an arrangement of decently outlined and definite exact study by altering the affecting variables, and the re-enactment results demonstrate that AEMRP-LB beats the Directed Diffusion and MERP plans in numerous perspectives, for example, the vitality of sensors is devoured in a more even-handed manner which guarantees a more elegant corruption of administration and the system lifespan is drawn out, the correspondence translation postponement is unimportant.

Jungang ZHENG, C WU, Hao CHU, Yang XU (2010) discussed about the localization algorithms which are divided in two categories: range based and range free. Range based method calculates localization between neighbouring nodes. Different parameters can be used in this method such as time of arrival (TOA), time difference of arrival (TDOA), Received signal strength indicator (RSSI). In range based algorithms generally additional hardware is required but RSSI is considered as more appropriate than others as it does not require any additional hardware and does not increase the cost. RSSI improves the transmission loss model and also reduces the error in the distance estimation.

Chiara Buratti, Andrea Conti, Davide Dardari and Roberto Verdone (2010) explained the wireless network that it consist of small devices which are usually sensors and can sense the environment and can communicate with other nodes through wireless links. Then data is sent to sink via multiple hops which uses it locally or can be connected with other networks. Nodes can be aware about their location or not. Different applications of Wireless Sensor Networks are described like event detection and spatial process estimation which includes estimation of temperature of given area. Different features of Wireless Sensor networks are also discussed which include self-organization, energy efficiency, low cost and size of nodes.

Ahmed et. al (2010) portrays a convention named as LEACH. TDMA plan is utilized by LEACH by which time is partitioned into distinctive rounds of altered length for every node. Drain contains two stages that are setup and relentless state stage. In first stage that is setup

stage nodes make bunches. In every group one node is allocated as bunch head. In setup stage there is a notice stage, the CHs which are chosen arbitrarily send their status as cluster heads to its neighbourhood sensor nodes. Bunch head gives settled time opening to transmission to node in group utilizing TDMA plan. Amid second stage correspondence between bunch heads and different nodes happens. Non bunch heads transmit their information to group heads. Drain convention does not take after bounce by-jump steering while different conventions utilization jump by-jump routing.

Guo Li-Qing et.al (2010), uses ACHTH-LEACH in which the cluster head is chosen on the basis of energy level which is remaining in the node and transfers the data to BS using two hop transmission that is the data from the cluster head is not transferred directly to BS but instead it is sent to one of the cluster head which is near to BS and then this cluster head further sends it to BS [10]. This way the energy of the nodes is saved. The cluster is divided into two regions near region and far region. The cluster head in far region when wish to transfer the data to BS, it sends it to the cluster head of near region and then cluster head of near region transfers it to BS. The basic drawback being that it works on the homogenous cluster only and in case the near cluster head is not activated then the far cluster head sends he information to the base station directly which wastes the energy of cluster head of far region and the cluster head is being elected only on the parameter of remaining energy of nodes. Authentication of cluster head is not being taken care of.

Shujiang Li, Xin MA, Xiangdong Wang, Minghao Tan (2011) in this paper Because of the vitality and asset imperatives of a remote sensor node in a remote sensor system (WSN), configuration of vitality productive multipath directing conventions is an essential sympathy toward WSN applications. To give high calibre checking data, numerous WSN applications oblige high-rate information transmission. Multipath steering conventions are regularly used to expand the system transmission rate and throughput. Albeit vast scale WSN can be upheld by high transmission capacity spine organize, the WSN remains the bottleneck because of asset obligations of remote sensors and the impacts of remote obstruction. In this paper, we propose a multipath vitality proficient steering convention for WSN that considers remote obstruction. In the proposed steering convention, hubs in the impedance zone of the found way are checked and not permitted to participate in the consequent steering procedure. Along these lines, the nature of remote correspondence is moved forward since the impacts of remote impedance can be diminished however much as could be expected. The system burden is appropriated on different ways as opposed to focusing on stand out way, and hub

vitality expense is more adjusted for the whole remote system. The steering convention is recreated in NS2 programming. Reproduction result demonstrates that the proposed directing convention attains to lower vitality expense and more system lifetime than that in the writing

Energy productive directing is urgent configuration sympathy toward WSN applications because of vitality and asset demands of the remote sensor hub in WSN. This paper considers impacts of remote obstructions and proposes multipath vitality productive directing convention for remote sensor system. Nodes in the obstacle zone of the found way are checked and not permitted to tune in consequent steering procedure. Along these lines, the impacts of remote impedances can be lessened however much as could reasonably be expected. The system load is dispersed on different ways as different to focusing on one and only way. Along these lines, more hubs tune in transmitting information parcels, and hub vitality expense is more adjusted for the whole remote network.

Radi, M., Dezfouli, B., Bakar, K. A., Razak, S. A., & Nemat-bakhsh, M. A. (2011) aims to construct minimum interfering paths from every event area towards the sink [7]. Since overhearing of the RREP packets enables nodes to update their interference levels, it does not sanction the source node to establish minimum interfering paths con-currently. Furthermore, the path cost function of LIEMRO estimates data transmission cost of a given path through summation of the links' ETX values along that particular path [6]. However, as the ETX metric postulates the link layer provides an illimitable number of transmission end beavers over individual links; this protocol may not be able to identify efficient paths in the cases where the link layer offers a constrained number of transmissions per packet distribution.

Sajal K. Das, Mario Di Francesco (2011) portrays about adaptability and heartiness destinations of WSN. WSN to accomplish adaptability and heartiness distinctive sensor nodes are partitioned into groups. One node in group is alluded as a bunch head which stores detected information in group. These group heads are important to build courses in bunch based WSN. These group heads have longer radio extent than different nodes in the bunch so they can speak straightforwardly with one another. In this paper circulated heuristic methodology named BOCH (Broadcast over bunch heads) is depicted which is utilized to enhance versatility and bury group correspondence. BOCH convention makes course between group heads and TV over bunch heads. The transference of data devours expansive measure of the vitality and transfer speed in WSN's minimizing control message overhead turns into a key issue in accomplishing adaptability and vitality proficiency. In this paper they concentrated on diminishing the transmission of control messages consequently enhancing

the versatility and vitality effectiveness of between group correspondence when TV a parcel to all CHs.

Gao, D., Yang, O., Zhang, H., & Chao, H. C. (2012) is developed to elongate network lifetime through distributing the traffic engendered by given source node over two node-disjoint paths. In MSMRP, every source with event data packets to transmit which has not identified any path towards the sink, initiates the route revelation process by broadcasting RREQ packets. Each node that receives a RREQ packet updates the hop-count and path quality is speaker fields of the received packet and rebroadcasts the updated packet. Upon reception of the RREQ packets by sink node, it culls two of the best discovered paths predicated on the hop-count and path quality designator fields of the received RREQ packets. According to the operation of this protocol, it does not consider the effects of inter-path interference on the packet distribution performance of individual paths.

Kewei Sha, Jegnesh Gehlot, Robert Greve(2012) in this paper Multipath directing is a proficient strategy to course information in remote sensor systems (WSNs) on the grounds that it can give unwavering quality, security and burden parity, which are particularly discriminating in the asset compelled framework, for example, WSNs. In this paper we give an overview of the cutting edge of proposed multipath steering conventions for WSNs, which are ordered into three classes, base based, non-framework based and coding based, based on the unique methods utilized as a part of building different ways and conveying sensing information. For every class, we contemplate the outline of conventions, break down the trade-off of each one configuration, and what's more diagram a few speaking to conventions. Also, we give a summary of outline objectives, difficulties, and assessment measurements for multipath directing conventions in asset obliged frameworks all in all.

WSN group multipath steering conventions primarily focused around whether the proposed directing convention makes numerous way base or not. Moreover, due to the exceptional essentialness of coding systems in multipath directing, we talk about a set of coding strategy based multipath steering conventions in subtle element. Also, a gathering of multipath directing convention outline issues, for example, significant configuration objectives, difficulties and assessment measurements are exhibited in the paper.

Baolin Sun, Chao Gui, Ying Song, Hua Chen (2013) in this paper Theoretical as of late, there have been numerous advances in the field of data hypothesis also remote sensor system (WSN) advances. System coding is another standard in information transport and guarantees

to change numerous angles of WSN. This paper proposes a system coding multipath directing calculation in WSN (NC-WSN). It is commonly proposed in place to expand the dependability of information transmission or to give burden adjusting. We assess what's more contrast our method and a few existing methodologies by a set of re-enactments, utilizing diverse situations and topologies. Recreations results propose that the multipath assorted qualities accomplished with our suggestion can fundamentally enhance the system reaction time.

This paper talks about multipath directing issue, which may manage the system coding model for inquiring about the remote sensor system (WSN) multipath directing issue. It presents proposes a Network Coding Multipath Routing calculation in WSN (NC-WSN). It is ordinarily proposed with a specific end goal to expand the dependability of information transmission, and by applying system coding, which permits parcel encoding at a transfer hub. Recreation results demonstrate that, with the proposed system coding in remote sensor system multipath steering convention (NC-WSN), throughput pick up, parcel conveyance proportion, bundle misfortune rate and Average end-to-end deferral of information bundles can be enhanced in the majority of cases. Later on, we plan to add to streamlining multipath steering in coded WSNs. We likewise wish to coordinate the transfer nodes encode the parcels to enhance the execution of WSN.

Jean Marie, Priyanka Rawat, Hakima (2013) clarified remote sensor network as a network of little and ease gadgets called sensor nodes, which are arbitrarily put and cooperate to exchange data from the checked field through remote connections. The information which is assembled by number of nodes sent to sink which can utilize information by regional standards or can be associated with different networks. Sensor nodes can be sent in adhoc or preplanned way. Adhoc arrangement is suitable for extensive ranges where a network can be left unattended. Preplanned arrangement is suitable for constrained scope where quantities of nodes are less and is conveyed at particular areas. Remote sensor network has numerous preferences over customary network, for example, lower expense, dependability, precision and adaptability. Sensors are littler, less expensive and more intelligent hence WSNs are utilized as a part of different applications.

Muhamad Akhlaq, Tarek R. Sheltami, Elhadi M (2013) clarified about productive use of vitality. The C3 convention utilizes the thought of virtual rings development in the network, triangular-tessellation based arrangement and RSSI- based separation estimation. C3

convention does not accept nodes to be area mindful and it utilizes RSSI for separation estimation as a part of request to characterize rings in network. The network is isolated in groups too. In triangular tessellation repetitive nodes are recognized and permitted to rest. Nodes at ideal positions like corners are kept dynamic and others are permitted to rest. The RSSI measures the force of got sign. The RSSI worth can be utilized to gauge the distinction between two nodes.

Marjan Radi, Behnam Dezfouli, Kamalrulnizam Abu Bakar, Shukor Abd Razak, Tan Hwee-Pink et.al. (2014) in this paper regarding the characteristic preferences of multipath routing, these days multipath directing is known as a productive instrument to give even system asset usage and dynamic information transmission in unique systems. In this setting, a few multipath routing conventions have been produced over the previous years. However, because of the time-changing qualities of low-power remote interchanges and show nature of radio channel, execution advantages of movement dispersion over different ways in remote sensor systems are more subtle. Moved by the disadvantages of the current multipath steering conventions, this paper shows an Interference-Minimized Multipath Routing protocol (IM2PR) which expects to find a sufficient number of least meddling ways with high information transmission quality between every event region and sink nodes to give proficient occasion information bundle sending in occasion driven remote sensor systems. Far reaching execution assessments demonstrate that IM2PR presents upgrades over the Micro Sensor Multipath Routing Protocol and Energy-Efficient information Steering Protocol as takes after: 50 and 70 % in term of bundle gathering proportion at the sink, 44 and 80 % in term of good put, 33 and 40 % in term of bundle conveyance dormancy, 40 and 57 % in term of vitality utilization, 50 and 60 % in term of bundle conveyance overhead.

This paper proposed a multipath routing convention to give expert event bundle sending in event driven remote sensor arranges by utilizing distinctive systems amid the way development and information transmission stages. Most importantly, IM2PR manipulations the telecast nature of remote interchanges to build least meddling ways from each occasion region towards the sink in a limited way without obliging particular equipment gears or specific suppositions. Also, it considers the confinement on the number of offered connection layer transmission endeavours at single person joins and the relative position of the connections along the ways to choose the ways that acquire a minimum number of bundle transmissions for each and every parcel conveyance. Thirdly, to attain to the most extreme conceivable system execution, IM2PR decides the productive number of ways that can be

utilized at the same time based to the DRR of the sink node. At last, in IM2PR every source nodes modifies the movement rate of singular ways focused around their information conveyance likelihood in the vicinity of dynamic meddling connections and battery limit. Recreation examination studies demonstrate the higher execution of the proposed convention contrasted with the MSMRP, also EERP conventions as far as PRR, good put, idleness, energy utilization and bundle conveyance overhead. The attained to results uncover that developing least meddling ways with high parcel transmission quality enhances execution of parcel conveyance in occasion driven remote sensor systems.

Pires Adonias et.al (2011), proposed CHEATS which elects the cluster head on the basis of three parameters: energy remaining, distance from BS and the probability in order to elect the cluster head [22]. The cluster head thus elected will have sufficient energy to transfer the data to BS and the node which will take least time to transfer the data to BS will be elected as cluster head because CHEATS takes into account the distance or delay also. This method could be improved as the data transferred to BS by the cluster head is sent directly. So the time taken by the cluster node to communicate with BS is more. So it results into early energy depletion. It could be improved if we divide the region into near and far cluster as proposed by Li-Qing Guo.

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CHAPTER 3

PRESENT WORK

3.1 Scope of Study

Scope of study uses of energy efficient multiple routing algorithm design in wireless sensor network to increase the performances. As per survey, there is need to develop a method which can minimize packet failure mechanism, delay in whole process of transmission of the packet should be minimized and reduce the packet loss transmission during the construction the path. Researchers worked on some specific type of algorithm which can minimize the buffer over flow issue and service rate of active nodes. So there is need to enhance some parameters which can impact energy efficient multiple routing protocols in wireless sensor network.

3.2 Problem Formulation

Low-Interference Energy-Efficient Multipath Routing Protocol (LIEMRO) aims to construct minimum interfering paths from every event area towards the sink [1]. Since overhearing of RREP packets enables nodes to update their interference levels, it does not allow the source node to establish minimum interfering paths con-currently. Furthermore, the path cost function of LIEMRO estimates data transmission cost of given path through summation of links' ETX values along that particular path [2]. However, as the ETX metric guesses link layer provides an infinite number of transmission attempts over individual links; this protocol may not be able to identify efficient paths in cases where link layer offers a constrained number of transmissions per packet distribution.

Than the problem over comes of the result LIEMRO does not consider consequence of buffer capacity and service rate of active nodes, than do not how to adjust the traffic rate of active path.

3.2 Objective

Here is a mechanism which provides resources over large network with its full utilization and transmission of data on different network, this mechanism known as multipath routing mechanism. In this context, several multipath routing protocols have been developed over past years. However, due to the time-varying characteristics of low-power wireless communications and broadcast nature of radio channel, performance benefits of traffic distribution over multiple paths in wireless sensor networks are less obvious.

Motivated by drawbacks of the existing multipath routing protocols, here are some objectives which describes in research work on the basis of these objectives, solution have been made.

Hypothesis basically works on these three parameters, which make research work interesting and it provide efficient event packet forwarding in event-driven wireless sensor networks by using different mechanisms during the path construction and data transmission phases.

1. To minimize the delay in propagation time from source to sink.
2. Packet delivery process from multiple paths is to be done without any loss.
3. To reduce the number of packets of transmission during path construction process.

3.3 Methodology

In order to improve the LIEMRO process presented in base paper route construction and route refinement has to be modified, as they presented route maintenance which is very effective and improving process so this dissertation is focusing on only route construction and route refinement. New algorithms are taking consideration of energy saving and reducing packets so combination of Location based protocol with LIEMRO is suggested as the LBP is using GPS for taking record of nodes hence the combination of both would fulfil our purpose.

The solution of method categories in two parts: route construction and route developing. The route construction part algorithm construct in two parts:

1) Auxiliary Algorithm
2) Route Construction Algorithm.

The route developing part algorithm construct in two parts:

1) Route Refinement Algorithm
2) Threshold Stability Algorithm.

(a) Auxiliary Algorithm: The auxiliary algorithm done by any heuristic than start from the starting vertex node, a set of, and depot of fix location that return a set of routes that fulfil the constraints of the LBR and intermediate nodes.

(b) Route Construction Algorithm: In construction algorithm, denoted by Hc, routes are constructed successively. Provide partial solution and set of un-routed data packets, the algorithm uses auxiliary heuristic to search for the minimum cost set of routes that given a set of un-routed data packet. Construction of path is done by the conjugating of intermediate nodes. When all the nearby nodes start contacting with each other then they uses energy, which can be used for constructing the route and it is done by different algorithm. Like LBR and LIEMRO.

Functions or Algorithms:

1) Route building heuristic.

2) Set of packet data to route.

3) Route heuristic generalized cost function parameters.

(c) Route Refinement Algorithm: after completed route construction algorithm, every path of routing cost can be reduce using a route refinement algorithm. Refinement algorithm works arranged a subset (S) of routes. In route refinement algorithm two functions are performing. In this function k returns a set of p routes that belong to S and are located in the proximity of route which is declared by threshold value.

Flowchart of proposed methodology

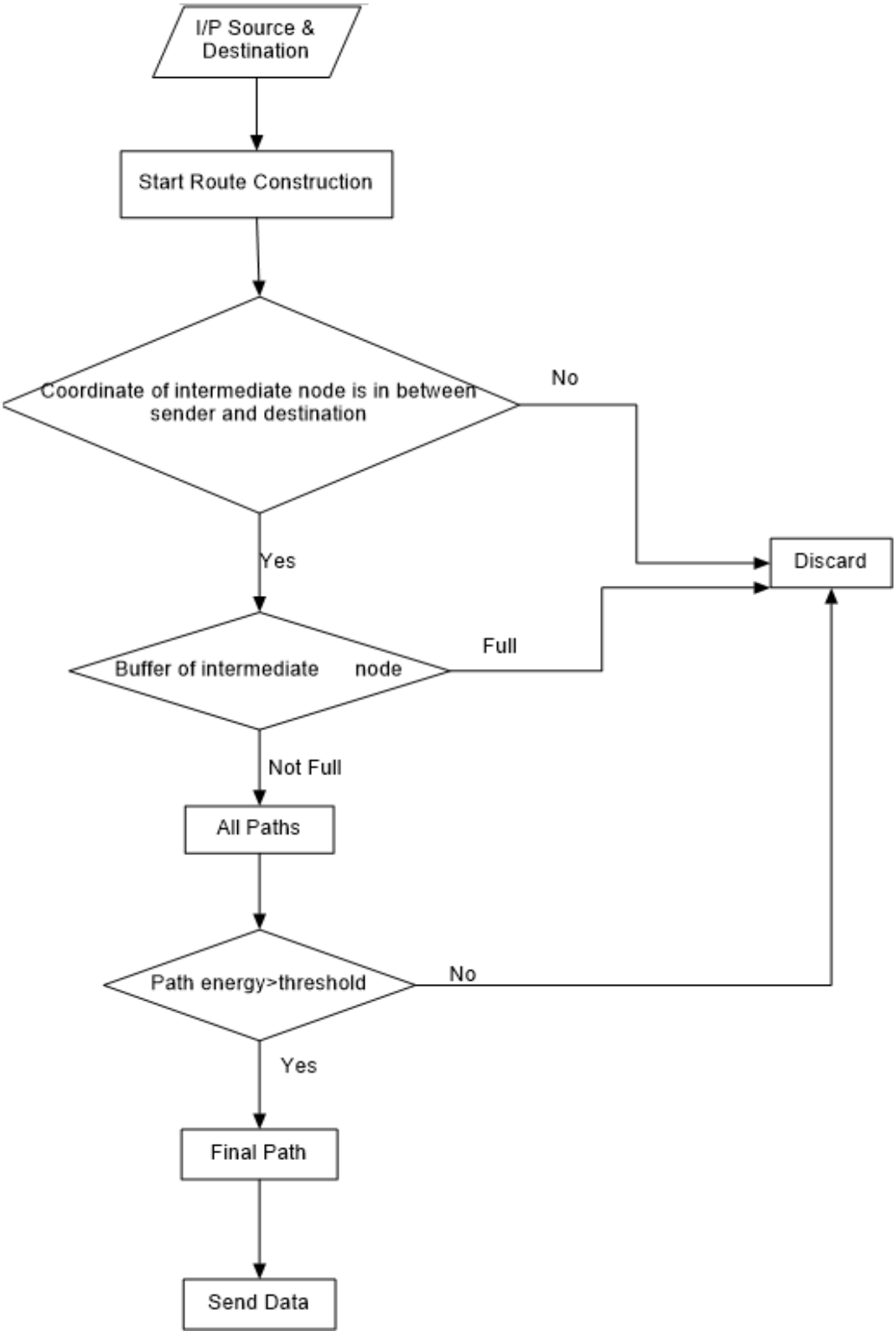

Figure 3.1 Flowchart of Proposed Methodology

Algorithm- Constructing Path and Route Refinement

Start from heuristic searching of nodes.

Get list number of nodes & arrange with decreasing order Utilization (U).

Initial vertex.

Set of data packet to be routed (C).

Sink location.

Utilization cost of each node.

Start<-initial node.

U<-initial node.

CCopy<-C.

Foreach node €node.

While(C≠Ø **AND** Lower Utilization<node capacity **AND** node capacity< data packet utilization) do

T<-min(cost, C)

C*<-w(start, C, U)

If node exit && energy>utilization cost

Then send data packet

Else

Foreach NODE as node

If node's co-ordinate is in between sender and destination

Then send packet RR

Endif

endfor

i=0

repeat

start<-lowest Next.

C<-C/lowest Next.

R<-Utilization(U) ∪ heuristic search(lowest Next, U, C, initial node)

Best route<-Utilization (U) ∪ lowest Next.

Data packet<-set of routes R.

end while

C<-elapsed Node(N)

If N>data packet nodes then

Re-correct the elapsed node.

i=i+1;

until i>3 and no RREP is received

if RREP is received **then**

update routing table

send DATA to sink

else cannot reach the sink

endif

endif

CHAPTER 4

RESULTS AND DISCUSSION

According to our thesis work, this part describes about the results. In this chapter, mainly focuses on different graph which is generated according to parameters of cost, buffer capacity, packet delivery ratio, energy, and packet lifetime ratio. Now, description of each result has been discussed in next few lines.

Figure 4.1 is the initial figure which describes about source node and destination node. With the help of this interface, user can insert the values for source node and destination node to generate output value of my proposed work and base paper and also generate graph according to output values and show the duration of path selection of my proposed work and base paper. Hence, the figure 4.1 is the description about how to plot a graph by entering the values of source node and destination nodes.

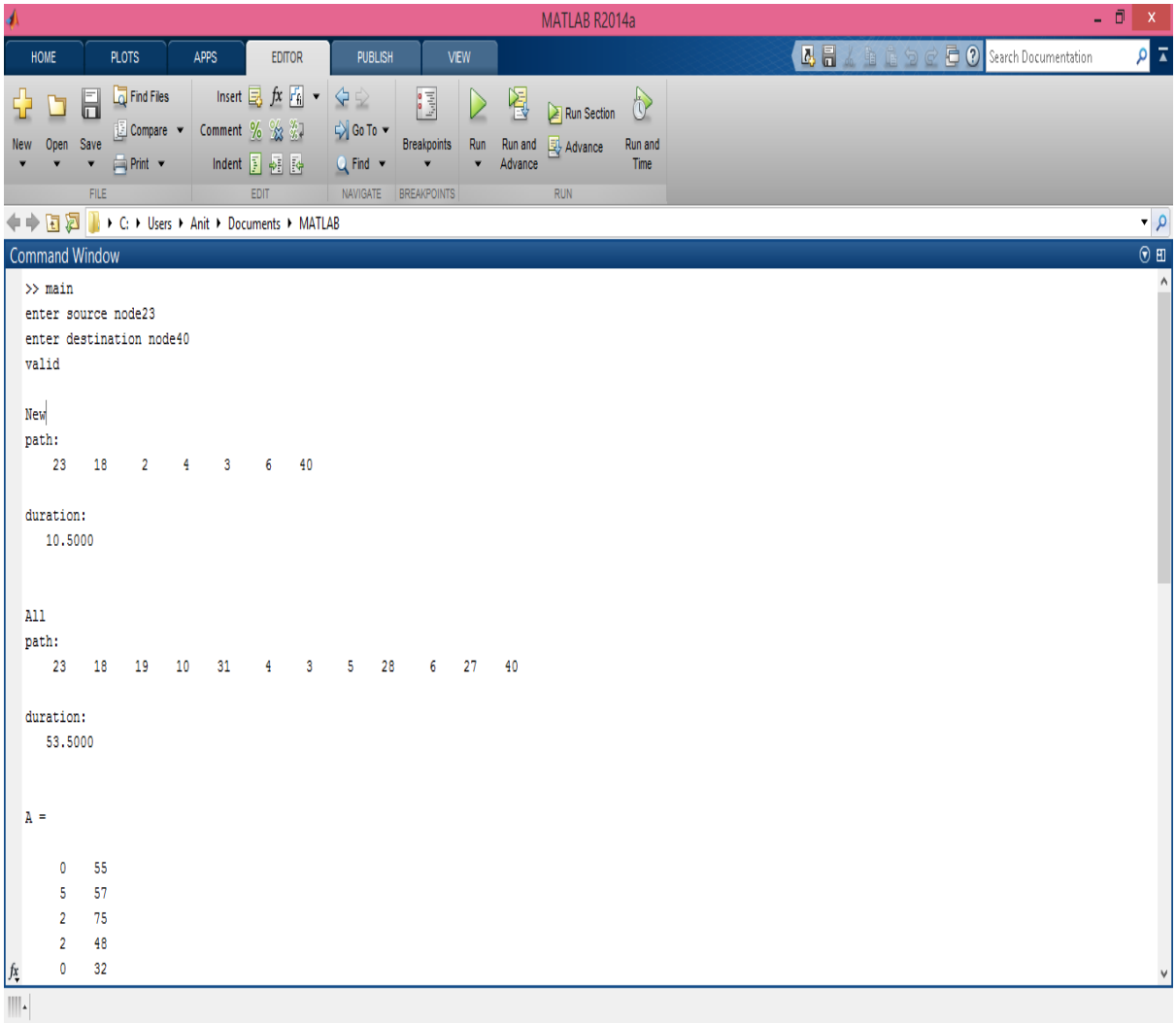

Figure 4.1 User Interface Command Window

4.1 Plotting of Route Proposed Algorithm

Figure 4.2 constructing multipath routing, in figure 4.2 showing send packet or message source to destination, in figure 4.1 command window put the input of source and destination where the packet send here in this graph go through source to destination multiple path. This graph showing our proposed methodology, in figure 4.1output of new path select to send the packet or message. In figure 4.2 our methodology covered auxiliary function, route construction and route refinement algorithm, to selecting new path the time duration is also show to the selecting path.

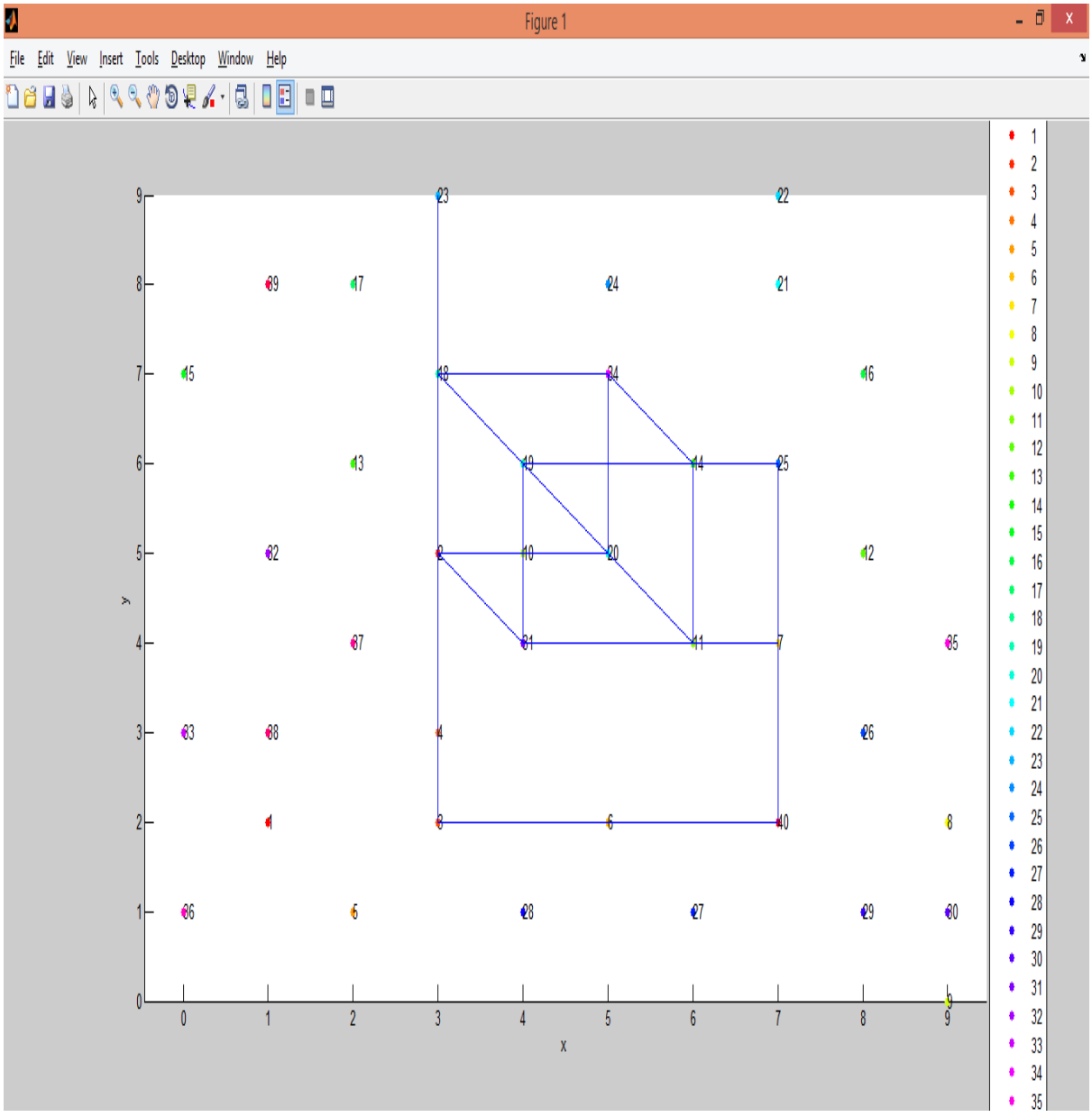

Figure 4.2 Plotting of Route (Proposed Methodology)

- In auxiliary function of the algorithm done by any heuristic than start from the starting vertex node, a set of, and depot of fix location that return a set of routes that fulfil the constraints of the LBR and intermediate nodes. In figure 4.1 arrange the node in decreasing order of utilization cost done by the heuristic and find the co-ordinate where the destination node in which co-ordinate and find the route than next step route construction mentioned in below.
- The route construction algorithm done by the node capacity energy and buffer capacity. Provide a partial solution and a set of un-routed data packets, the algorithm uses the auxiliary heuristic to search for the minimum cost set of routes that given a set of un-routed data packet. The construction of path is done by the conjugating of intermediate nodes. When all the nearby nodes start contacting with each other then they uses energy, which can be used for constructing the route and it is done by different algorithm. Like LBR and LIEMRO. When the route is construct the sending packet or message choose one path here is construct multiple path than choose the actual path next step done by the proposed algorithm route refinement in mentioned in below.
- The route refinement algorithm figure 4.1 construct the multiple path select minimum utilization cost of the path than find the actual path to send the packet or message. The route refinement algorithm done by set threshold value according to less utilization of cost. The every path of routing cost can be reduce using a route refinement algorithm. The refinement algorithm works arranged a subset (S) of routes. In route refinement algorithm two functions are performing. In this function k returns a set of p routes that belong to S and are located in the proximity of route which is declared by threshold value.

4.2 Plotting of Route LIEMRO Algorithm

Figure 4.3 construct the route to find the destination location of node, according to base paper construct the path without location based, when send the packet or message source node to destination node firstly send acknowledgement to intermediate node or neighbor node every node send acknowledge every intermediate node. Since overhearing of the RREP packets enables nodes to update their interference levels, it does not allow the source node to establish minimum interfering paths concurrently.

Furthermore, the path cost function of LIEMRO estimates data transmission cost of a given path through summation of the links' ETX values along that particular path [2]. However, as the ETX metric guesses the link layer provides an infinite number of transmission attempts over individual links; this protocol may not be able to identify efficient paths in the cases where the link layer offers a constrained number of transmissions per packet distribution.

Than the result comes does not estimate and adjust of buffer capacity consider than over comes of the result size is full than failure of the path and select the new path to send RREP to next neighbouring node also consume more energy of the nodes. In figure 4.1 in command window comes the output selecting path duration of packet receiving is increase.

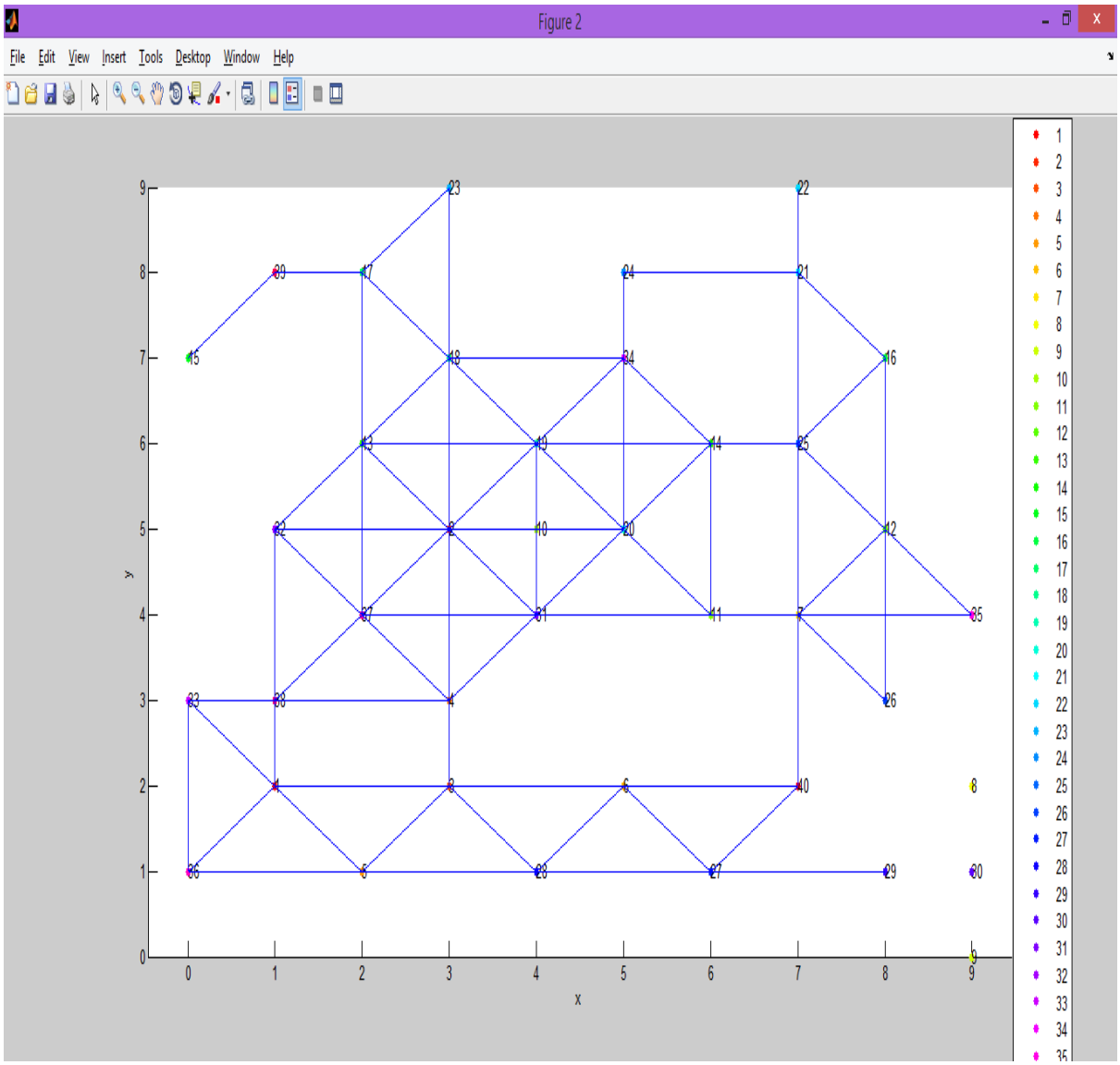

Figure 4.3 Constructing Path of LIEMRO

4.3 Overall Energy Consumed Graph

Figure 4.4 is show energy consumed proposed methodology and base paper of selecting path, graph 1 generate the proposed methodology and graph 2 generate the base paper methodology, graph 1 only select the path minimum cost of energy used in source to destination path and find the in which location the destination nodes and also check the buffer capacity used in energy basis, other hand graph 2 covered the maximum nodes in intermediate nodes and no fix co-ordinate than select the path link layer and maximum no of transfer the packet or message in one path than the choose path they used the ETX value for the packet send the output comes the buffer capacity does not adjust and estimate of the packet than the result is comes more energy consumed.

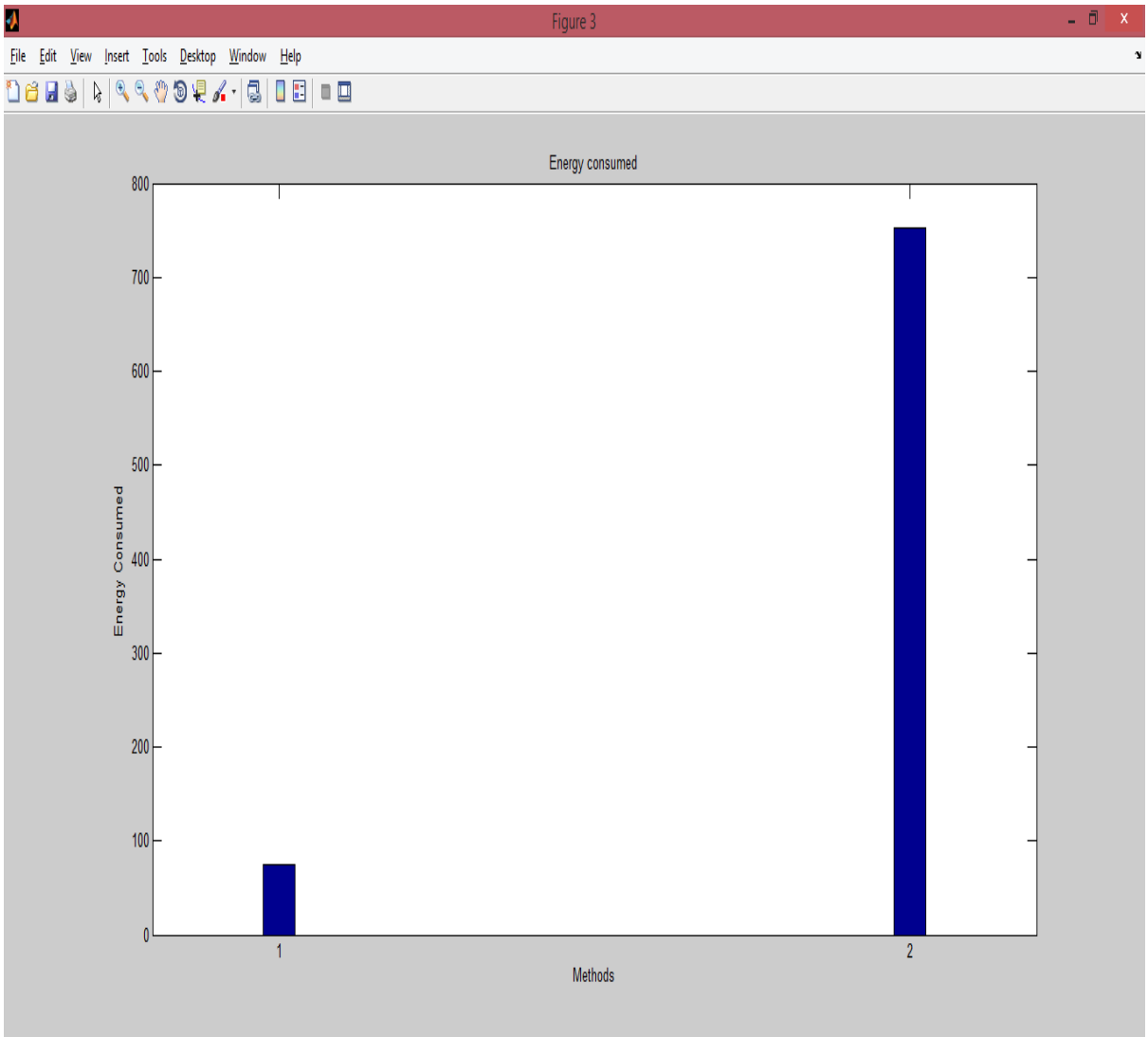

Figure 4.4 Overall Energy Consumed Graph

4.4 Buffer Size of Every Nodes

Figure 4.5 output result of the buffer size of every nodes in column 1 output result is my proposed methodology for selecting the path to source to destination nodes according to the path construction and column 2 output result comes according to the path construction. The overall result comes to explain through the graph.

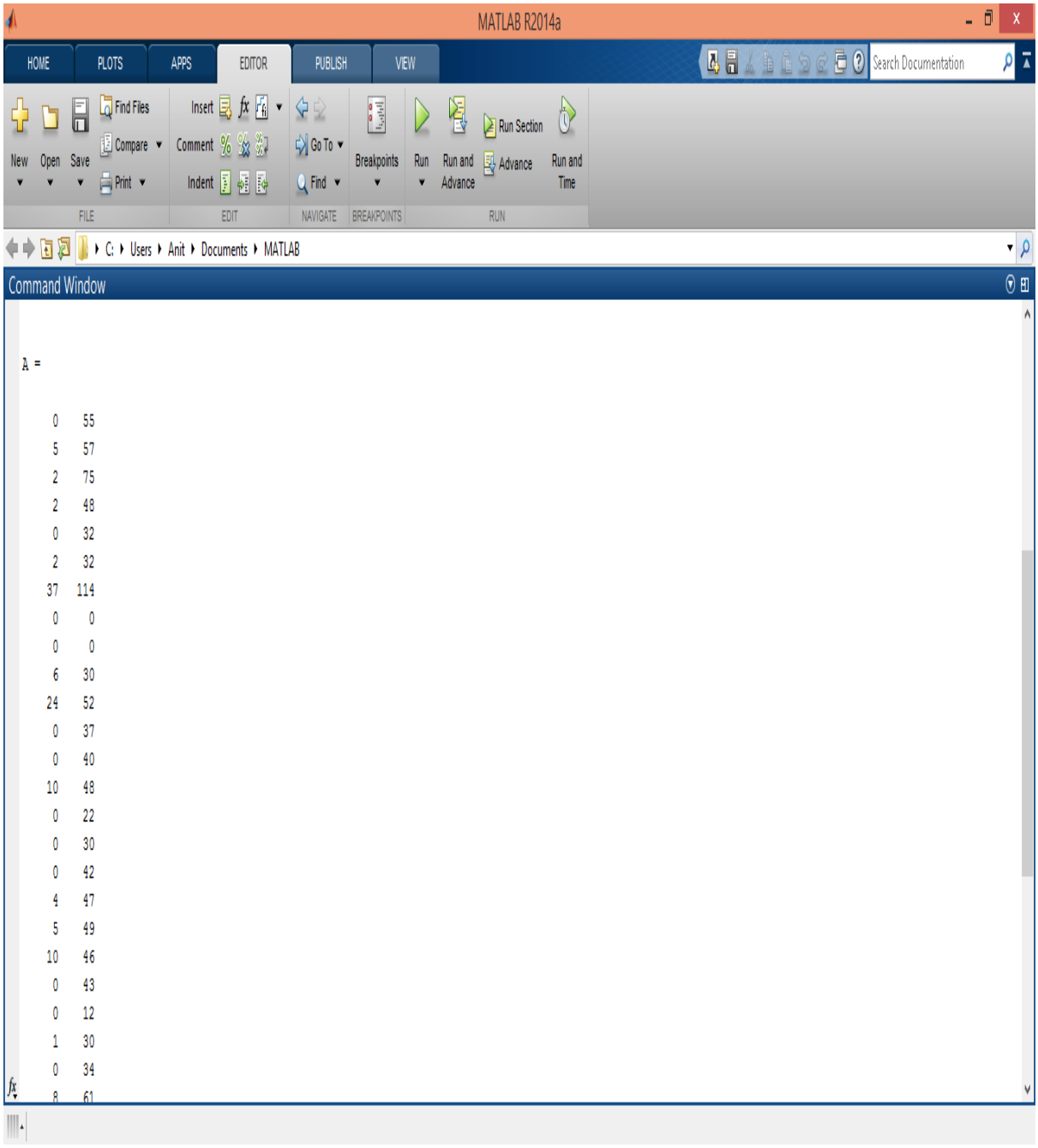

Figure 4.5 Buffer Size of Every Node

4.5 Plotting Graph Buffer Size of Every Nodes

Figure 4.5 comes the result of figure 4.4 to buffer size graph of every nodes capacity check, blue line is proposed methodology graph and red line is proposed methodology graph. In plotting graph on the basis of apply the method in proposed algorithm to improve parameter like packet delivery ratio, life time of nodes and minimum energy consumption. Here apply the method for efficient packet delivery ration to estimate and adjust of buffer capacity in active path, here is the method apply or set threshold value of every nodes to send the packet or message to neighbor node firstly to send in cache memory of the nodes for the communicate to check the next node if node is already full or failure node than send acknowledgment source node another route select for the send data for the communication, the overall result is come no buffer size used and no energy used for this task to used next time used for the communication.

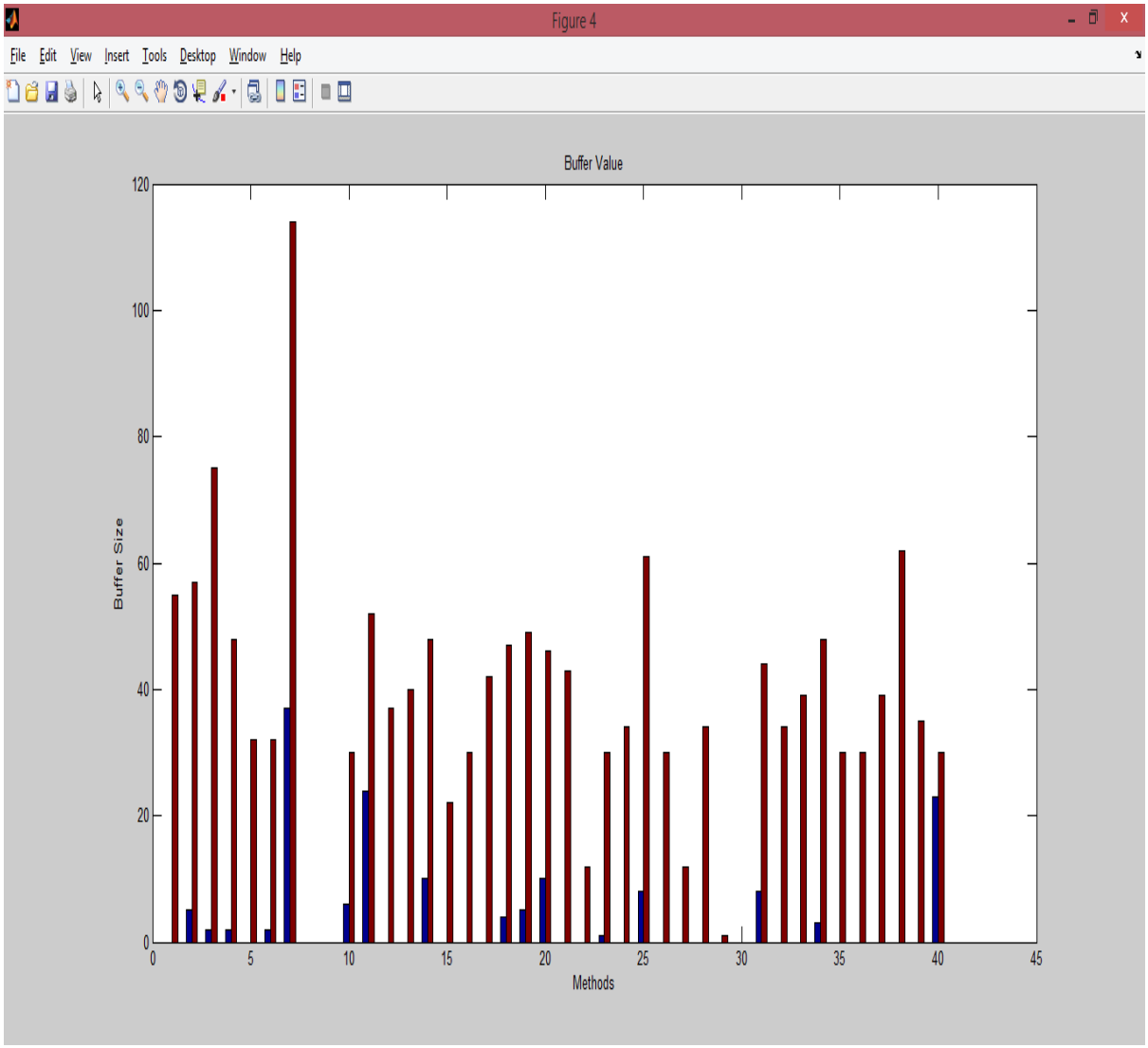

Figure 4.6 Plotting Graph Buffer Size of Every Nodes

4.6 Plotting Graph Every Nodes Energy Consumed

Figure 4.6 plot the graph energy consumption for proposed methodology and base paper methodology. Blue line of graph generate the proposed methodology and red line of graph generate the base paper work. To the graph generate in the basis of path selection method and packet or message sending time to use the battery power of every nodes in used for the communication and total calcite energy after the selection the path and how much energy in every nodes to save for the next time communication.

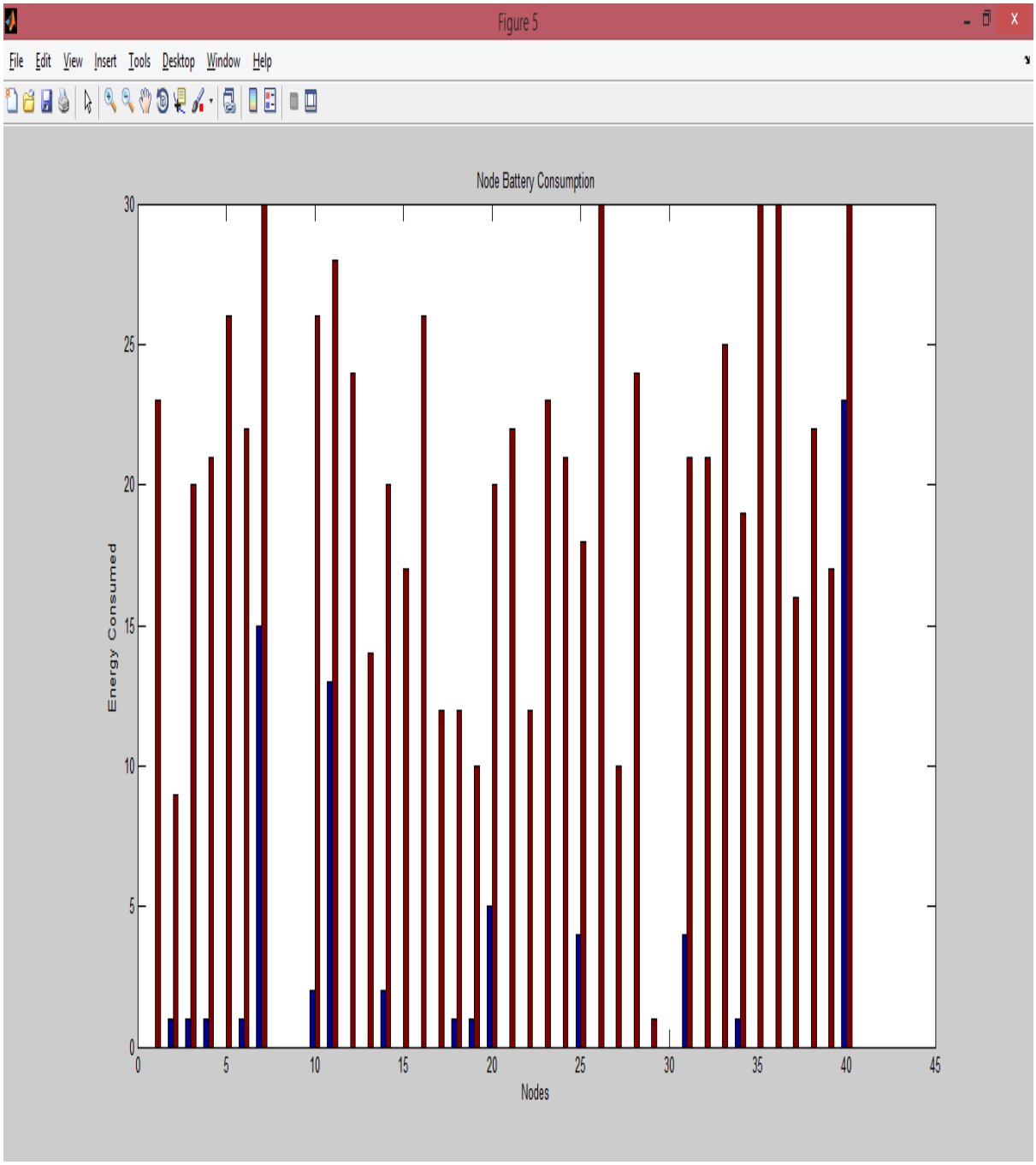

Figure 4.6 Total Energy Consumed in Every Nodes

4.7 Number of Nodes Used in path Construction

Figure 4.7 plot the graph of output total number are nodes used in path construction, here line 1 of the graph proposed methodology to used nodes in command window input and comes the output in figure 4.2 to construct the path 16 nodes are covered to source to destination nodes, in other hand line 2 of the graph base paper methodology to used nodes in command window input and shown the figure 4.3 to covered the nodes to reached to source to destination 36 nodes are covered than the result over comes the more nodes are covered than more energy consumed.

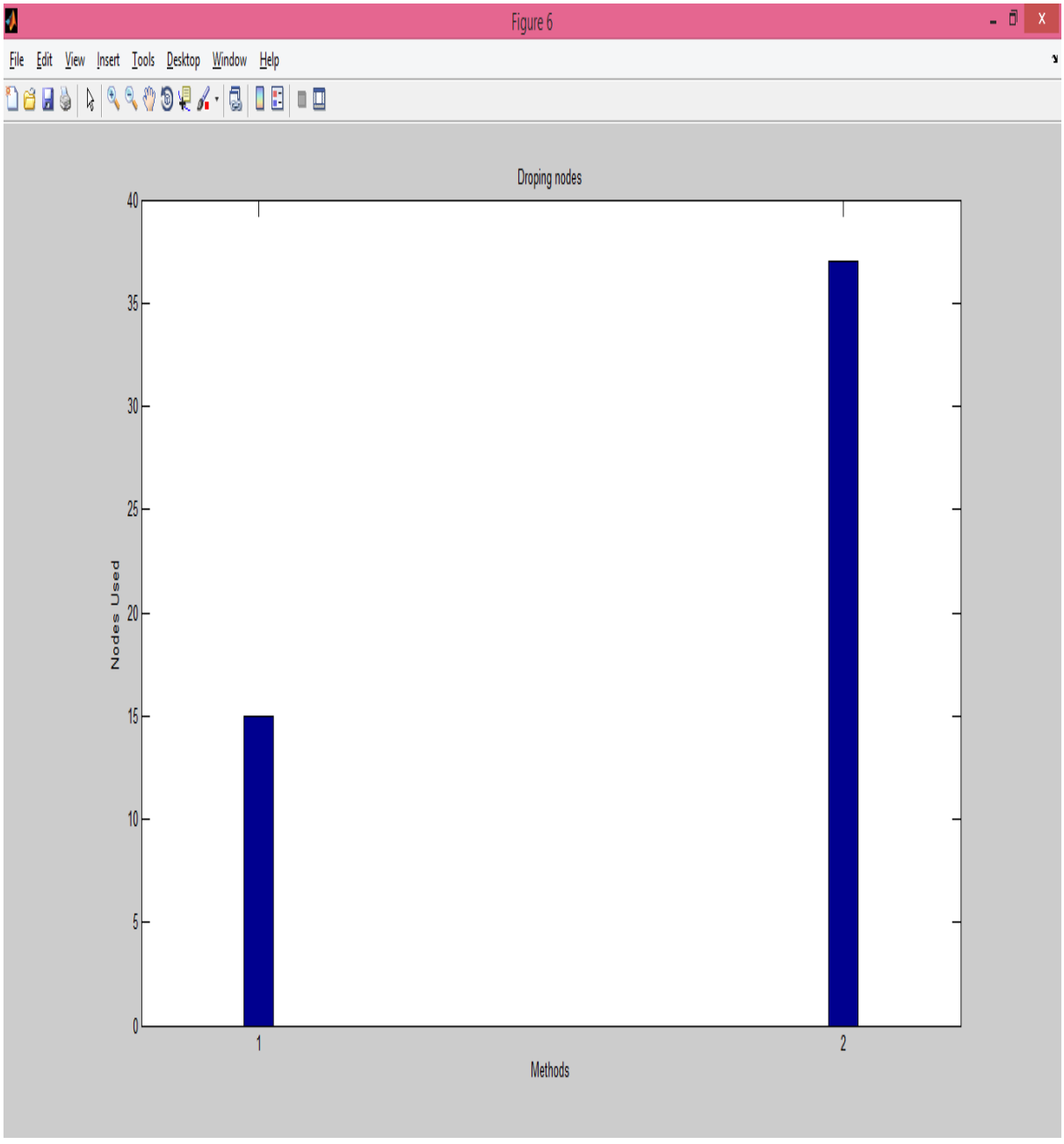

Figure 4.7 Number of Nodes Covered in path Construction

4.8 Network Lifetime

Figure 4.8 plot the graph in between method and lifetime in second, line 1 of the graph propose methodology to show the network life of every nodes because proposed methodology data packet delivery ratio good and buffer capacity free and less energy consumed time in packet sending or communication, in other hand line 2 in the graph base paper the maximum number of nodes covered than the result packet delivery ratio increase because buffer capacity maximum than the result more power consumed time of packet sending or communication to intermediate node.

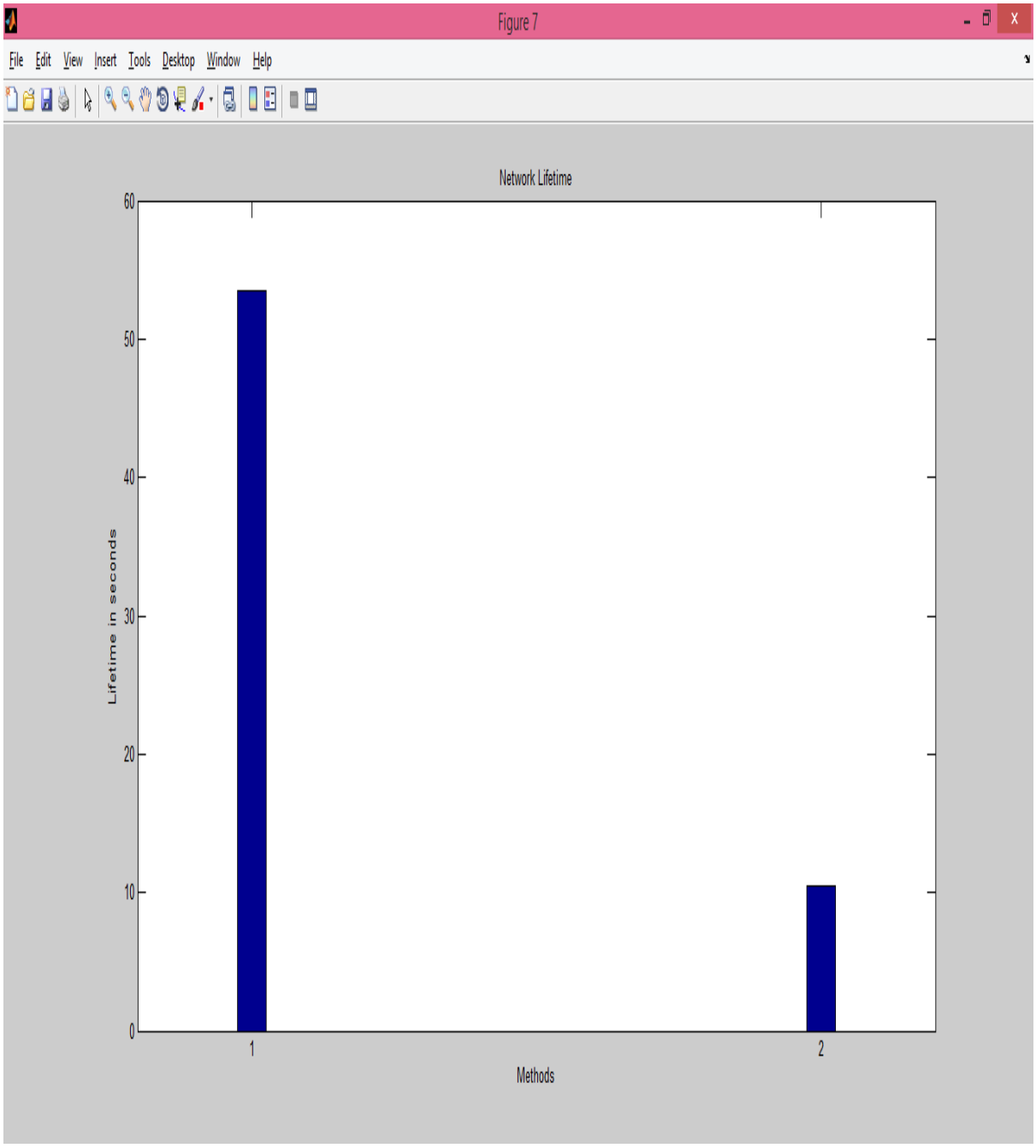

Figure 4.8 Overall Network Lifetime

CHAPTER 5

CONCLUSION AND FUTURE WORK

There are different types of energy efficient multipath routing algorithm in wireless sensor network to increase the network performance this days, researcher developed routing protocols like LIEMRO, IM2PR etc. But these protocols also suffer from the energy efficient, buffer capacity problems. Till now researchers addressed the issues related to load balancing, interference, energy efficiency etc. Solution proposed in this research work can improve the buffer capacity, packet delivery process and delay from source to sink.

In future the proposed work will be compared with other protocols as well and its performance will be evaluated based upon other parameters.

Chapter 6

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Chapter 6

APPENDIX

List of Abbreviation

WSN	Wireless Sensor Network
QoS	Quality of Service
DERP	Delay-minimum Energy Aware Routing Protocol
SAR	Sequence Assignment Routing
LEACH	Low-Energy Adaptive Clustering Hierarchy
TEEN	Threshold-Sensitive Energy-Efficient Sensor Network Protocol
GPS	Global Positioning System
GAF	Geographic Adaptive Fidelity
IM2PR	Interference-Minimized Multipath Routing protocol