

# **Design and Evaluation of Localization Algorithm in Wireless Sensor Networks**

A Dissertation Proposal submitted by

**Gurbir singh**

**10800600**

**To**

**Lovely school of computer science engineering**

In partial fulfillment of the Requirement for the

Award of the Degree of

In partial fulfillment of the Requirement for the

**Master of Technology in computer science**

Under the guidance of

**Gulshan kumar**

**Assistant professor**

**(June 2015)**

School of: COMPUTER SCIENCE & ENGINEERING

DISSERTATION TOPIC APPROVAL PERFORMANCE

Name of the Student: Gurbir Singh Registration No.: 10800600  
 Batch: 2008 Roll No.: 2008  
 Session: 2014-2015 Parent Section: K2006  
 Details of Supervisor: Designation: A.P.  
 Name: Gulshan Kumar Qualification: M.Tech  
 U.I.D.: 16865 Research Experience: 5 years

SPECIALIZATION AREA: Network Security (pick from list of provided specialization areas by DAA)

PROPOSED TOPICS

1. A Novel approach to determine location in WSN  
(Wireless Sensor Network)
2. location estimation and verification algorithm in WSN
3. Design & Evaluation of location estimation Algo. in WSN  
WSN

Gulshan Kumar  
 Signature of Supervisor

PAC Remarks:  
Topic 3 is approved.

APPROVAL OF PAC CHAIRPERSON:

Signature: [Signature]

Date: 19/9/14

\*Supervisor should finally encircle one topic out of three proposed topics and put up for a 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 final report.  
 \*One copy to be submitted to Supervisor.

## **ABSTRACT**

**Ad-hoc** network is an BSS(Basic service set) without an access point and the BSS with an access point is called as an infrastructure network. Basically ad-hoc network is made up of mobile nodes that are movable nodes without any type of communication infrastructure which comprises of mobile nodes and an access point or any type of base station(BS).It is also called as an self organizing network because when any of the node moves out of the network it automatically rearrange its routing table. It also have cooperative nodes which means that each node firstly decodes and then forwards packet for other nodes.

**Wireless sensor networks (WSN)** consist of number of sensor devises. The collection of the hundreds or thousands of sensor nodes deployed over a large geographical area the parameter of which has to be measured. They have attracted intensive attention in recent years due to wide variety of applications which include environmental, traffic control , health care etc. basically what is wireless sensor network it is an distributed network of small, lightweight wireless nodes

In wireless sensor network localization is very wide area for research. Localization simply mean to estimate the location of node. Main motive of localization is to determine the location or the position of the sensor nodes, we gather the information of sensor nodes for data tagging.

## **Acknowledgement**

I would like to express the deepest appreciation to my Mentor Asst. Professor **Mr Gulshan kumar**, you have been a tremendous mentor for me. I would like to thank you for encouraging my research work and for allowing me to grow as a research scientist. Your advice on both research as well as on my career have been priceless. He has shown the attitude and the substance of a genius: she continually and persuasively conveyed a spirit of adventure in regard to research and scholarship, and an excitement in regard to teaching. Without her supervision and constant help this research would not have been possible.

Gurbir singh

## DECLARATION

I hereby declare that the dissertation proposal entitled “**Design and Evaluation of Localization Algorithm in Wireless Sensor Networks**” 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.

Date:

Investigator Regd. No. \_\_\_\_\_

## CERTIFICATE

This is to certify that Gurbir singh has completed M.Tech dissertation proposal titled “**Design and Evaluation of Localization Algorithm in Wireless Sensor Networks**” 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 submission and the partial fulfillment of the conditions for the award of M. Tech Computer Science & Engineering.

Date \_\_\_\_\_

Signature of advisor

Name: Gulshan kumar

UID: 16865

## TABLE OF CONTENT

Abstract.....	i
Acknowledgment.....	ii
Declaration.....	iii
Certificate.....	iv
List of figure and tables.....	vii

### CHAPTER 1

#### INTRODUCTION

1.1 Heterogeneous and homogeneous network.....	1
1.2 Different types of ad hoc network.....	2
1.3 Wireless sensor network.....	3
1.3.1 Features of wireless sensor network .....	3
1.4 Existing wireless network vs. sensor network.....	3
1.5 Sensor network model.....	4
1.6 Sensor network architecture.....	5
1.6.1 Sensor node components.....	5
1.7 Environment.....	5
1.7.1 Uses of sensor network.....	6
1.8 Localization.....	6
1.8.1 Localization problem.....	6
1.8.2 Different localization techniques.....	6
1.8.3 Techniques to remove localization problem.....	6

### CHAPTER 2

Literature review.....	11
------------------------	----

### CHAPTER 3

Scope of study .....	16
----------------------	----

<b>CHAPTER 4</b>	
Research objective .....	17
<b>CHAPTER 5</b>	
Research methodology.....	18
<b>CHAPTER 6</b>	
Results and discussions.....	22
<b>CHAPTER 7</b>	
Future scope.....	30
<b>CHAPTER 8</b>	
References.....	31



## **LIST OF FIGURES AND TABLES**

- 1.1 Heterogeneous mobile network
- 1.2 Homogeneous mobile network
- 1.3 Ad hoc network
- 1.4 Sensor network model
- 1.5 Sensor node components
- 1.6 Received signal strength indicator
- 1.7 Time of arrival
- 1.8 Time difference of arrival
- 1.9 Research methodology
- 2.0 Various techniques of localization
- 2.1 Working model of Network Simulator 2

## **LIST OF TABLES**

- 1.1 Existing wireless network vs. sensor network

# INTRODUCTION

### **AD-HOC NETWORK**

Ad-hoc network is an BSS(Basic service set) without an access point and the BSS with an access point is called as an infrastructure network. Basically ad-hoc network is made up of mobile nodes that are movable nodes without any type of communication infrastructure which comprises of mobile nodes and an access point or any type of base station (BS).It is also called as a self organizing network because when any of the node moves out of the network it automatically rearrange its routing table. It also have cooperative nodes which means that each node firstly decodes and then forwards packet for other nodes. In Ad-hoc wireless network there is collection of two or more mobile devices which are capable of networking and wireless communications. if the device is capable of wireless communication and networking then these devices can communicate with each other easily by creating a network between them within their radio range. An ad-hoc network does not rely upon any fixed access point or the base station the network itself is called as an infrastructure less .The ad-hoc network are also called as self organizing as we said earlier we can form and deform our network easily because there is no any system administrator. Ad-hoc nodes or devices should be capable of detecting another such device which is capable of performing wireless communication to perform handshaking which allow one device to share the information and the services between them. Ad-hoc network is also a decentralized type of wireless network. This is called as the ad-hoc network because it does not depend upon the pre existing infrastructure such as any type of router in wireless network[18]

### **1.1 Heterogeneous and homogeneous network**

**1.1.1 Heterogeneous network-:** In this type of network there are distinct devices all the different devices are connected with each other in the ad hoc network some are high power consuming and some are of less power consumption.

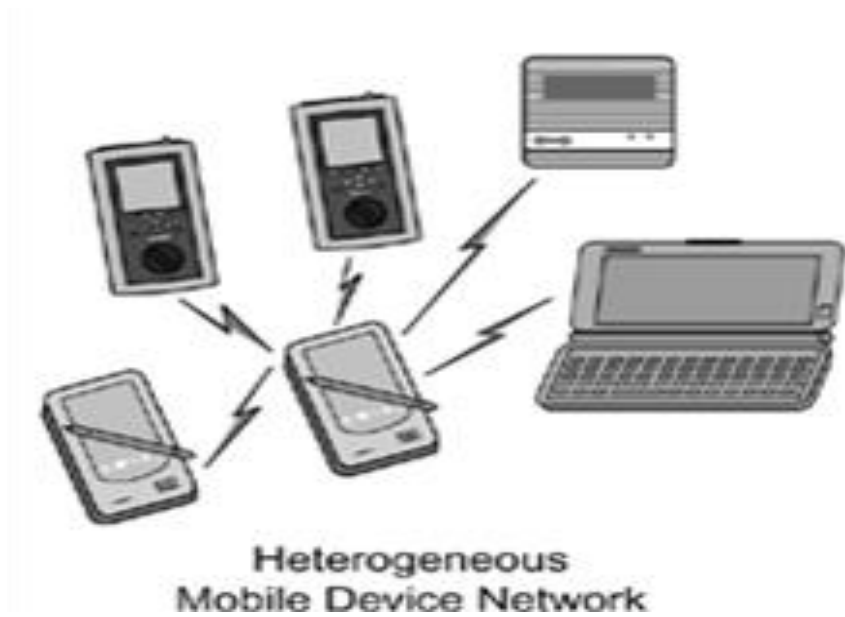


Fig 1.1 Heterogeneous Mobile Device

**1.1.2 Homogeneous network-:** In this type of network all the devices are of same type all the devices consumes same amount of power in this type of network contains all the laptop computers.

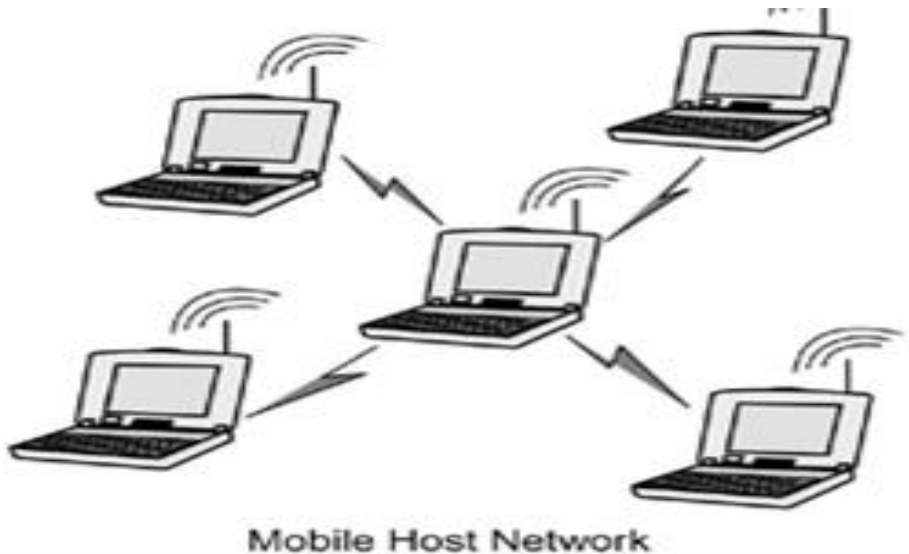


Fig 1.2 Homogeneous Mobile Device

### 1.2 Different type of ad hoc network

- a) Wireless sensor network
- b) Mobile ad-hoc network

### 1.3 Wireless sensor network

Wireless sensor network is an form of ad hoc network. Basically what is wireless sensor network it is collection of large number of small sensor nodes that are originated in particular area these sensors are wirelessly connected and at the appropriate times they use to send information back to some of the selected nodes these nodes can perform some operations on the collected data by the sensor nodes to collect some useful information to get the critical decision to be made. There are variety of sensors which are available which are used to sense different things like for sensing earthquake we have different sensor and different sensor for sensing smoke, heat etc. For sound (ACOUSTIC SENSOR).For earthquake , heat, smoke and temperature(SEISMIC SENSOR).

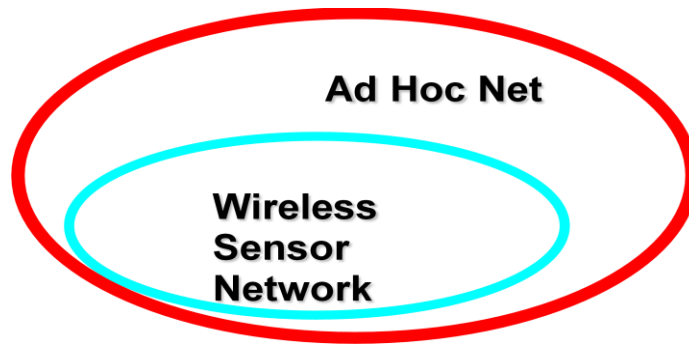


Fig 1.3 Ad hoc Network

#### 1.3.1 Features of sensor network

Most common feature of wireless sensor network is that it comprises of low cost,low power, malfunction and small small sensor nodes. Sensor node has capability of sensing the data .processing of data and the components for communication. Sensor network protocol must have the capability of self organizing. Multihop routing and very short range broadcast communication. Frequency changing topology due to fading and node topology. Sensor nodes are very densely deployed and topology changes very frequently.

### 1.4 Existing wireless network vs sensor network

In this table we had compared different wireless networks (Bluetooth, Cellular system) with the wireless sensor network .And had studied these networks on various aspects like hop count

,energy efficiency, Band width and how these networks transfers the data from one device to other.

Cellular system	Bluetooth, Manet	Sensor network
It is single hop	Is multi hop	It is multi hop
High QOS band width efficiency	High QOS	Power conservation
NA	NA	Limited bandwidth Large number of nodes
station to base station	Peer to peer Peer to multimode	Peer to multimode

Table 1.1

### 1.5 Sensor network model

In this network model there are various sensor nodes scattered over a area .There are various application dependent components like location finding, power generator and mobilizer which are scattered in the sensor field they collect the data and route data back to the sink. Then the sink communicates with the task manager via internet or the satellite.[19]

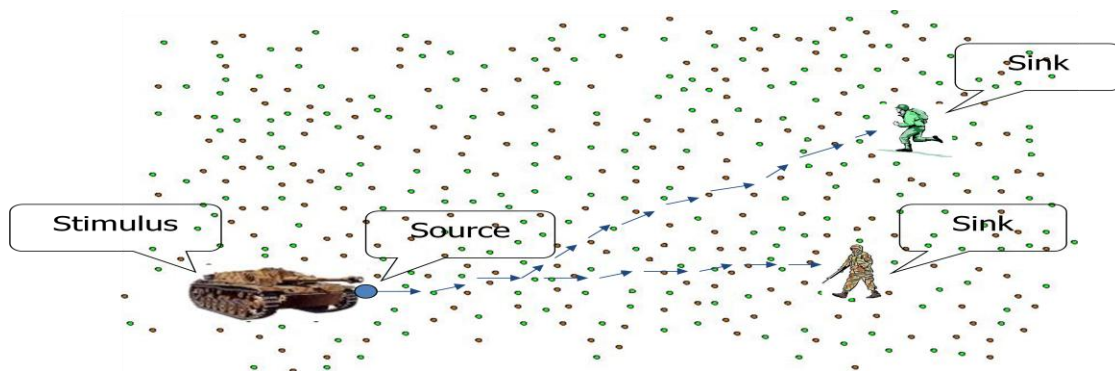


Fig 1.4 Sensor Network Model

## 1.6 Sensor network architecture

### 1.6.1 Sensor node are made up of four components:

- a) Sensing unit has two subunits (sensors and analog to digital convertor).
- b) Processing unit it manages the procedures that the sensor nodes communicate with other sensor nodes to carry out the assigned sensing task.
- c) Transceiver connects the sensor nodes with the network.
- d) Power unit it is the most important unit.

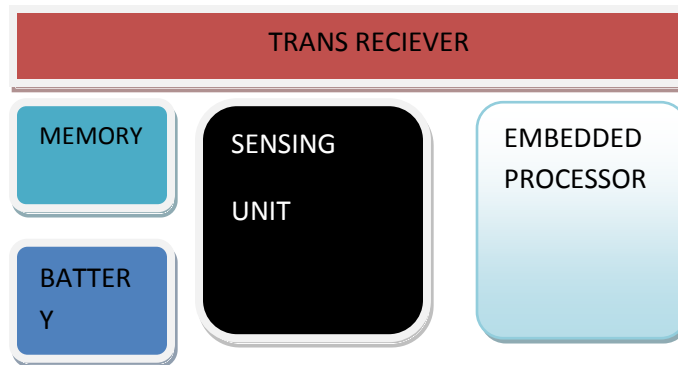


Fig 1.5 Sensor node components

Various additional application dependent components

Location finding systems, power generators and mobilizers.

Sensor nodes are scattered in sensor fields.

Collect data and then it sends back to the sink.

SINK(sink communicates with the task user via net).

### 1.7 Sensor nodes can be work under different conditions like :

- a)In the interior side of large machinery.
- b)At the bottom of ocean.
- c)In battlefield beyond the enemy lines, homes and large building

### **1.7.1 Different use of sensor network**

- a) In military use for surveillance for enemy field and for target tracing
- b) In health care industry sensors are used for the continuous monitoring of life critical information in the hospitals.
- c) Food industry micro sensors are used as the biosensor technology applies to the quality check this allow us to check the quality of the food with the help of this if quality is checked we can prevent the shipping of rejected food from being shipped.
- d) Agriculture micro sensors are used in agriculture to determine the quality of soil and the moisture level.
- e) Micro sensors are also widely used to gather the information regarding environmental and weather conditions. They enable us to be prepare for facing the bad weather and natural disasters.

### **1.8 Localization**

Localization is estimating the location of node. Scheme for localization in the wireless sensor network has been widely developed in past 20 years most widely motivated by military use. since then there have been performed various study in localization field for the civil use. Researches have been pointed out mostly in the region of noise in the localization process and various researches have been performed to increase the accuracy and efficiency of localization process. But till now there has not been such algorithm designed so that efficiency and accuracy of localization can be done so that it can be used in civil use. Motive of localization-:main motive of localization is to determine the location or the position of the sensor nodes we gather the information of sensor nodes for data tagging .[18]

**1.8.1 Localization problem:** Nodes are widely spread in the environment for ex-:we have sensor nodes to know the enemy location in there side we have to spread the sensor nodes in there side also. To get the information about the proper position of sensor node is very difficult if we don't get the position of the sensor node then we cant tag our data means we cannot collect the data.

#### **1.8.2 Different localization techniques**

There are two types of localization techniques

- a)Range base
- b)Range free

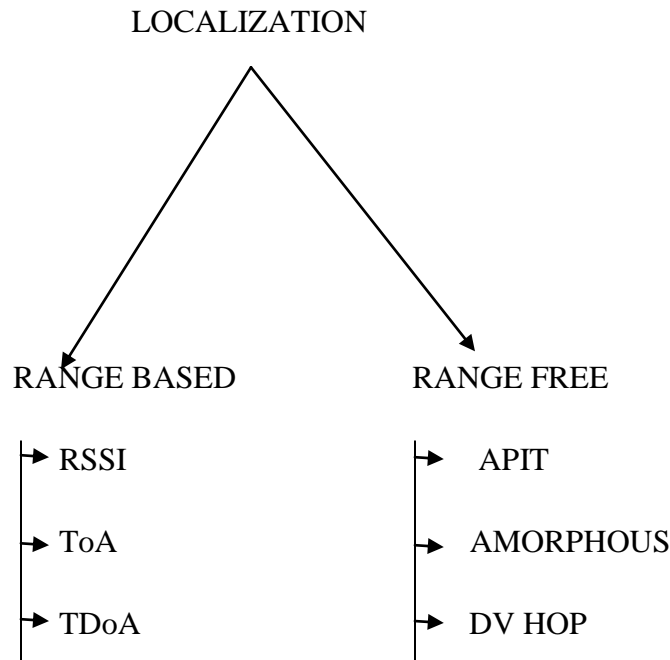


Fig 2.0 Various techniques of localization

**Range based:** An algorithms can be classified into two categories range or range free methods. Their main principle in case of localization is to estimate the distance between the two node pairs and then compute the position of the individual nodes in the global network. Before giving the detail of different range methods we see how we can calculate or estimate the intern node distance.

**RSS (Received signal strength):**In case of Rss by knowing the power emitted and the compare it with the signal strength received we can estimate the attenuation and can calculate the distance

$$g=d^{-a}$$

Issue -:There is no particular or unique path from the transmitter to the receiver.

**Time of flight:** When the environment is supposed coherent enough for the transmission of the signal at the constant speed, then by knowing the speed of the signal and the time of the propagation we can estimate the distance between the nodes.

The basic principle of time of flight that could also be applied onto radio signals as we know that the speed of the radio signals are very large i.e. equals to the speed of the light time measurements should be very accurate to avoid the uncertainties.



### 1.8.3 Different types of techniques used to remove the localization problem

a) **RSSI** In telecommunication system Rssi generally means the strength of the radio signal received. Received signal strength indicator is an indication of power level that is being received by the receiver or the antenna.

Relative strength signal indicator sends the signal and the strength of the signal is known then we use the signal strength that is received and the coefficient of path loss to estimate the distance. Basically received signal strength indicator estimates the distance between the two wireless sensor nodes in case of localization there are two techniques used that is range based and range free and in range based technique there are further algorithms that are used to estimate the distance between the different nodes.

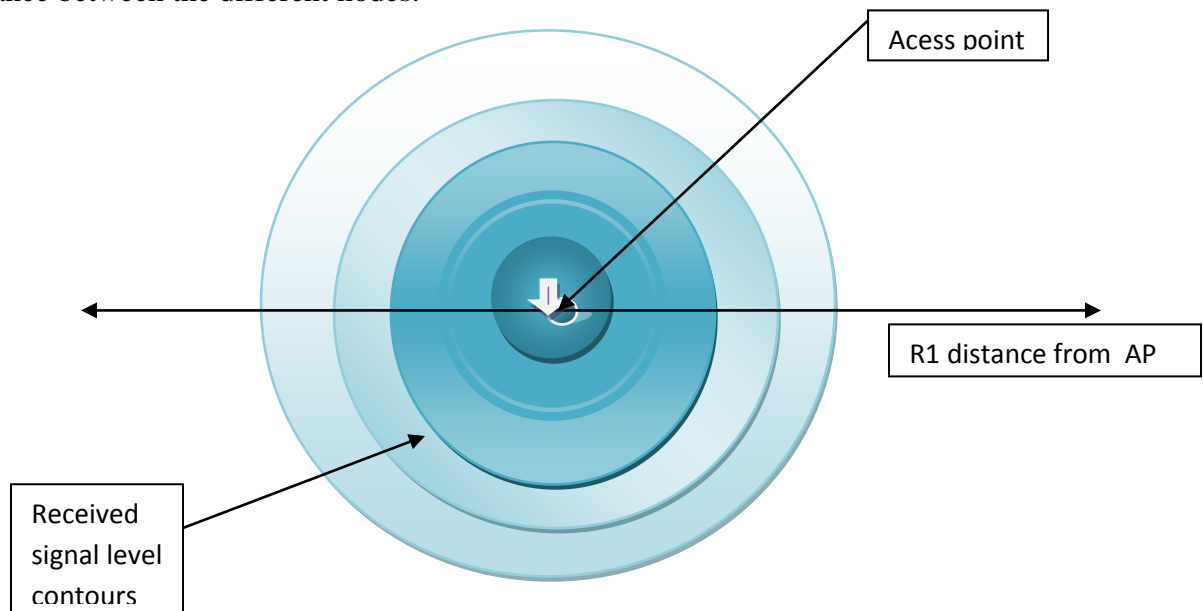


Fig 1.7 Relative strength signal indicator

b) **ToA** (Time of arrival) other name of ToA is time of flight. It is a travel time of radio signal from transmitter to the remote signal receiver. Basically the ToA uses the time of transmission, propagation speed, and the arrival time to compute the distance between the two nodes. Time of arrival just see the actual time of receive of signal at an particular base station rather than knowing the time difference taken to reach the signal from the transmitter to the receiver. In ToA distance between the two nodes can be easily calculated with the help of time of arrival if the actual velocity of the radio signal is known by this we can measure the distance between the various wireless sensor nodes by the velocity of radio signal that is received.

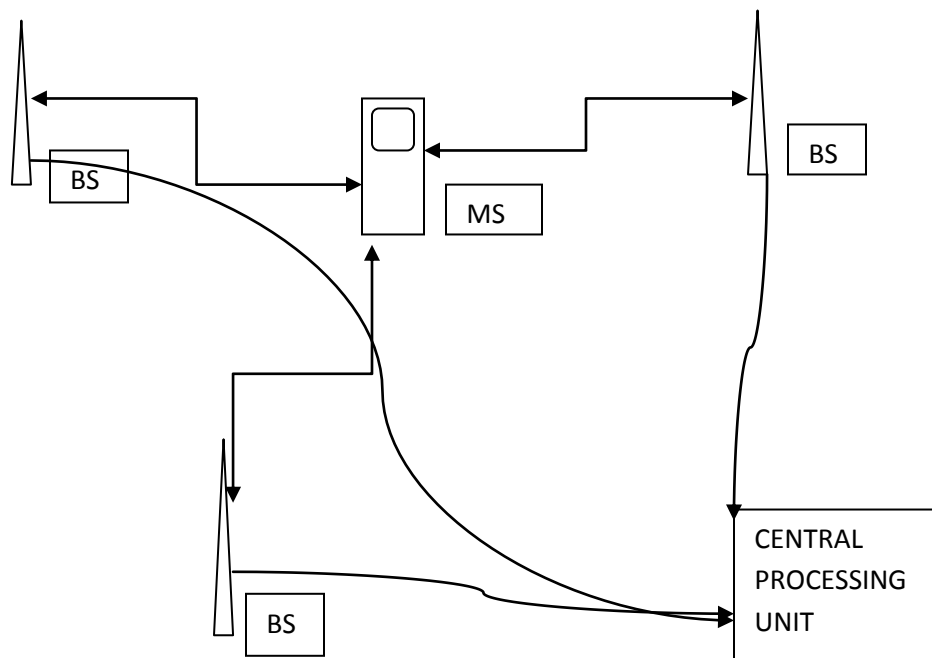


Fig 1.8 Time of Arrival

**TDoA** (Time difference of arrival) technology now a days widely used in GPS(global positioning systems)and the navigation systems. Position estimation of source can be estimated with the help of time difference of arrival. The TDoA has many applications in civil as well as in military. In civil in case of mobile communication TDoA is widely used. It is used to perform the location of mobile user and the base station. In the coastal stations with the help of this we can locate the position of the ships in the sea using the acoustic waves. In case of military it is used to locate the enemies emitting devices like radars and other communicating devices. The TDoA also reduce the localization problem.

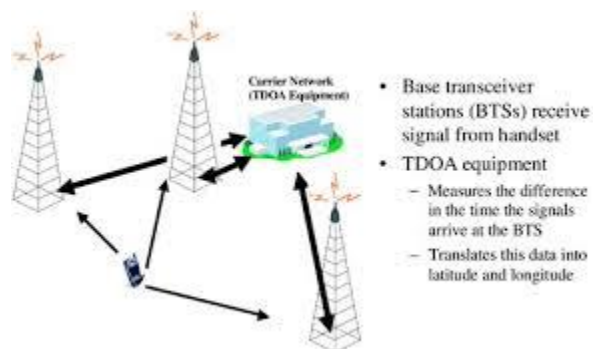


Fig 1.8 Time difference of Arrival

**RANGE FREE METHOD** In this technique we use the information about the neighboring node this technique fits perfectly to reduce the localization problem. In this type of scheme each and every node use only the direct communications to give its position estimates and when it achieves a given desired accuracy it broad casts the results. Its main advantage is that it saves very much traffic.

#### **Various range free localization algorithms**

**APIT** In this technique we generally divide the given environment into triangles given by the beaconing nodes. In the triangle we know the presence and absence of each and every node will allow us to reduce the possible location area.

**Amorphous localization algorithm** In amorphous localization algorithm it is basically derived from the Dv Hop algorithm which is used for estimating the position of nodes in the localization. Firstly in amorphous algorithm as same as like Dv Hop each node will firstly get the hp distance that is distance of node from the distributed anchors with the help of beacon propagation. Once the anchor estimates are collected the estimation of hop distance is obtained from the local averaging .In this each node will collect the hop distance of neighboring nodes and after that compute the average distance from all its neighboring values. Half of the ratio range is deducted from that average value to compensate the error caused

**Dv Hop localization algorithm** In Dv Hop localization algorithm it uses a same method that is similar to classical distance vector. In this method the anchor firstly broadcast the beacon which contains the location of the anchor with hop count parameter initialized to one. By this each node maintains the counter value from anchor of all beacons and will ignore the beacons with the higher hop count. Through this mechanism all nodes in the network will gets the shortest path .In order to convert the ho count into the physical distance the system will estimates the average distance per hop without range base.

Traditional DV-Hop algorithm [17] positioning process is divided into three phases:

- 1) Beacon nodes broadcast their locations to the neighbors of information packets, including the jump number field is initialized to 0. Receiving node records to each beacon nodes having the minimum number of hops, ignoring a beacon node from the same large number of hops a packet.

Then hop count plus one, and forwarded to the neighbors. Through this method, all nodes in the network to be able to record each beacon node under the minimum number of hops.

2) Calculate and obtain the unknown node average hop distance. Beacon nodes by saving the coordinates of the other beacon nodes and the minimum number of hops using the equation in the network calculate the average hop distance

$$c_i = \sum_{i \neq j} \frac{\sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}}{\sum_{i \neq j} hop_{ij}}$$

Among  $(X_i, Y_i)$  and  $(X_j, Y_j)$  are the beacon coordinates of node  $i$  and  $j$  is a beacon nodes  $i$  and  $j$ . The beacon node will calculate the average distance per hop fields with a packet with a lifetime of broadcasting to the network, the unknown node record only received the first average distance of each jump, and forwarded to the neighbors. This strategy ensures that the most recent beacon node from the node receives the value of the average distance per hop. Unknown node receives the average hop distance, according to the recorded number of hops to each beacon node calculate the hop distance.

3) ) Using trilateration measurement to calculate its own position. Unknown node uses the second phase to each record jump distance beacon nodes using trilateration measurement or maximum likelihood estimation method to calculate their coordinates.

# LITERATURE REVIEW

Outlier Detection Khalid K. Almuzaini, Aaron Gulliver(2010) “**Range-Based Localization in Wireless Networks Using Density-Based** “ defines the algorithms for localization ie range based and range free algorithms .These algorithms use the location matrices like TOA , TDOA, RSSI ,and AOA to calculate the distance between the two nodes. Since range based algorithms are very complex but are more accurate. However in the target tracking the localization accuracy is important. In this author proposed the new algorithm based on the density based outlier detection algorithm(DBOD) from data mining in this algorithm selection of K nearest algorithm(KNN).DBOD assigns the density to each value used in the localization estimation. The mean of the densities are calculated and the points which have the density greater than the mean value the points are called as the candidate points. In this author compares different different performance measures with this defined algorithm. It is shown that the proposed algorithm is better than other algorithms. From this author has concluded that the new range based algorithm which is basically based on the density based outlier algorithm which is basically the concept of data mining. The newly algorithm which is proposed is used to select the best candidate point from the set of points .This algorithm is developed to show drawback of LSS and WLS and SVD algorithm.[1]

Ahmed Abdulqader Hussein AL-Qaysi 1,2 and Tharek A. Rahman1(2011)“**A Survey on Secure Range Based Localization Algorithms in Wireless Sensor Networks**” describes about the localization that it is compute the location of the sensor node in the global network. There are various applications that are developed based on the localization are emerging in the wireless sensor network. Schemes on which the localization is divided are range based and range free techniques. By using these two techniques we compute the distance between the two particular node in the global network. But as day by day the popularity of localization is increasing very fast there are various attacks that are taking place .These attacks cause the error in distance estimation and confuse the localization process. There are two methods that are available for

calculating the location of the sensor nodes. In this paper the main motive of author is to detect the attack that harms the distance estimation and confuse the localization process and resolution of the attack. In this paper the author has concluded that there is no single localization algorithm that will resolve all errors against all the attacks which he has explained. Also the use of single approach to the localization will be difficult to defend under all the attacks. He had identified the areas for further research on range based localization technique in the wireless sensor networks[2]

Jin Fan, D,J Parish (2007)“**Using a genetic algorithm to optimize the performance of a wireless sensor network**” describes the algorithm that can be used to increase or enhance the quality or performance of wireless sensor network. The major challenge in wireless sensor network is routing. In this the main aim of the researcher is to find the good algorithm so that performance of the entire network can be increase. In this paper the user offers the entire information of the target application and required performance to optimize the system. The information that is offered contains the application traffic, and the need of matrices in the system for the given application with that information the system will calculate the relative weight vector for different matrices to derive the required function an will set that which of the protocols can be applies for the application using genetic algorithm. After all the best and optimal protocols are selected and the protocols are applied to perform the routing in wireless sensor network and to increase the performance of wireless sensor network.[3]

Nagarajan. M and Dr . S. Karthikyan (2012) “**A New Approach To Incerese the Life time and Efficiency of Wireless Sensor Network**” has introduced a new algorithm that is use to increase the life time of the sensor nodes in the network. In this approach there are only few nodes that are in active state in the region which is covered and all the other nodes are ideal at that time that means at ideal state. The node which are at ideal state will be at active state for a shorter period of time they are only active when they check the active nodes that whether the active nodes are still at active state or not. If there is any node failure or the node die at that time the ideal sensor gets active and active node will sense the data. In this technique all the nodes change there status periodically between active and ideal state .It means that few nodes will be in active state and these nodes start to sense the data using there energy on the same time some nodes will be in

ideal state. So the energy of ideal state nodes can be saved and energy of these nodes will only be used when the node will become an active node from ideal node .this proposed algorithm will increase the life time of the network in optimal way. [4]

K. Ramesh (2011)”**A Comparative Study of Cluster head Selection Algorithm In Wireless Sensor Networks**” describes the different clustering techniques .These techniques are categorized according to there cluster head selection methods. These techniques are compared with respect to there cluster formation required after each rotation of role of cluster head ,distribution of cluster heads over the network, clustering during after each round for selecting the cluster head of each cluster, parameters used. In this paper it is also described the effect of cluster head selection method on the performance of these different techniques due to the selection of cluster head from the cluster it also effects the energy efficiency of wireless sensor network .This paper describes about the clustering and cluster head selection methods. There are many different types of algorithms and routing protocols to reduce the consumption of energy for the transmission of data. For the communication or forwarding of data from cluster head to other sink nodes ,distance from the corresponding cluster head and intermediate cluster should be maintained .The paper describes the some energy efficient and stable clustering scheme for the collection of data in wireless sensor network.[5]

Long Cheng “**Distributed Minimum Transmission Multicast Routing Protocol for Wireless Sensor Networks**” describes that utilization of energy is one of the key factor need to be consider in in wireless sensor networks (WSNs). Multicasting is one of the way to float the information amongst the group members of a particular communication area previous work has shown that formation of multicast tree has a advantage that it reduces the cost per communication and the problem then becomes NP- complete .In this work the authors presented a heuristic distributed minimum transmission multicast routing protocol (MTMRP) for WSNs. A new technique is introducing known as the biased back off scheme and taking advantage of the broadcast nature of wireless communication, MTMRP chooses the forwarding routes which can connect more multicast receivers. Moreover, MTMRP introduces a path handover scheme, which can prune redundant routes for multicast routing. As a result, the multicast transmission cost is reduced in a distributed manner. We conduct extensive evaluations to study the performance of

the proposed MTMRP compared with existing protocols. From the simulation results the authors came into know that the specified approach is more energy efficient in multicast environment. [6]

Jaspal Kumar, M. Kulkarni, Daya Gupta”(2013)**Effect of Black Hole Attack on MANET Routing Protocols**” describes that in mobile ad hoc network there may be insecure attack by malicious nodes. In this paper the researcher have analyzed the effects of black hole attack on mobile ad hoc routing protocols AODV and improved AODV have been considered the simulation has been performed on the basis of performance parameters and effect has been analyzed after adding black hole nodes in the network by performing this the result has been concluded that on which protocol is less affected by these protocols which means what are the protocols that are very less affected by these kinds of attack in the network. In this paper, researcher have analyzed the Black hole attack with respect to different performance parameters such as end-to-end delay, overhead and packet delivery ratio. We have analyzed the vulnerability of two protocols AODV and Improved AODV under varying pause time. [7]

Shayon Samanta<sup>1</sup>, Prof. Punesh U.Tembhare<sup>2</sup>, Prof. Charan R. Pote<sup>3</sup>(2013)**“A Survey on 3d Localization in Wireless Sensor Networks”** Describes that wireless sensor network is now used in various wireless applications in which each and every node has to localize firstly before sending any type of data. Coordinates of nodes are defined in the localization process .If the coordinates are defined then only the nodes are localized. There are various types of algorithms that are developed in the localization based on 2D works on two planes. It also provides the accuracy in 2 dimensional but in the real world we need all the 3 dimensions for correct estimation of nodes and accuracy in the localization. As the 2D works on the flat plain. According to the developer he need to implement wireless sensor network in the harsh terrain also the developer has to define the 3D algorithm for providing good accuracy and decrease the error . The paper works on localization of nodes using 3D algorithm.[8]

Tian He, Chengdu Huang, Brian M. Blum, John A. Stankovic, Tarek Abdelzaher”(2003) **Range-Free Localization Schemes for Large Scale Sensor Networks**” Describes that wireless sensor network have been proposed for the multitude of localization dependent applications for those



kinds of systems the limitations of hardware and the cost of sensing nodes prevents the use of range based localization techniques that are totally depended upon point to point distance estimates. In this paper developer worked on the newly developed localization algorithms APIT that is range free. He showed that APIT scheme works best when random nodes placements are considered and low communication overhead is derived. In conclusion to this the developer has compared his work via simulation tool with three state of art free localization scheme. In addition to this he has studied the effect of errors on routing and tracking performance and has shown the routing performance and tracking accuracy are not effected by the localization error when the error is 0.4 times lesser than communication ratio radius.[9]

Weihua Sun, Hirozumi Yamaguchi, Keiichi Yasumoto and Minoru Ito(2009)“ **Range-based Localization for Estimating Pedestrian Trajectory in Intersection with Roadside Anchors**” has worked on range bases localization for estimating pedestrian trajectory. According to the developer in ITS research field there are various efforts that have been made to develop (DSSS) Driving safety support system .In this paper developer has developed a localization method to calculate the movement trajectories of pedestrians near intersections with the anchors on the road side. In the developers’ method each and every pedestrian is provided with small devices which emits the signal that is radio signal and the anchor which is at road side receives the signal and will calculate the received signal strength. This method will estimate the position from RSS at each anchor based on maximum likelihood estimation to obtain the best result the developer applies the baye’s theorem to get the more accurate result. From simulation the developer has confirmed that the method estimates pedestrian position within 2m error.[10]

**Destination Driven On Demand Multicast Routing Protocol (D-ODMRP)**In this paper [15] by ‘Ke Tian, Baoxian Zhang, Hussein Mouftah, Zhuang Zhax and Jian Ma(2009)’the main objective in this is to enhance the efficiency of multicast forwarding . To attain the objective the paths which are there to reach to multicast destination ie from (sender to the receiver) is biased to those other paths which are passing through the other multicast destination.If there are various paths which are available we will select that path will will have less extra cost. In other words, D-ODMRP is basically used to reduce the counting of nodes which are to be added in the forwarding group.

Mohammed R. BAKER , M. Ali AKCAYOL(2011) **A survey of multicast routing protocols in mobile ad hoc networks** In these surveys they show the comparison between various routing protocols in mobile ad hoc network. The multicast routing plays an important role in point to point and multipoint to multipoint communication. Multicast routing protocol provide more secure and reliable network than the unicast routing protocol because the speed of the protocols and techniques that are developed or combined on multicast routing to work with the wireless technology.

There are various number of multicast protocol exist. Some of them work with the wired networks while others are work with the wireless network. There is one more type of protocol which works well with both type of network i.e with wired and wireless to. Wireless routing protocol is widely used now days. Multicast routing protocols is basically divided into two categories a tree based routing protocol and a mesh based routing protocols. A Tree based routing protocol are less stable in the ad hoc network as its frequent re-configuration in the dynamic network changes. It has a single path between source and receiver. Example of tree based routing protocols are MAODV (Multicast extension of on-demand distance vector) and Adaptive demand driven multicast routing protocol (ADMRP).

The second type of multicast routing protocol is mesh based routing protocols. They overcome the drawbacks of tree based routing protocol. It has multiple paths from source to receiver. It created a mesh in the network. There are many mesh based routing protocols. Examples of mesh based routing protocols are ODMRP (on demand multicast routing protocol), patch ODMRP , CAMP (core assisted mesh protocol).

The third type of routing protocol is the combination of tree and mesh based protocol and it is known as hybrid multicast routing protocol. Example of hybrid multicast routing protocol are AM route. As the wireless network consist of a numbers of mobile nodes that are connected with each other over the radio channel. The network topology changes while the nodes move on. So due to the dynamic topology and lack of center management the protocol which are already available to find the path from source to receiver in the traditional network cannot be directly used in the wireless network. So routing must be taken very seriously. A many routing protocol are there in compatible with the wireless ad hoc network.

## CHAPTER 3

### SCOPE OF STUDY

The scope of the project is to find the physical location of the sensor nodes. With the help of the algorithm which I am going to develop an algorithm which will help me to find the location of the sensor node in efficient manner . After calculating the physical location of the sensor nodes we will calculate the error rate of my algorithm and will calculate the mean error rate between the actual position and the estimated position of the sensor nodes. After calculating the error rate of my algorithm by simulating it in NS2 .We will compare the error rate of our algorithm with the pre existing algorithms which exists to calculate the physical position of the sensor nodes. In this project the algorithm will be designed in that manner that the error rate of that algorithm will be much lesser than the existing algorithms. For example in the military battle field there are soldiers which are sent at different locations in the field. With the help of the sensor nodes deployed over the area we can calculate the position of the soldiers with help of localization basically the mean of localization is to find the location of the sensor nodes. Another example is forest fire in the forests there are sensor nodes which are deployed in the whole forest for the fire detection in that the place the sensor which are deployed will sense the heat of fire and send the data back and we will find the location of the fire with the help of finding the location of the wireless sensor and will rescue from the fire in the forest before any great loss. There are various algorithms which are there of overcome the errors in the localization to find out the actual position of the sensor nodes but there are errors to calculate the actual position of the nodes .The algorithm which I am going to develop will work same as the other algorithms in the localization works but in this algorithm the error rate will be lower than other pre existing algorithms.

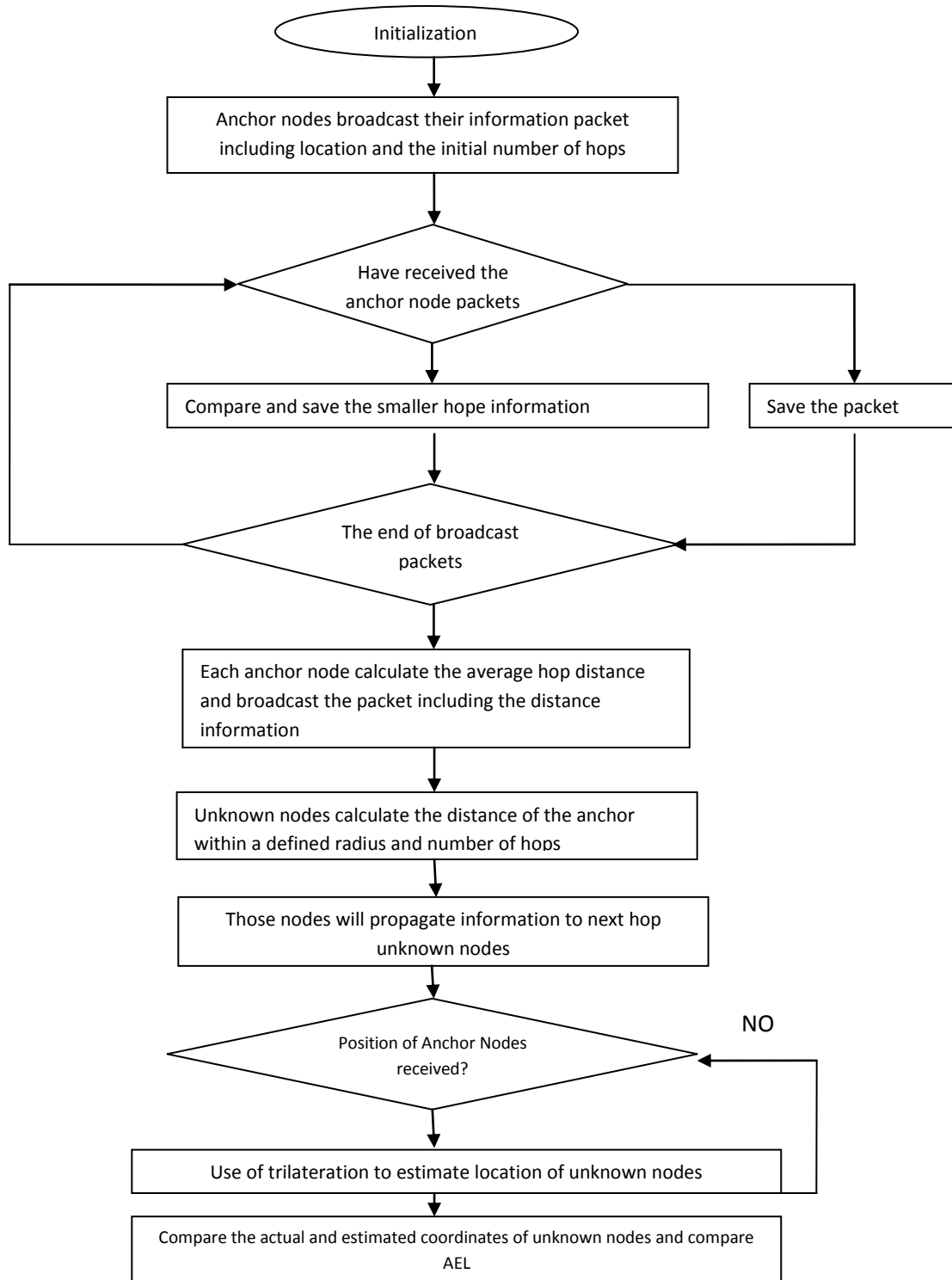
## Chapter 4

# RESEARCH OBJECTIVES

In wireless sensor networks there are sensor nodes which are scattered over a wide area and with the help of those sensor nodes we can monitor different locations even all over the world .In the wireless sensor nodes there is an technique called as the localization in this technique we can find the location of different sensor nodes deployed over the area. The major objective behind my study will be

- To develop an localization algorithm to find the physical location of the sensor nodes.
- To calculate the mean error rate between the actual position of the node and the estimated position
- To simulate the localization algorithm in Network Simulator 2 based on Average localization Error

# RESEARCH METHODOLOGY



Flow diagram of research

# RESULTS AND DISCUSSIONS

---

### TOOL USED

For implementing the proposal we are using tool name NS 2 (Network simulator 2)

1 NS2 is discrete event simulator which is used to simulate wired and wireless network. It consist of two different types of class hierarchy ie. Compiled and interpreted. It works on two different languages i.e. C++ and Tcl which are the part of oTcL. We will simulate the our proposed work using Network Simulator

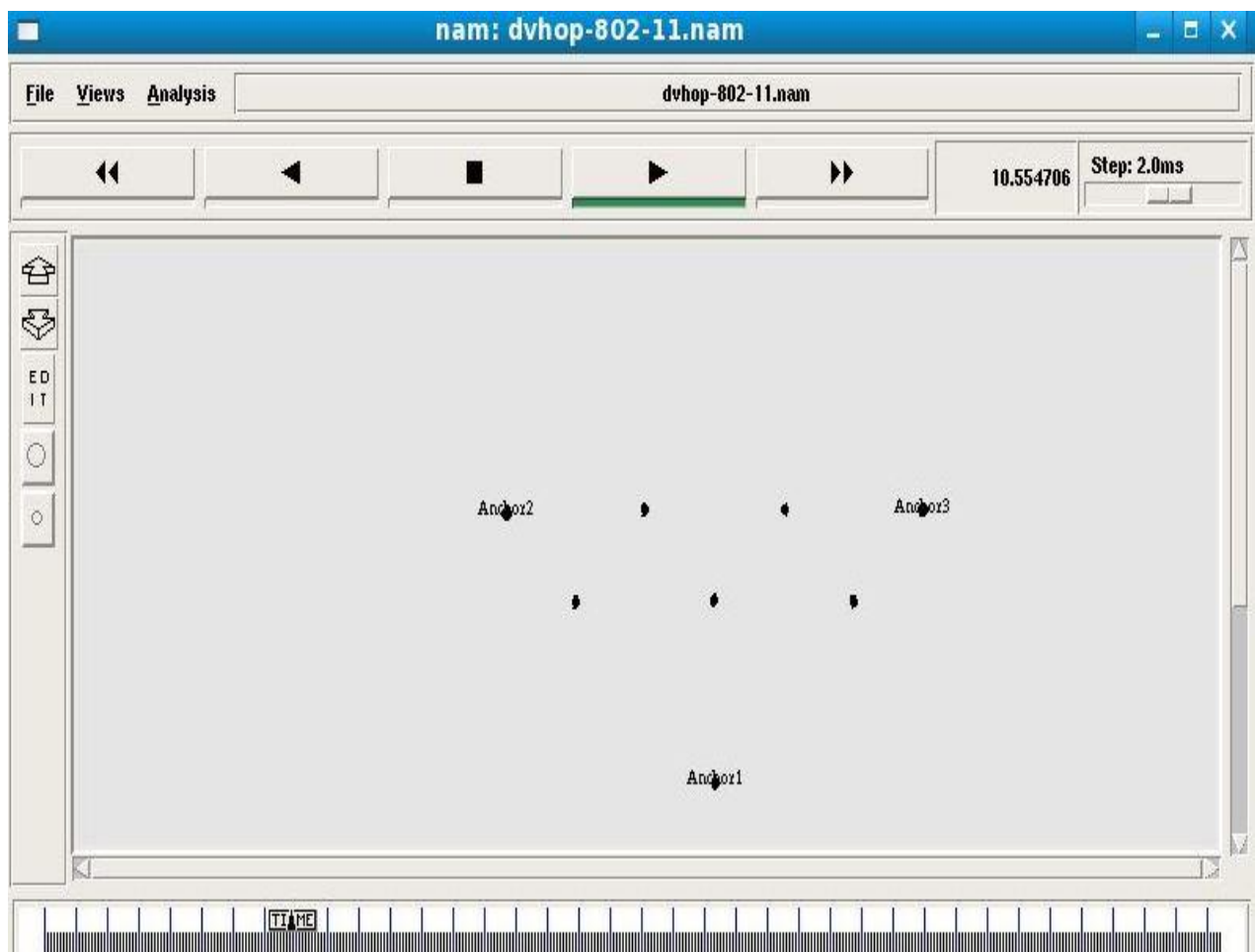
2. Basically, two languages are used to operate this tool that are TCL and c ++.Simulation with NS 2 results in form of animations etc.



Fig:2.1 Working model of network simulator 2

## NAM

Network animator is a visualizing tool that is being used to notify the movement and the placement of various nodes in the network. Network animator is commanded from the Tcl script where the user states its scenario regarding the nodes placement, topology control, the queuing principle and the nodes connectivity information. The flow of packets can be visually notified by the user using network animator. Also various set of functional buttons are provided in nam ie. Play , Fast forward, time control etc. In this chapter we shall describe the nam trace format and simple ns commands/APIs that can be used to produce topology configurations and control animation in nam.



After performing the simulation the deviation of position find by the localisation algorithm is computed based on average localization error

**Average localisation error.** The average localization error for Euclidean distance can be computed as follows:

$$\text{error} = \frac{1}{N_t} \sum_{i=1}^{N_t} \sqrt{(\hat{x}_i - x)^2 + (\hat{y}_i - y)^2},$$

Where (X,Y) is actual location of unknown nodes and (X<sub>i</sub>,Y<sub>i</sub>) is the estimated location.

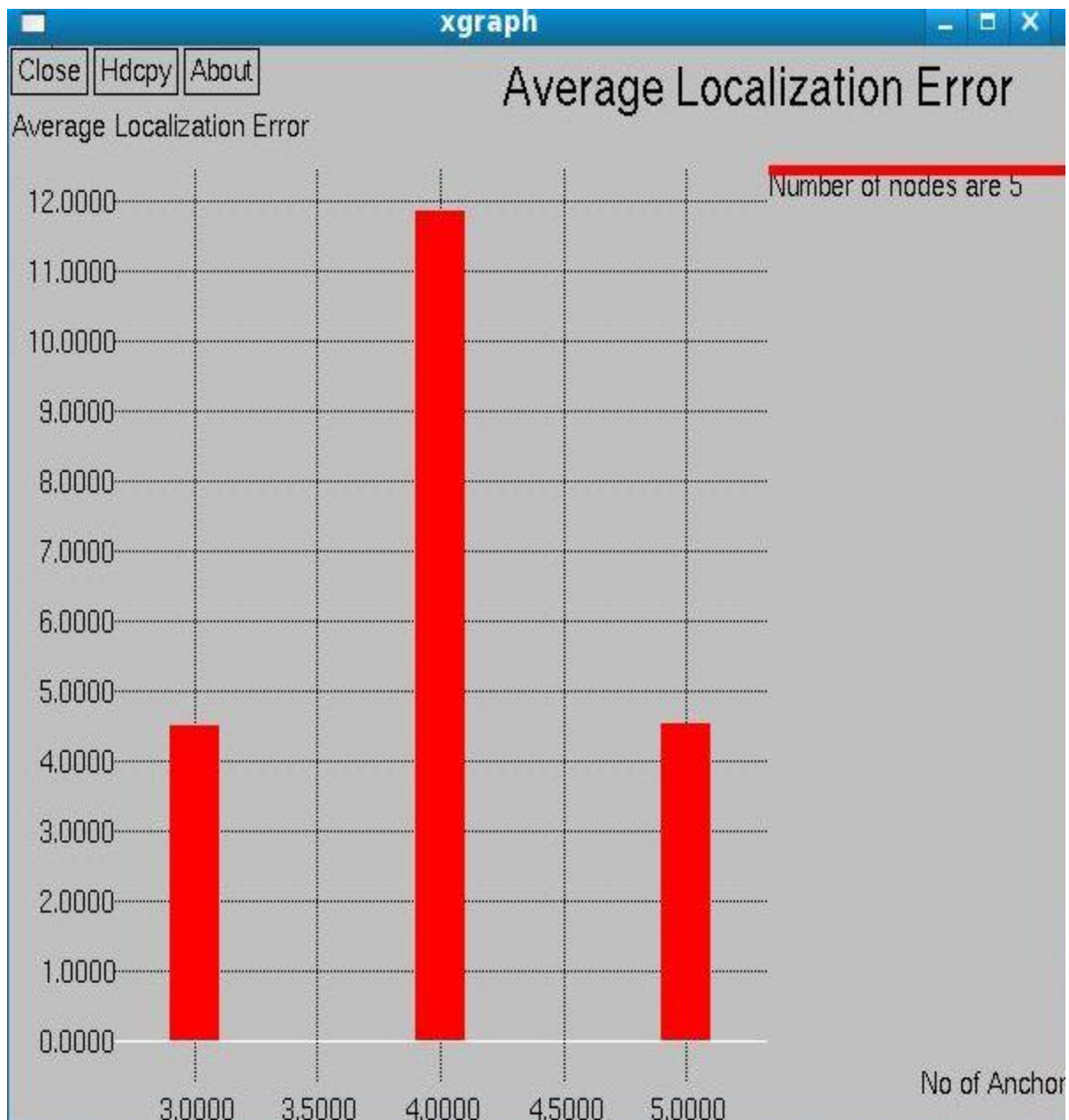
Time	Node no	Act X Cor	Act Y Cor	Est X Cor	Est Y Cor	Ref 1	Ref 2	Ref 3	Location Error
6.848507	6	500	499	502.1487	499.8513	1	2	2	0.192601
6.857211	6	500	499	502.1487	499.8513	1	2	2	0.192601
7.276474	6	500	499	502.1487	499.8513	1	2	2	0.192601
7.377827	3	399	598	428.6689	671.3311	1	2	2	6.592133
7.377827	4	601	599	554.5112	652.0688	1	2	2	5.879284
7.377827	5	300	498	308.9187	550.3673	1	2	3	4.426778
7.377827	7	700	498	644.0743	562.5057	1	2	3	7.114481
7.465479	7	700	498	694.8042	549.6958	1	2	3	4.329688
7.465479	4	601	599	573.3756	671.1244	1	2	2	6.436134
7.526435	7	700	498	694.8042	549.6958	1	2	3	4.329688
7.800969	3	399	598	428.6689	671.3311	1	2	2	6.592133
7.800969	4	601	599	573.3756	671.1244	1	2	2	6.436134
7.800969	5	300	498	308.9187	550.3673	1	2	3	4.426778
7.800969	7	700	498	694.8042	549.6958	1	2	3	4.329688
7.817718	6	500	499	502.1487	499.8513	1	2	2	0.192601
7.817718	3	399	598	428.6689	671.3311	1	2	2	6.592133
8.043639	5	300	498	308.9187	550.3673	1	2	3	4.426778
8.433244	6	500	499	502.1487	499.8513	1	2	2	0.192601
8.433244	3	399	598	428.6689	671.3311	1	2	2	6.592133
8.902477	7	700	498	694.8042	549.6958	1	2	3	4.329688
8.902477	4	601	599	573.3756	671.1244	1	2	2	6.436134
9.127696	5	300	498	308.9187	550.3673	1	2	3	4.426778
9.127696	3	399	598	428.6689	671.3311	1	2	2	6.592133
9.161627	6	500	499	502.1487	499.8513	1	2	2	0.192601



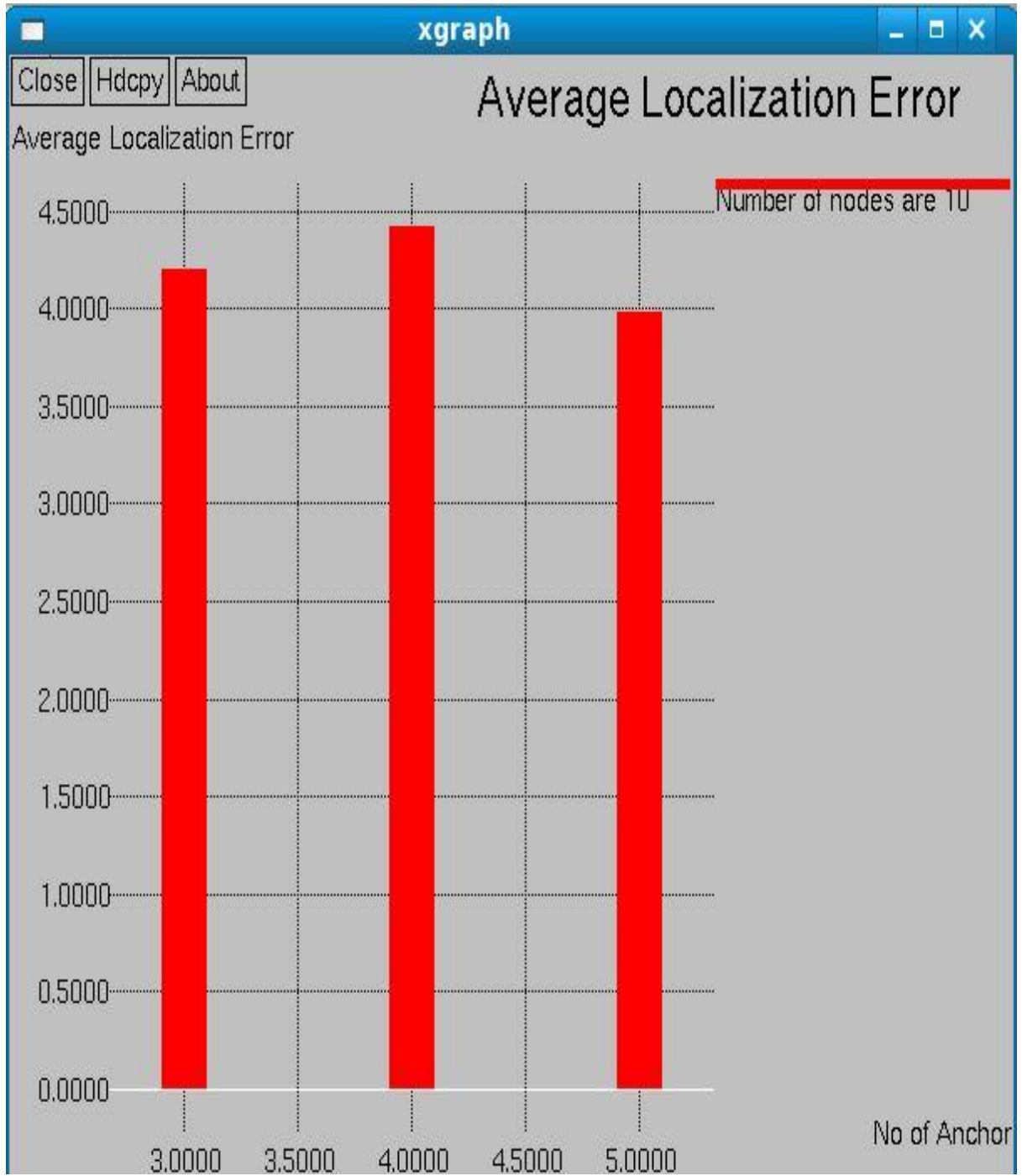
## PARAMETERS ON WHICH WE COMPUTED THE RESULTS

We have 4 scenarios on which we are analysing our results

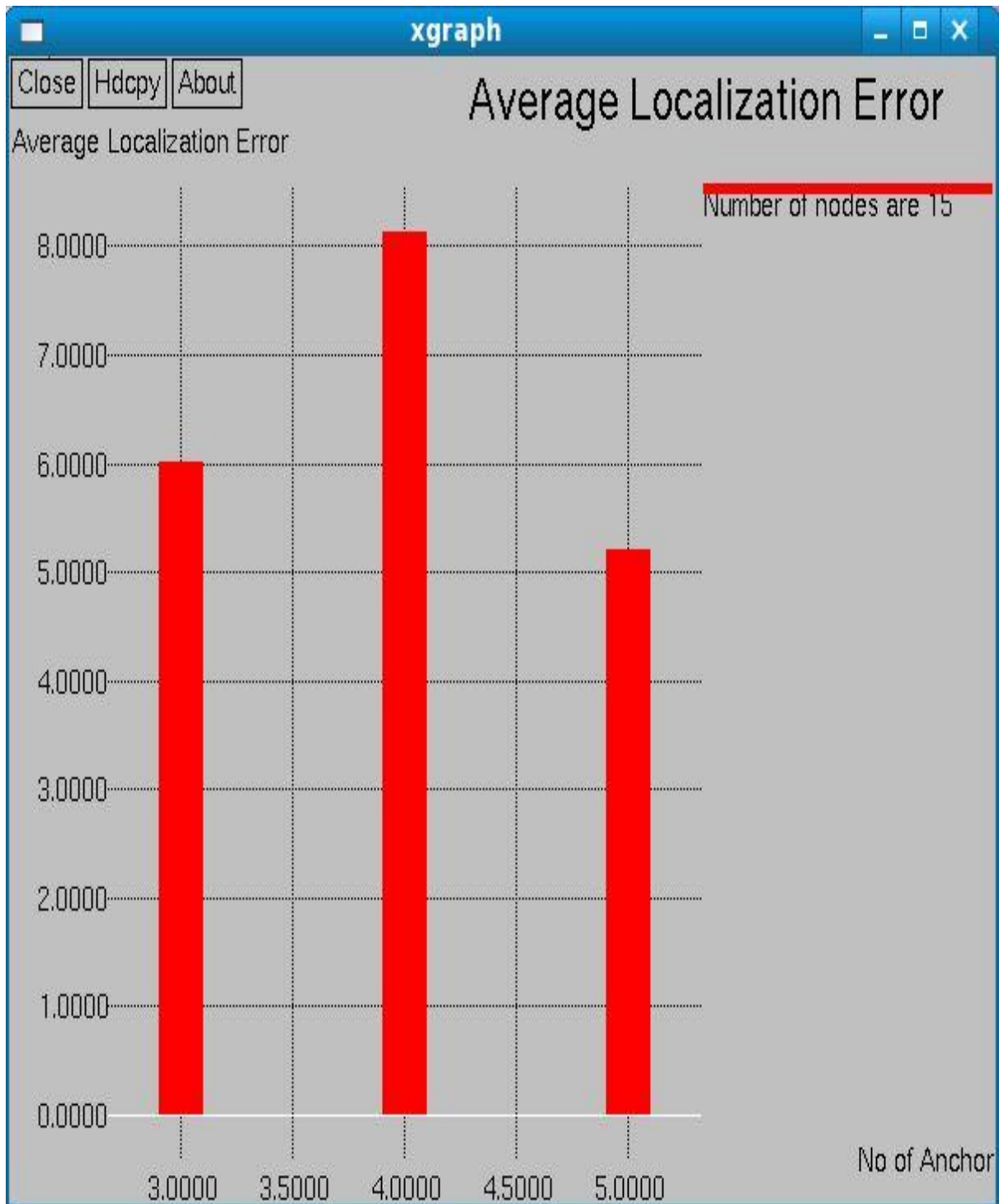
1. In first scenario we have 5 unknown nodes computed with 3, 4, 5 anchor nodes.



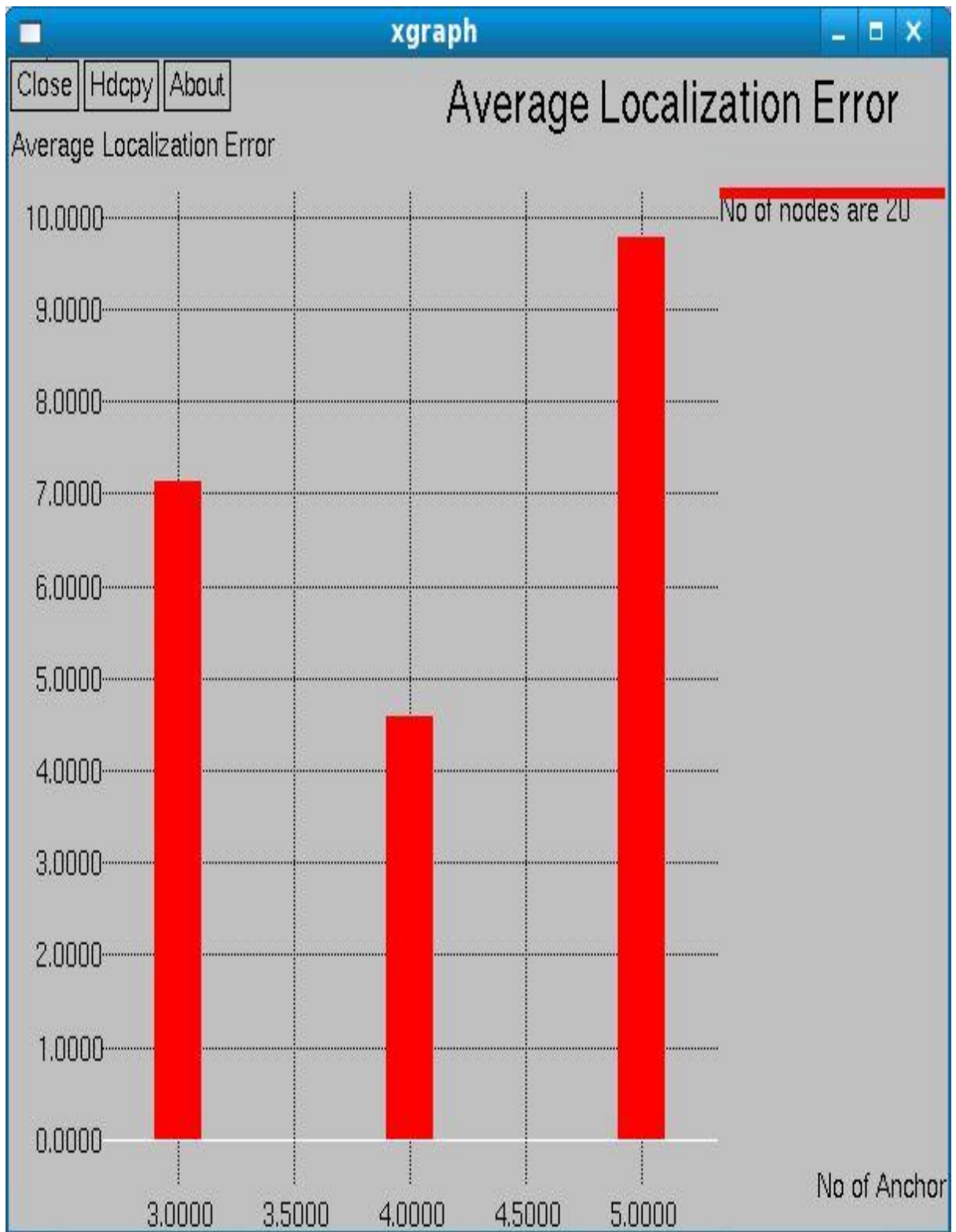
2. In Scenario 2 we have 10 unknown nodes computed with 3,4,5 anchor nodes



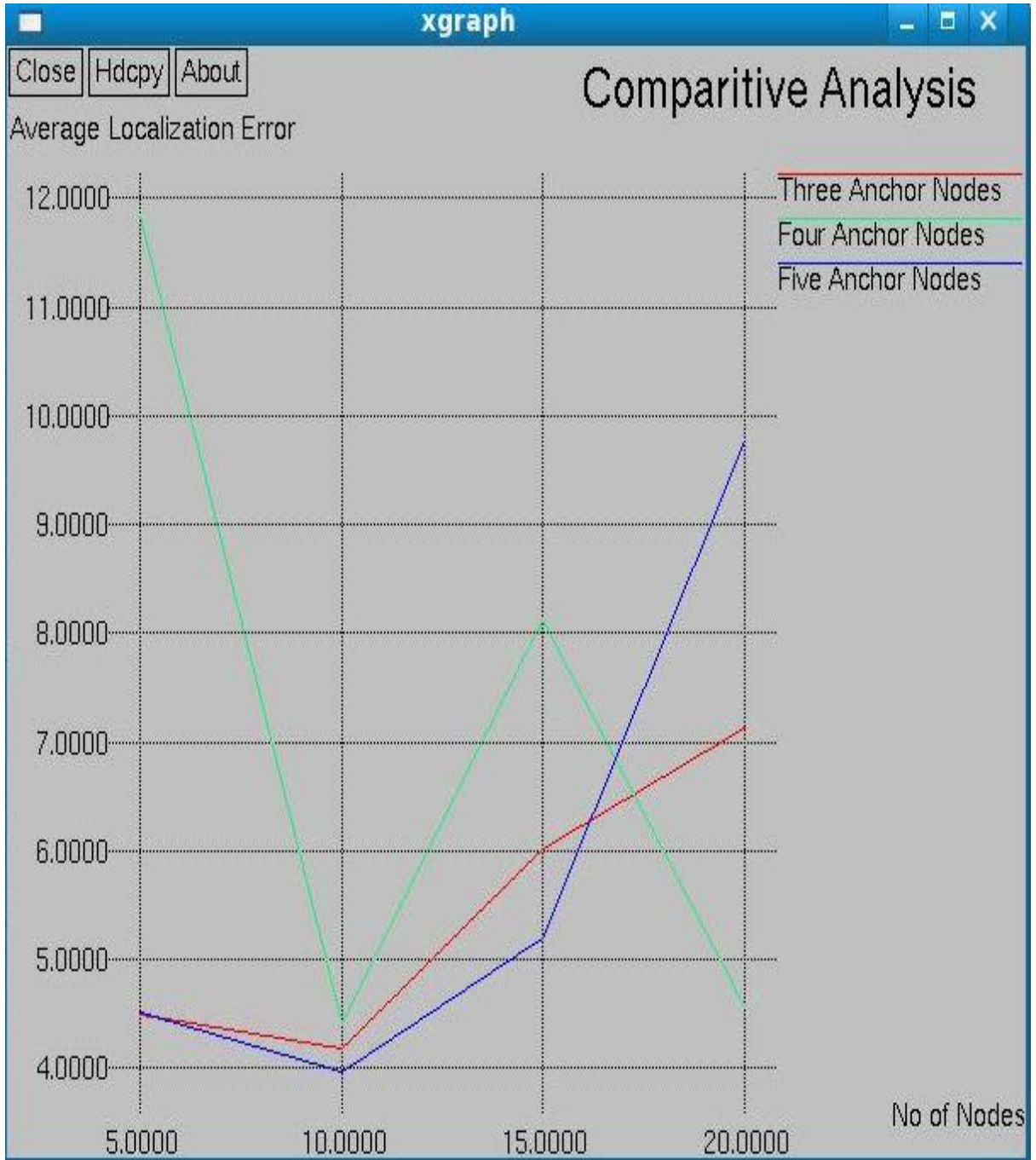
3. In scenario 3 there are 15 unknown nodes computed with 3,4,5 anchor nodes



4 In scenario 4 there are 20 unknown nodes computed with 3,4,5 anchor nodes



Comparitive analysis to compute the average localisation error based on above 4 scenarios



## CHAPTER 7

# FUTURE WORK AND CONCLUSION

---

The research work does focused upon the localization issue in the wireless sensor network. Considering the various types of localization algorithms focus has been drawn on range free localization Method. DV-Hop algorithm that was widely under research consideration has been taken as a challenge and conclusive results has been produced during the research work. Finally the variability of anchor nodes were taken and the drafted scenarios were evaluated on different parameters like no of anchor nodes in contrast to the anchor node availability. In the future work this work can be extended based on geometric mean instead of Average Localization error. Moreover time dependent localization can be another issue that can be addressed. Some insights can also be but on UWB signal based localization which is under the focus of various researchers these days.

# REFERENCES

1. Outlier Detection Khalid K. Almuzaini, Aaron Gulliver “Range-Based Localization in Wireless Networks Using Density-Based”2010.
2. Ahmed Abdulqader Hussein AL-Qaysi 1,2 and Tharek A. Rahman1”A Survey on Secure Range Based Localization Algorithms in Wireless Sensor Networks”2014.
3. Jin Fan, D,J Parish (2007)”Using a genetic algorithm to optimize the performance of a wireless sensor network” 2007 PGNNet.
4. Nagarajan.M and Dr . S. Karthikyan (2012) “A New Approach To Incerese the Life time and Efficiency of Wireless Sensor Network”2012 IEEE
- 5 . K.Ramesh (2011)”A Comparative Study of Cluster head Selection Algorithm In Wireless Sensor Networks” International journal of computer science and engineering survey (IJCSEC) Vol ,No4,November 2011.
6. Long Cheng “Distributed Minimum Transmission Multicast Routing Protocol for Wireless Sensor Networks” Nokia Research Center, Beijing, China
7. Gupta” Effect of Black Hole Attack on MANET Routing Protocols” I. J. Computer Network and information Security, 2013
- 8 Shayon Samanta<sup>1</sup>, Prof. Punesh U.Tembhare<sup>2</sup>, Prof. Charan R. Pote<sup>3</sup> “A Survey on 3d Localization in Wireless Sensor Networks”2013.
- 9 Tian He, Chengdu Huang, Brian M. Blum, John A. Stankovic, Tarek Abdelzaher” Range-Free Localization Schemes for Large Scale Sensor Networks”2003.
10. Weihua Sun, Hirozumi Yamaguchi, Keiichi Yasumoto and Minoru Ito “ Range-based Localization for Estimating Pedestrian Trajectory in Intersection with Roadside Anchors”2009.
11. Kiran Yedavalli and Bhaskar Krishnamachari “Sequence-Based Localization in Wireless Sensor Networks”2008.
12. Mark Cummins Paul Newman “FAB-MAP: Probabilistic Localization and Mapping in the Space of Appearance”
13. Avinash Srinivasan and Jie Wu Florida Atlantic University, Boca Raton, FL, USA “A Survey on Secure Localization in Wireless Sensor Networks”

14. Noha El Gemayel, Sebastian Koslowski, Friedrich K. Jondral “A low cost TDOA localization System: Setup, Challenges and Results”
15. Ke Tian, Baoxian Zhang, Hussein Mouftah, Zhuang Zhax and Jian Ma(2009) “Destination-Driven On-Demand Multicast Routing Protocol for Wireless Ad Hoc Networks” IEEE ICC 2009.
16. Real-Time Computing Laboratory Department of Electrical Engineering and Computer Science The Anees Shaikh and Kang G. Shin () “Destination-Driven Routing for Low-Cost Multicast ” University of Michigan Ann Arbor.
17. D Niculescu, B Nath. Ad-Hoc Positioning System (APS)[J].IEEE Global Telecommunications, 2001, 5: 2926-2931.
18. C. K. Toh, “Ad Hoc Wireless Networks”, Prentice Hall, 2002
19. D. P. Agrawal and Qing-An Zeng, , “Wireless & Mobile Systems”, Thompson/Brooks Cole, 2003