Visitor Tracking System using Mobile Ad hoc Network

BY

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Visitor Tracking System using Mobile Ad hoc Network

Major Project

Submitted in partial fulfillment of the requirements

For the degree of

Master of Technology in Computer Science and Engineering

By

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Guide

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May 2014

Undertaking for originality of the work

I, Sudha B. Patel, Reg.No. 11MCEC52 , give undertaking that the Major Project entitled "Visitor Tracking System using Mobile Ad hoc Network" submitted by me, towards the partial fulfillment of the requirements for the degree of Master of Technology in Computer Science and Engineering of Nirma University, Ahmedabad, is the original work carried out by me and I give assurance that no attempt of plagiarism has been made. I understand that in the event of any similarity found subsequently with any published work or any dissertation work elsewhere; it will result in severe disciplinary action.

Sudha B. Patel (11MCEC52)

Date: 23-5-2014

Place: Institute of Technology, Nirma University

Certificate

This is to certify that the Major Project entitled "Visitor Tracking System using Mobile Ad hoc Network" submitted by Sudha B. Patel (11MCEC52), towards the partial fulfillment of the requirements for the degree of Master of Technology in Computer Science and Engineering of Nirma University, Ahmedabad is the record of work carried out by her under my supervision and guidance. In my opinion, the submitted work has reached a level required for being accepted for examination. The results embodied in this major project, to the best of my knowledge, haven't been submitted to any other university or institution for award of any degree or diploma.

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Abstract

A Visitor Tracking system using an Ad hoc network and Infrastructure in which a set of domain nodes shares the responsibility for producing and storing monitoring information about a set of visitors. This information is stored gradually when the set of visitor nodes grows and shrinks. Such a system can be used to store monitoring information of visitors and maintain the traffic through monitoring system by deciding the threshold value for number of visitors. The feature of system include: Counting the number of visitors through monitors located at every entry/exit points, Track the visitors at a particular place, and the approx location of individual visitor at the time of natural disaster and storing this information in a persistent, efficient and searchable manner. The database must be such that the administrator can search all the information and details of the visitor at any given point of time. The records in the database must be persistent such that entries are not affected by the network disruption or lost due to the same. The algorithm for maintaining the database should run with minimal message and computational overhead.

Acknowledgements

With immense pleasure, I would like to present this report on the dissertation work related to "Visitor Tracking System Using Mobile Ad hoc Network".
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- Sudha B. Patel (11MCEC52)

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Abbreviation Notation

MANET ..... Mobile Ad-Hoc Network
IU ..... Infrastructure Unit
RFID ..... Radio Frequency Identification
IC ..... Integrated circuit
EPC ..... Electronic Product Code

List of Tables

Chapter 1

Motivation

1.1 Motivation

Disasters whether natural or man-made can strike at any time. The importance of adequate emergency management is acknowledged by most countries in the world. Disasters have always happened and they will continue to. The cause of such emergencies could be natural disasters like flooding, earthquakes, volcanoes etc. Man-made disasters like terrorist attacks, industrial disasters, radiation contamination, etc. have increased dramatically in recent times. The impact can be reduced through a good understanding of preventive actions. So at tourist places for control the total damage of life and belongings I have decided the threshold value for the tourists. So at the time of disaster at least we have an idea regarding to the number of visitors inside the place. By the pre disaster setup we can identify the location of individual visitor in persistent manner. It is very crucial to find out the human being after the disaster was happened at the tourist places, so through the system at least I can identify the approximate location of visitor in the place.

1.2 Thesis Outline

In Chapter 2, literature survey of related work and various location tracking systems are presented. In Chapter 3, problem definition is given.

Chapter 2

Literature Survey

2.1 Introduction

A mobile ad hoc network is a self-configuring infrastructure less networks of mobile devices. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently[1]. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet.

2.1.1 MANET Application Areas

Following are the different application areas where MANET can be used [2].

Table I: MANET Application area

Application	**Possible scenarios/services**
Tactical networks	Military communication and operations Automated battlefields
Emergency services	Search and rescue operations,Disaster recovery,Replacement of fixed infrastructure in case of environmental disasters,Policing and fire fighting,Supporting doctors and nurses in hospitals
Commercial and civilian environments	E-commerce: electronic payments anytime and anywhere Business: dynamic database access, mobile offices Vehicular services: road or accident guidance, transmission of road and weather conditions,taxi cab network, inter-vehicle networks Sports stadiums, trade fairs, shopping malls Networks of visitors at airports
Home and enterprise networking	Home/office wireless networking Conferences, meeting rooms Personal area networks (PAN), Personal networks (PN) Networks at construction sites
Education	Universities and campus settings Virtual classrooms Ad hoc communications during meetings or lectures
Entertainment	Multi-user games Wireless P2P networking Outdoor Internet access Robotic pets Theme parks
Context aware services	Follow-on services: call-forwarding, mobile workspace Information services: location specific services, time dependent services Infotainment:touristic information

2.1.2 Characteristics of MANET

- Autonomous and infrastructure less
- Multi-hop routing
- Dynamic network topology
- Device heterogeneity
- Energy constrained operation
- Bandwidth constrained variable capacity links
- Limited physical security
- Self-creation, self-organization and self administration

2.1.3 Introduction to Hybrid network

A hybrid network is a local area network having a mix of both wired and wireless devices[3][4] [5].Common hybrid network components include routers, repeaters, hubs, bridges, switches, modems and cables.

2.2 Broadcasting mechanisms and suggested approaches

Broadcast mechanisms for data dissemination are as follows [6]:

Simple Flooding

- Probability based approach
- Counter based scheme

Area Based Methods

- Distance based approach
- Location based approach

Neighbour Knowledge Methods

- Self Pruning
- Scalable Broadcasting Approach
- Ad Hoc Broadcasting Approach

2.3 Various location tracking approaches

Comparison between various locations tracking system as given in following table.

Table II: Comparison between various locations tracking system

Location Tracking Approach	**Mechanism**	**Pros.**	**Cons.**
Patient movement tracking system[7]	Track the location of patients in an indoor environment and monitor their physical status i.e. walking, running.	• We can track an individual patient in the organized network • Also track the motion or the movement of the patient like walking, running etc	• Localization network which required multiple power consuming sensors • The use of a relatively large mobile node • The power and running lifetime of the mobile node
Visitor tracking in theme park[8]	In this system, the model of the movement of visitors in a theme park	It decreases the number of waypoints in a map and allowing the simulation of a large number of visitors	It uses trace based model so it uses GPS for tracing. It is difficult to collect real data and the amount of publicly available data is limited.
Visitor face tracking system[9]	This system will record the visitor face by camera	Track the face of the visitor at various places	Visitor needs to appear in front of the camera for at least 10 seconds so it is time consuming process
RFID Based Equipment Monitoring System[10]	Tracking of laboratory equipments movement to ensure its availability	It aims at helping the lab administrator in monitoring the equipment from lost or misplaced	• Reader collision when the signals from two or more readers overlap • The tag is unable to respond to simultaneous queries

Table III: Comparison between various locations tracking system

Location Tracking Approach	**Mechanism**	**Pros.**	**Cons.**
Online Student Monitoring System Using Passive RFID (GUI based)[7]	Online student monitoring system to ensure the availability of the students in the campus	• Improving the current tradition way of monitoring the students • Used GUI interface so it is more efficient way to review the attendance • Easy to handle and convenient for college/university level • This system gives time saving, easy to control and reliability	• Reader collision when the signals from two or more readers overlap • The tag is unable to respond to simultaneous queries
Boarding school students monitoring systems using RFID[11]	Monitoring Boarding school student movement using by using RFID technology	It can ease the workload of school management and save time	• Cannot control the punctuation of student • Reader collision when the signals from two or more readers overlap • The tag is unable to respond to simultaneous queries

2.4 RFID

2.4.1 Introduction of RFID

RFID stands for radio frequency identification. It is an automatic identification technology whereby digital data encoded in an RFID tag or "smart label" is captured by a reader using radio waves. Put simply, RFID is similar to bar code technology but uses radio waves to capture data from tags, rather than optically scanning the bar codes on a label. RFID does not require the tag or label to be seen to read its stored datathat's one of the key characteristics of an RFID system [12][13].

Information is sent to and read from RFID tags by a reader using radio waves[14][15][16]. In passive systems, which are the most common, an RFID reader transmits an energy field that "wakes up" the tag and provides the power for the tag to respond to the reader. In active systems, a battery in the tag is used to boost the effective operating range of the tag and to support additional features over passive tags, such as temperature sensing. Data collected from tags is then passed through communication interfaces (cable or wireless) to host computer systems in the same manner that data scanned from bar code labels is captured and passed to computer systems for interpretation, storage, and action.

Passive smart label[12][16] [13] RFID systems offer unique capabilities as an automatic data capture system in that they: Provide real-time, wireless transmission of data without human intervention; Do not require line-of-site scanners for operation; Allow stored data to be altered during sorting or allow workflow process information to be captured with the data; and Work effectively even in harsh environments with excessive dirt, dust, moisture, and extreme temperatures.

2.4.2 RFID tag

RFID tags consist of an integrated circuit attached to an antennatypically a small coil of wiresplus some protective packaging (like a plastic card) as determined by the application requirements. Tags also sometimes are called "transponders," and sometimes they are called "inlays," although technically an inlay is a tag mounted on a substrate that is ready to be converted into a smart label. RFID tags can come in many forms and sizes[17]. Some can be as small as a grain of rice. Data is stored in the IC and transmitted through the antenna to a reader. RFID tags are either "passive" (no battery) or "active" (self-powered by a battery). Tags also can be read-only (stored data can be read but not changed), read/write (stored data can be altered or rewritten), or a combination, in which some data is permanently stored while other memory is left accessible for later encoding and updates[18].

2.4.3 RFID-Frequencies

RFID tags are also available in various frequencies[19]. These include low frequency (LF), high frequency (HF), ultra-high frequency (UHF), and ultra-wide band (UWB). Typically, higher frequencies offer more bandwidth and data exchange, and a higher communication range.The radio frequency table is as given below.

Table IV: RFID-Frequencies table

Type of tag	**EPC(Electronic Product code)class**	**Memory type**	**Radio frequencies used**	**Word Length Bits**	**Power source**	**Reading Distance Meters**
RFID passive	0	ROM	138KHz 13.85MHz	64	Reader EMF	0.04-3
RFID Active	4	ROM	13.85MHz	64	Battery	3-10
RFID passive programmable	1	EEPROM	138KHz 13.85MHz 96	more than 128	Reader EMF	0.04-3
RFID active programmable	2,3,4	EEPROM	138KHz 13.85MHz	more than 128	Battery	3-10
Data tag	2,3,4	CMOS RAM, Flash RAM	13.85MHz 985MHz(UHF)	more than 128	Battery	3-10
RF location	-	EEPROM or CMOS RAM	303Mhz 2.4/5.8 GHz UWB	64	Battery	1-100

2.4.4 Difference between Passive tag and Active tag

The differences between Passive and active tags are as given below:

Table V: Difference between Passive tag and Active tag:

Passive tag	**Active tag**
Operate without a battery	Powered by an internal battery
Less expensive	More expensive
Unlimited life (because of no battery)	Finite lifetime(because of battery)
Less weight(because of no battery)	Greater weight(because of battery)
Lesser range(up to 3-5m, usually less)	Greater range(up to 100m)
Lesser range(up to 3-5m, usually less)	Greater range(up to 100m)
Subject to noise	Better noise immunity
Derive power from the electromagnetic field generated by the reader	Internal power to transmit signal to the reader
Require more powerful readers	Can be effective with less powerful readers
Lower data transmission rates	Higher data transmission rates
Less tags can be read simultaneously	More tags can be read simultaneously
Greater orientation sensitivity	Less orientation sensitivity

Chapter 3

Problem Introduction

3.1 Problem Definition

To develop a Visitor Tracking System in Ad hoc infrastructure/infrastructureless network.

3.2 Assumptions

- All visitors have RFID tag
- Movement of visitors is independent with respect to each other.
- All infrastructures are directly or indirectly connected to the monitor
- Monitor is having Internet facility.

3.3 Objectives

- To form a network for defining the number of visitors inside any tourist places
- To develop a location tracking system to maintain the track of every individuals

3.4 Intended outcome

- Designed and evaluation of proposed mechanism
- A system will be developed which provides details of visitors at a specific location. At the time of disaster we are able to know the number of visitors at tourist place and approx location of individual visitor at the time of natural disaster and storing this information in a persistent, efficient and searchable manner

3.5 Proposed approach

Figure 3.1 shows the model of Visitor Tracking System. There are three entry/exit points and 6 Infrastructure units. All the visitors have RFID Tags and broadcasts its own information. When the visitor is in the vicinity of an infrastructure, the information broadcasted by visitor will be stored into the infrastructure's own file and sends that information to the Monitor.

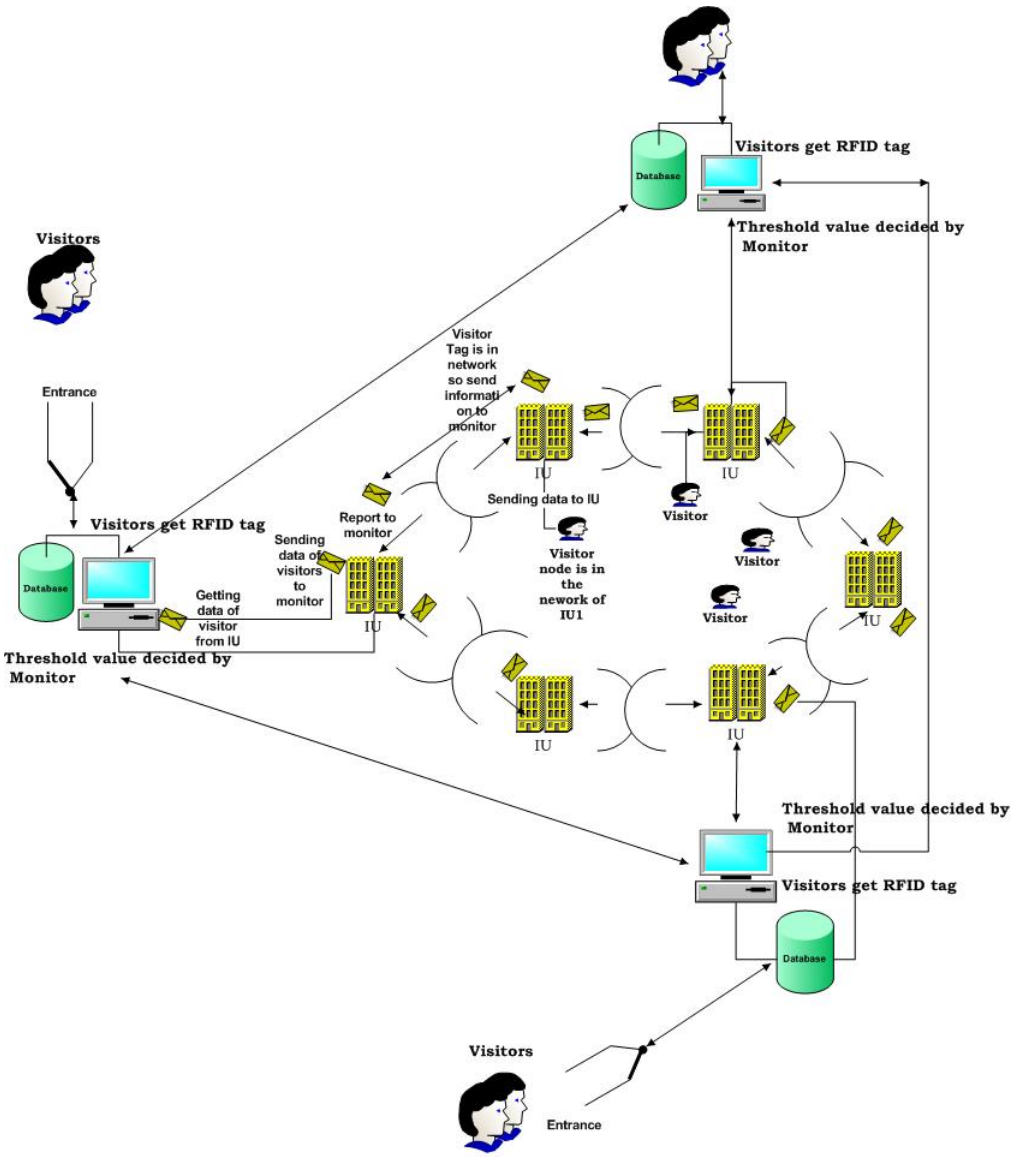

Figure 3.1: Life Saving application model

3.6 Modules of the system

3.6.1 Monitoring module by monitor

- Define the threshold value for number of visitors will be allowed at tourist place
- Issue the tag for new user with the consideration of threshold value
- Gets the information from Infrastructure unit regarding visitor
- Monitor send (Broadcast) query or request to the Infrastructure for individual visitor at a particular location, if visitor is in vicinity of infrastructure then infrastructure will reply to the monitor for tracking the visitors
- Once received information from infrastructure units, update user information in the database
- At the time of disaster give approx location of visitors
- Monitor upload all the information on the internet.

3.6.2 Infrastructure unit

- Once received the message from visitors through tag, the location and visitor tag information is sending to the Monitor from infrastructure unit
- Once received search request from monitor, send appropriate information of visitor to the monitor

3.6.3 Visitors

- Periodically broadcast its own information when he or she is in the vicinity of the infrastructure

3.7 Algorithm for Visitor tracking system

[Monitor Module]

```
Step1: [Initialize Process for pre-setup]

No_users=0;
Threshold_value=N;
No_Infrastructure=5
No_monitor= 1
L_id[No_Infrastructure index]
L_mid[Monitor index]

Step2:[Registration of Visitor]

"Check for threshold":
if No_users <= Threshold_value then
   Insert the details in to the database:
   <Visitor_id(Serial_ No),Visitor_name,Date,Time_arrival,
    Leaving_time, tag_id, Address,Phone_no>
   Issue the tag to visitor manually with <TAG (visitor_id, tag_id)>
else
    go to Step2

Step3: [Insert information to the database of Monitor]

"Compare the visitor details detected and provided by all L_id:"
if(Visitor_id,tag_id already exist for particular L_id)
  {
```

```
  Update the information of File1 with <L_id, time>
  }
else
  Make new entry into File2 with all tracking detail for all L_id with
  <tag_id, visitor_id, L_id, time>

Step4: [Search for Request]
-Request()
if (Request for V_id ,L_id, time from L_mid)
   {
   <request to all infrastructure for L_id of V_id for specific time>
   }
-Reply()
if (requested V_id is found from L_id)
   {
    print V_id and Tag_id with L_id
store V_id and Tag_id with L_id in search_file
   }

Step5: [Monitor send information to internet]
       Monitor is having internet facility
```

[**Visitor Module**]

```
Step1:[Get tag(tag_id) form monitor]
      <get registered and get tag from monitor>

Step2:[Start Moving]
      Broadcast the information
```

```
      <BROADCAST(tag_id, visitor_id )>
```

[**Infrastructure Module**]

```
Step1:[Establish all Infrastructure]
      <Infrastructures have their own L_id>

Step2:[insert into DATABASE]
 if(V_id FOUND)
   {
   insert into database(V_id,L_id,time)  and
   Send ACK of visitor detection to Monitor with L_id,Visitor_id,tag_id,time
   }

Step3:[Search for Request]
if(request FOUND for L_id of V_id)
  {
  Give response to the monitor for L_id, time of V_id,tag_id
  }
```

3.8 Flowchart of the system

3.8.1 Flowchart for Infrastructure Unit

Figure 3.2 shows the flow chart of an Infrastructure Unit. All the infrastructure unit stores the information of the visitors into their own file and sends the information of all visitors, who are in the vicinity of it's own to the monitor.

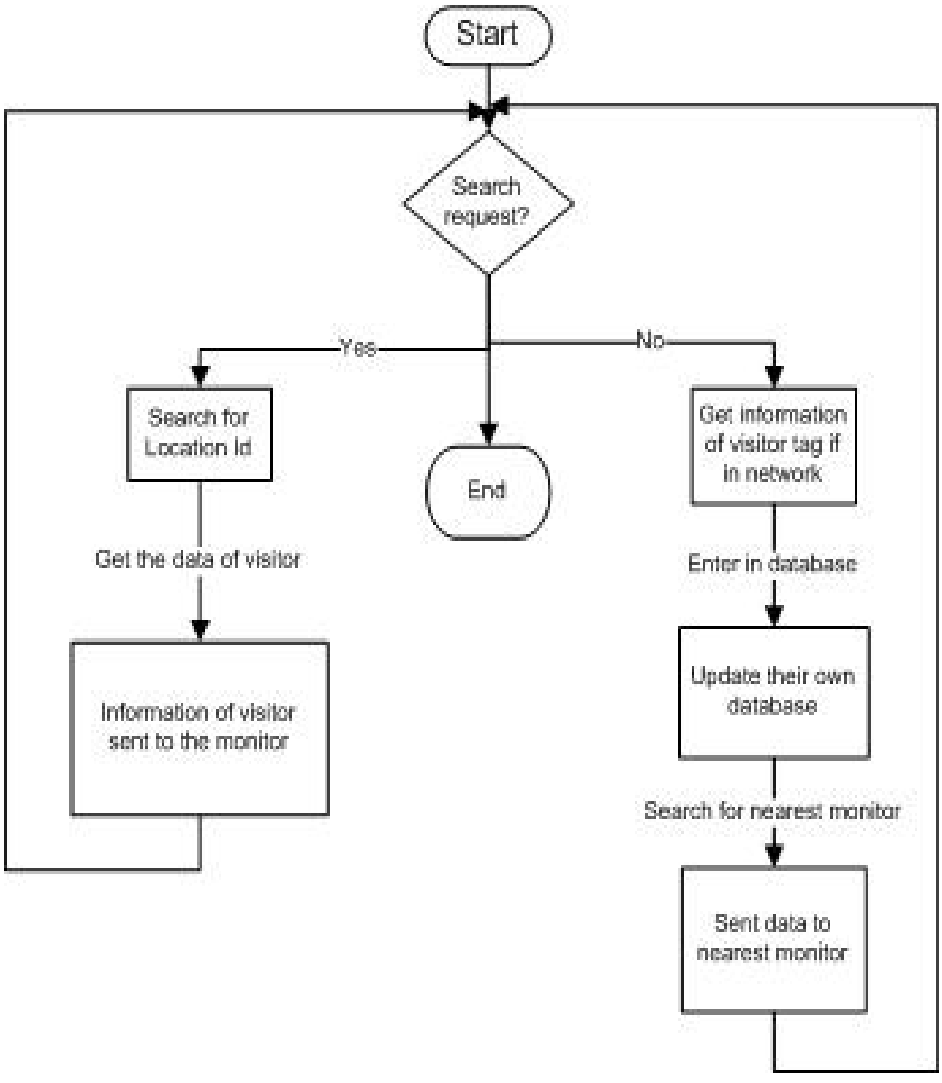

Figure 3.2: Flow chart of Infrastructure Unit

3.8.2 Flowchart for Monitor

Figure 3.3 shows the flow chart of the monitor unit. Monitor stores the information of all the visitors and can search the individual visitors' details.

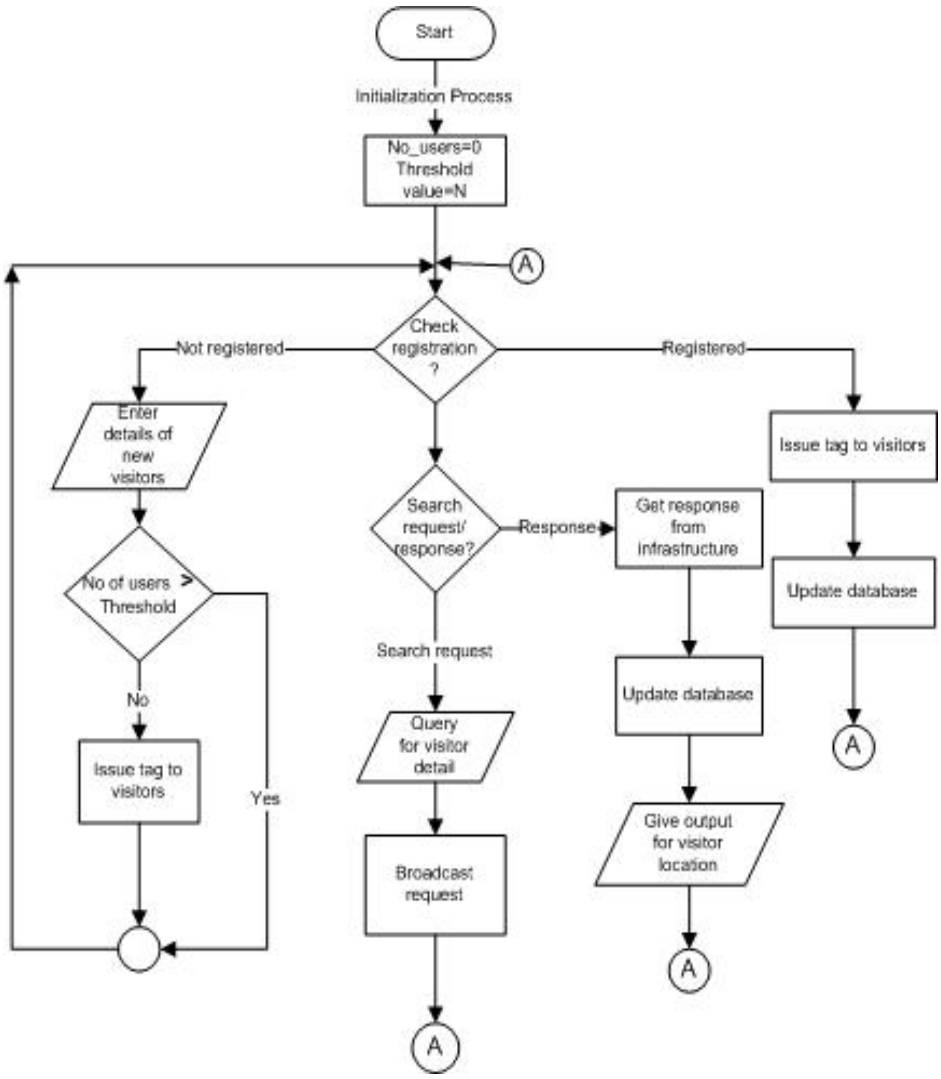

Figure 3.3: Flow chart of Monitoring Unit

3.8.3 Flowchart for Visitor

Figure 3.4 shows the flow chart of the visitor unit. All the visitor have RFID Tag issued by monitor. RFID Tag continuously broadcasts the information of its own.

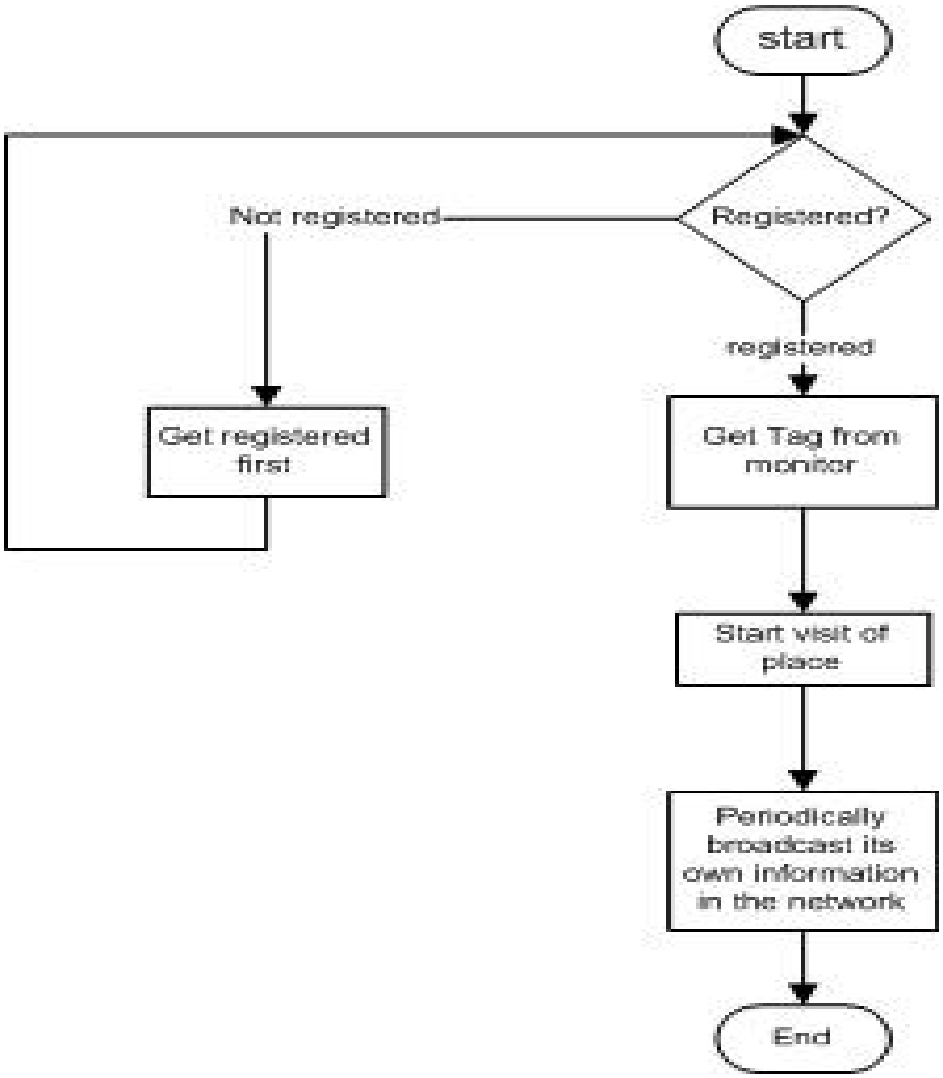

Figure 3.4: Flow chart of Visitor

Chapter 4

Network Simulators

4.1 Network Simulators

4.1.1 NS-2.34

It is a discrete event simulator[20] [21] [22] developed by the VINT project research group at the University of California at Berkeley.The simulator was extended by the Monarch research group at Carnegie Mellon University to include: (a) node mobility, (b) a realistic physical layer with a radio propagation model, (c) radio network interfaces, and (d) the IEEE 802.11 Medium Access Control (MAC) protocol using the distributed coordination function (DCF).

Steps to install NS-2.34 in Fedora

a. Download NS2.34.

b. Copy the file to /home/yourhome (in my case it is, /home/sudha/).

c. Open terminal.

d. Untar it using tar zxvf ns-allione-2.34.tar.gz.

e. cd ns-allione-2.34/

f. ./install

g. Once installation over, set the PATH.

4.1.2 Create a new agent in NS2.34

A new agent created in ns2.34.[21] Follow the following steps to create a new agent in ns2: **Steps to create a new agent in ns2.34**

a. Create a myagent.cc and myagent.h files.

b. Put both files in NS2.34 folder.

c. Add MyPing object filename to the end of OBJECT CC list in Makefile.

d. Initialize packet size in ns-default.tcl.

e. Define the new packet type in packet.h.

f. Go NS2.34 folder.

g. Perform first make clean then make and make install.

h. Write MyAgent.tcl file to test newly created agent.

Chapter 5

Implementation

5.1 Implementation of VIS, INF and MON Agents

5.1.1 VIS Agent

In this topology two base stations are fixed and three visitors nodes are moving node.Three Visitor nodes are moving across 250*250 meters.The speed of moving nodes is approximately 15m/Sec.

Figure 5.1: VIS Agent Broadcasting information

In this topology total five base stations are fixed and 25 visitors nodes are moving node.The speed of moving nodes are approximately 15m/sec.

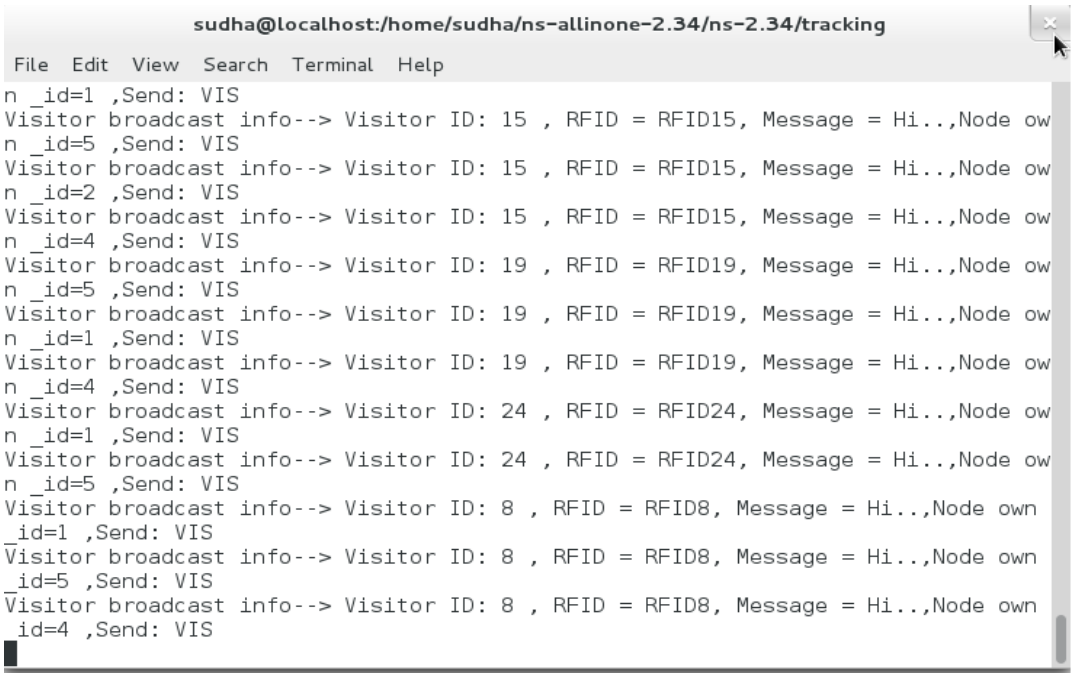

Figure 5.2: VIS Agent Broadcasting information(1)

5.1.2 INF Module

In this topology, total 100 moving nodes as visitor nodes and 5 nodes as fixed nodes are established in 5000*5000 meter area. The speed of moving node is 15 m/sec to 20 m/sec. All the infrastructure units have their own database in which all the details of visitors is maintained. All Infrastructure have two files to maintain the record. One "Viscur.txt" in which only current location of the visitor is maintained and the second file "Vishis.txt", in which all the tracking details are maintained. The search operation is performed accordingly.

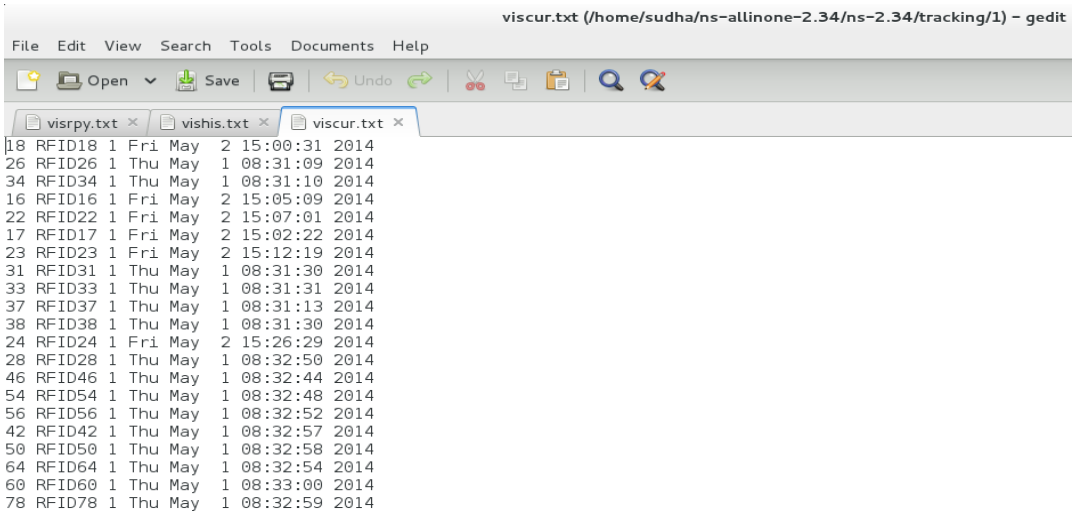

Figure 5.3: INF Agent store current information

As shown in Figure 5.4, infrastructure unit '1' has viscur.txt file to store the current location of the visitor who are in the vicinity of its own at different time.

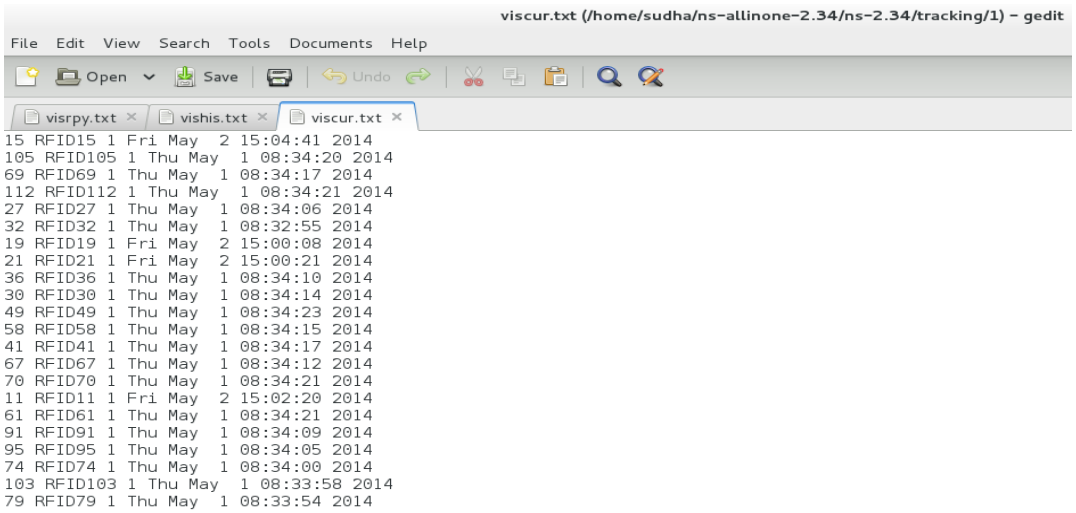

Figure 5.4: INF Agent store current information(1)

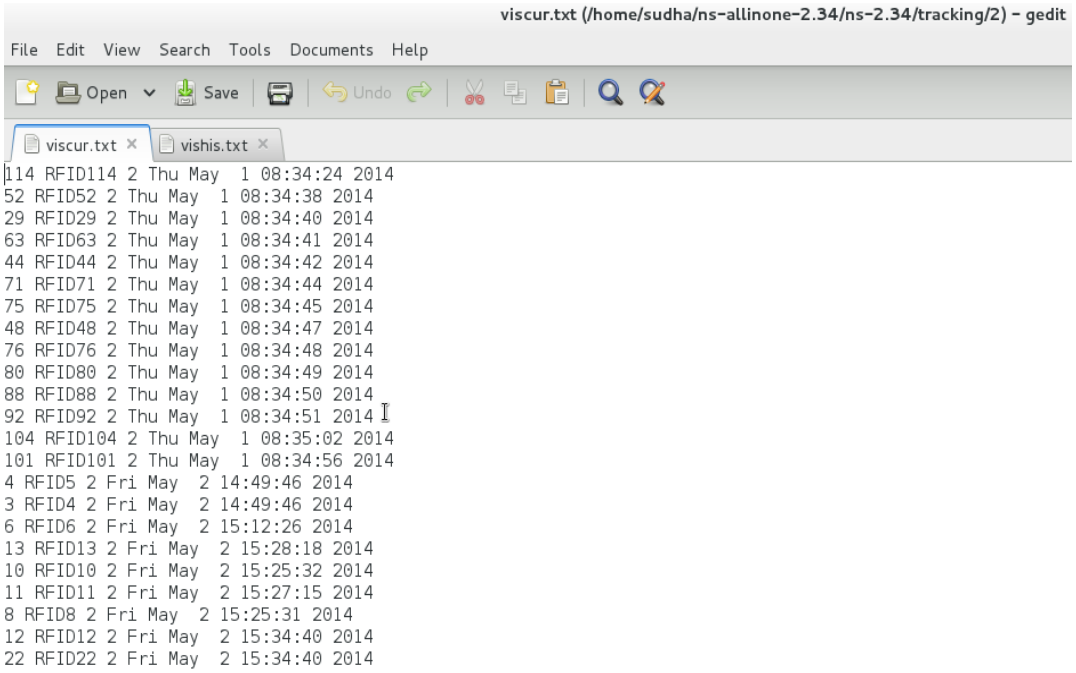

Figure 5.5: INF Agent store current information(2)

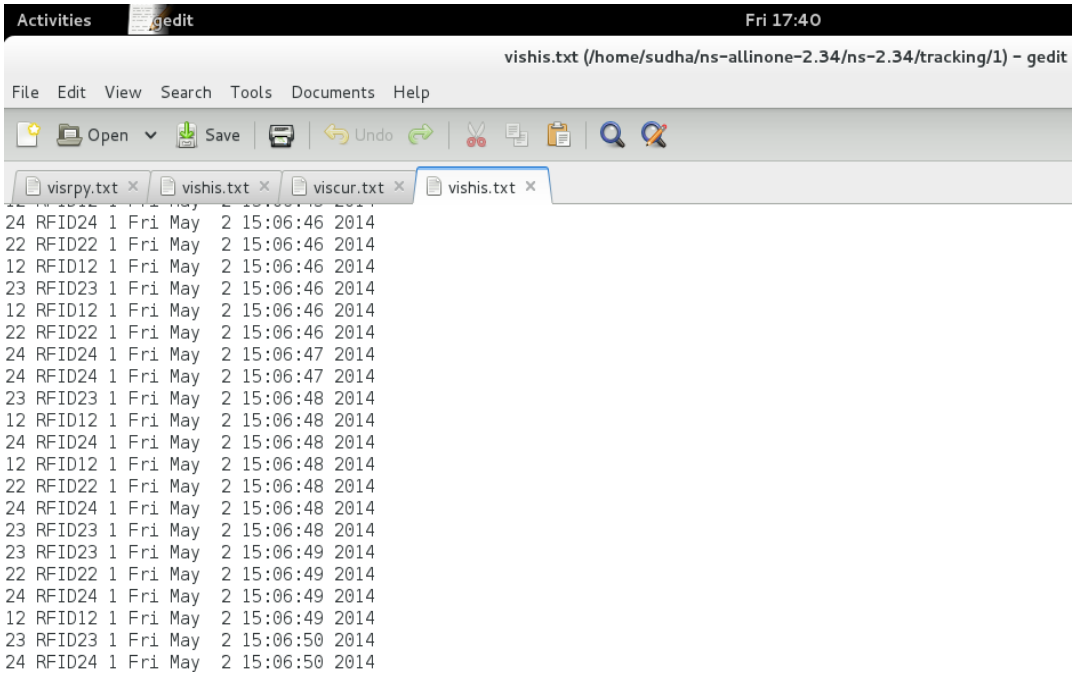

Figure 5.6: INF Agent store history

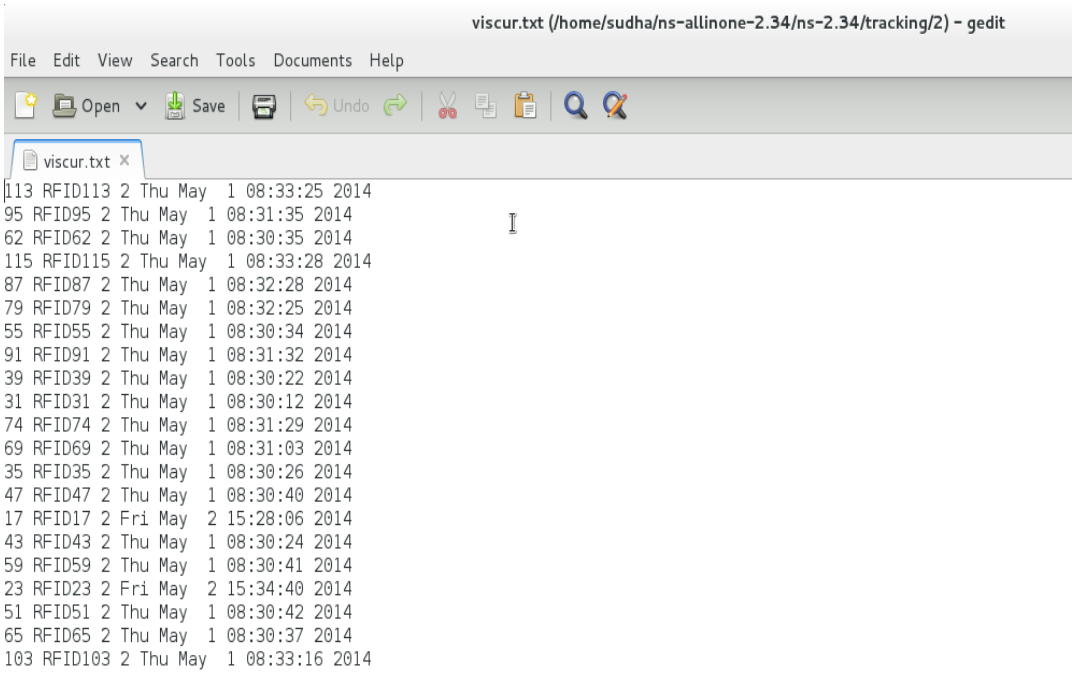

Figure 5.7: INF Agent store current location

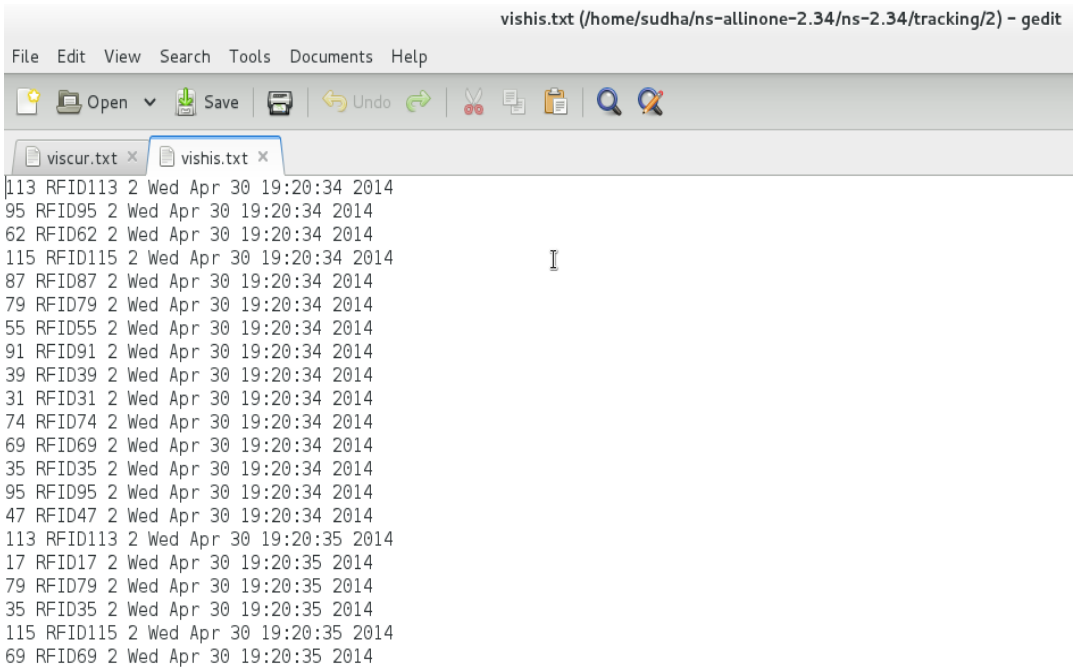

Figure 5.8: INF Agent store history

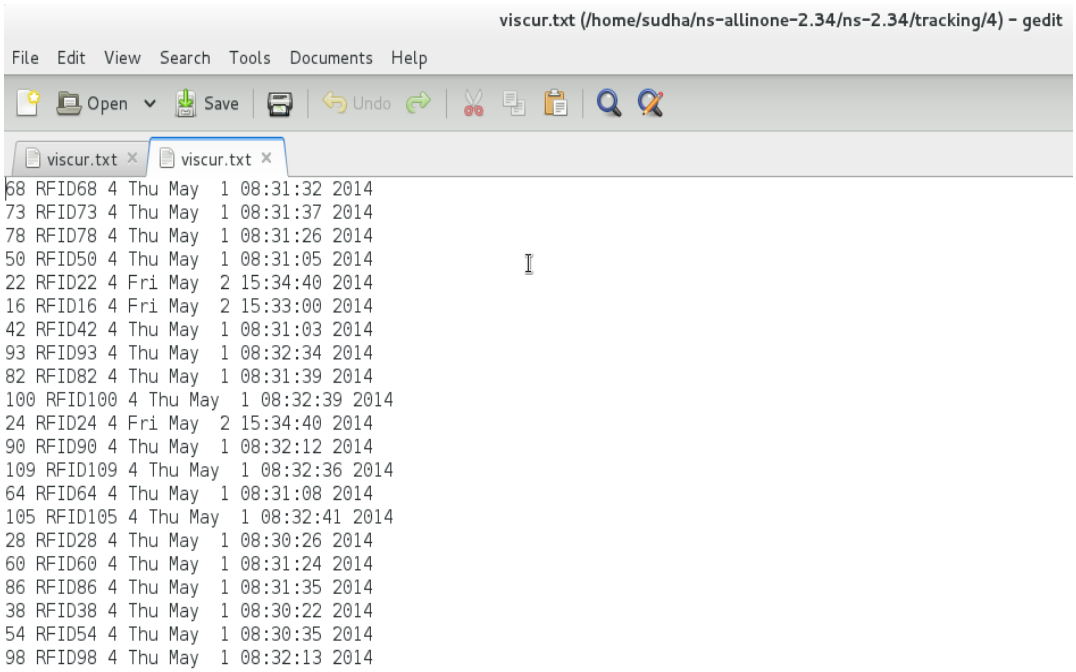

Figure 5.9: INF Agent store current location

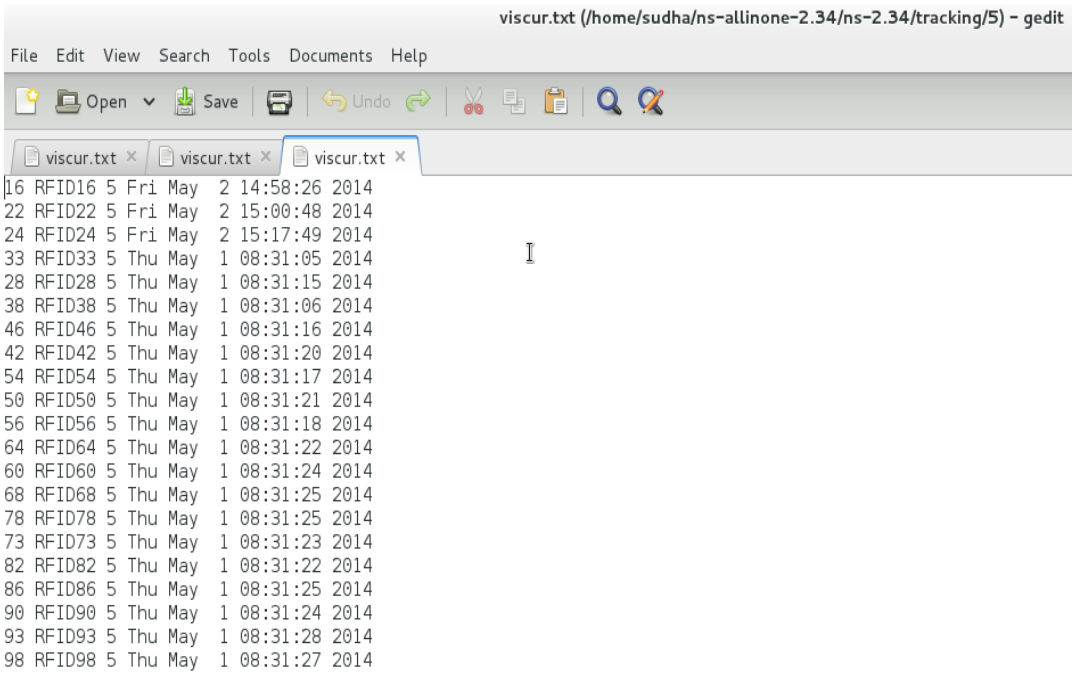

Figure 5.10: INF Agent store current location

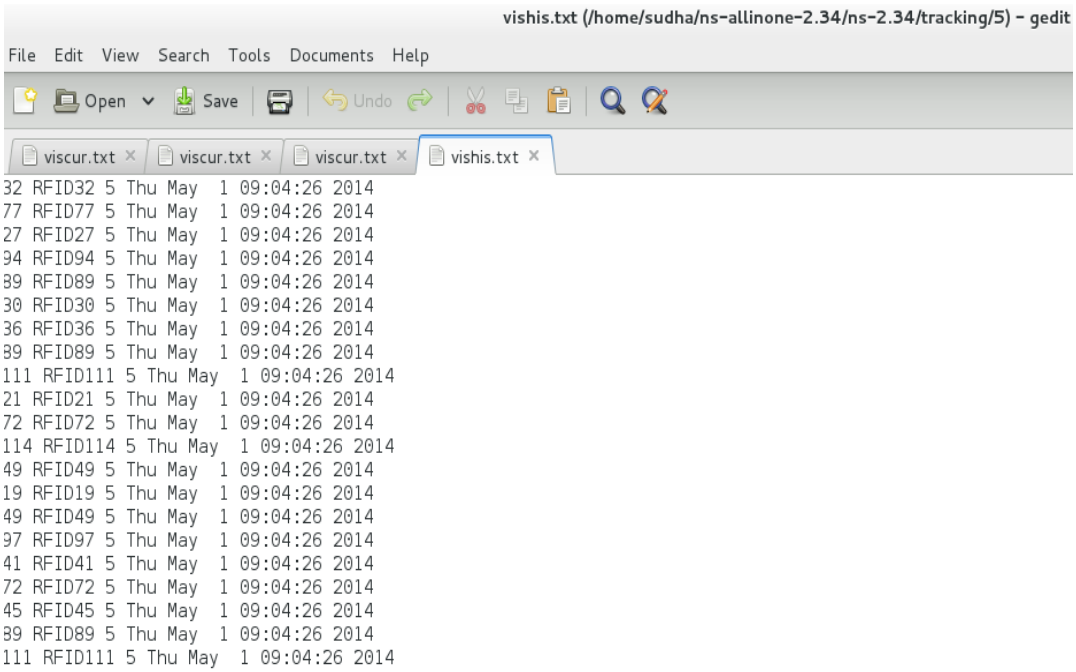

Figure 5.11: INF Agent store history

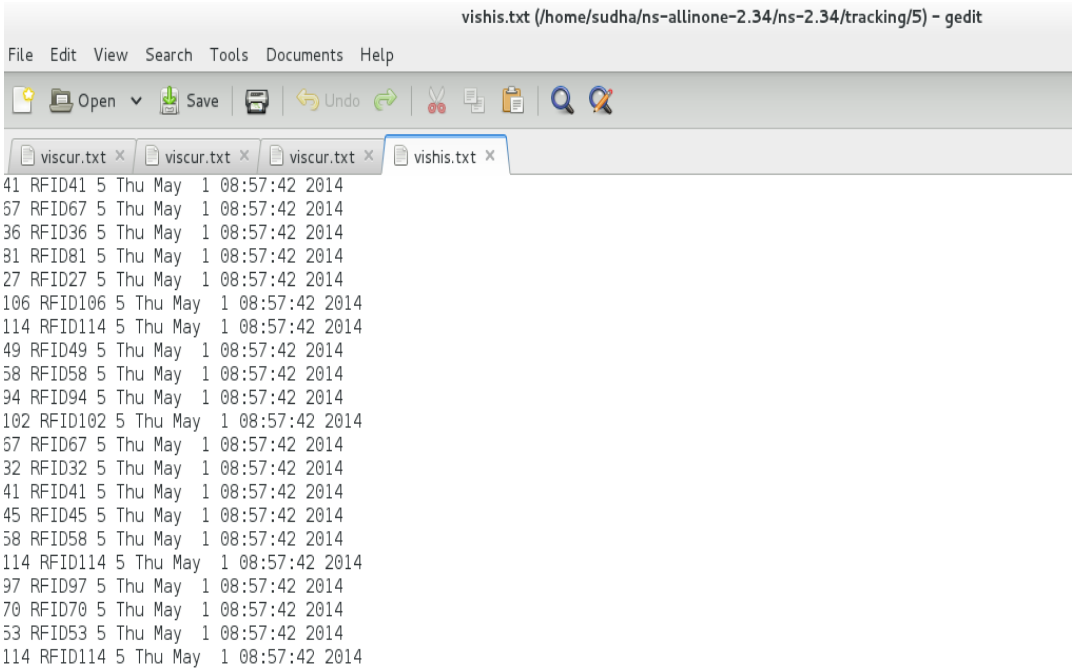

Figure 5.12: INF Agent store history

Chapter 6

Result and analysis

The network parameter of interest is Number of Base station(fixed node) and Number of visitor(moving node). The performance parameters of interest are Success ratio and searching delay. we have compared the results for different area with different configuration.We have compared all the result with different base station. We run the simulation for sufficient time such that each visitor node broadcast the information and all the base station receives the requested file from the monitor.

6.1 Performance Parameters:

Table I: Performance parameters:

Parameters	**Approx. Simulating value**
Antenna models	Omni-directional Antenna
Radio Propogation model	Two Ray Ground
MAC Type of MANET	IEEE 802.11
No. of visitors(Threshold value)	100 -150
Infrastructure range	250 m
RFID tag range	100 m (Active RFID tag)
Network area	5000 m X 5000 m
Number of monitors	1-5
Number of infrastructure	1-8

Graph in Figure 6.1 represents effect of changing area on performance parameter i.e. search Delay for searching the visitors.As the area increases search delay also increases. For 500*500 to 2000*2000 meter area the delay remains constant for 7 base stations. For 2 base stations the delay remains constant from 500*500 meter to 1000*1000 meter.For 500*500 meter to 1500*1500 meter area the delay remains constant for 4 base stations. For 4000*4000 meter area onwards,the search delay increases linearly.

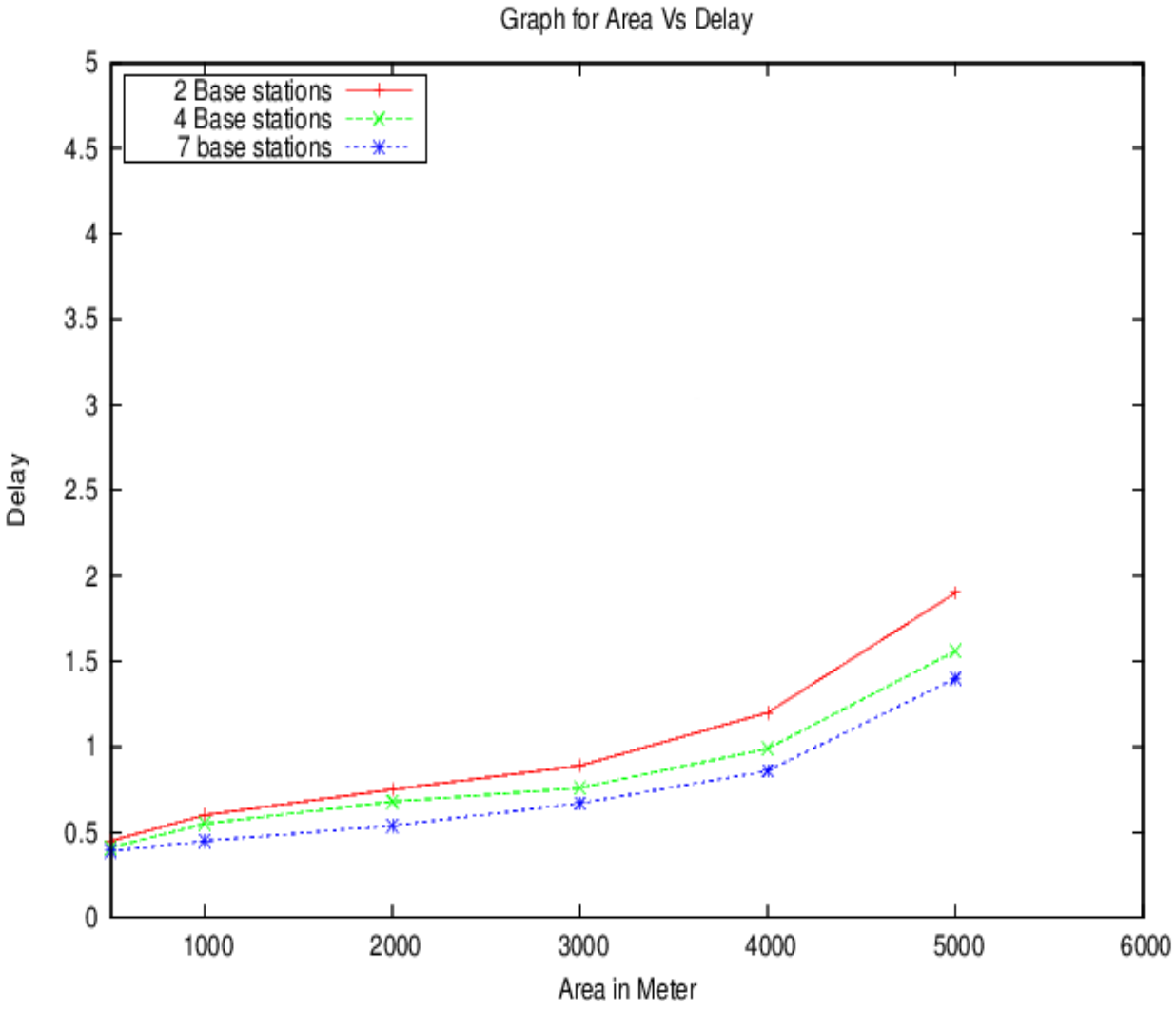

Figure 6.1: Area Vs Delay

Graph in Figure 6.2 represents the effect of number of requests on the success ratio. Success ratio is the ratio of "number of sending requests" and "number of receiving responses" from the base station. Simulation has been done for different number of base stations. As number of requests increases the success ratio decreases gradually.

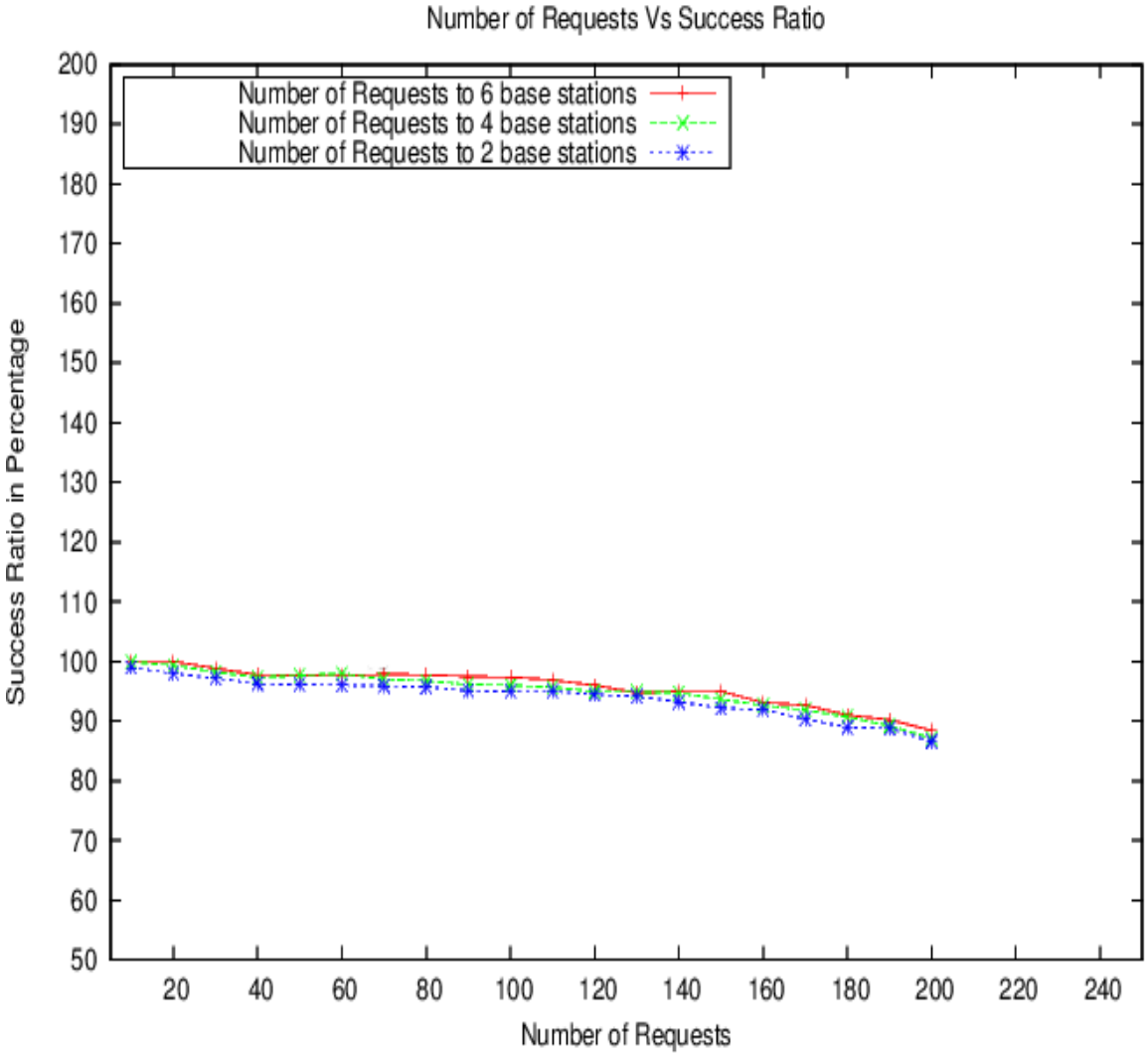

Figure 6.2: Number of request Vs success ratio

Graph in Figure 6.3 represents the effect of number of Visitors on the Performance parameter Search delay. As per analysis, by increasing the number of visitors in increasing area, the delay increases.

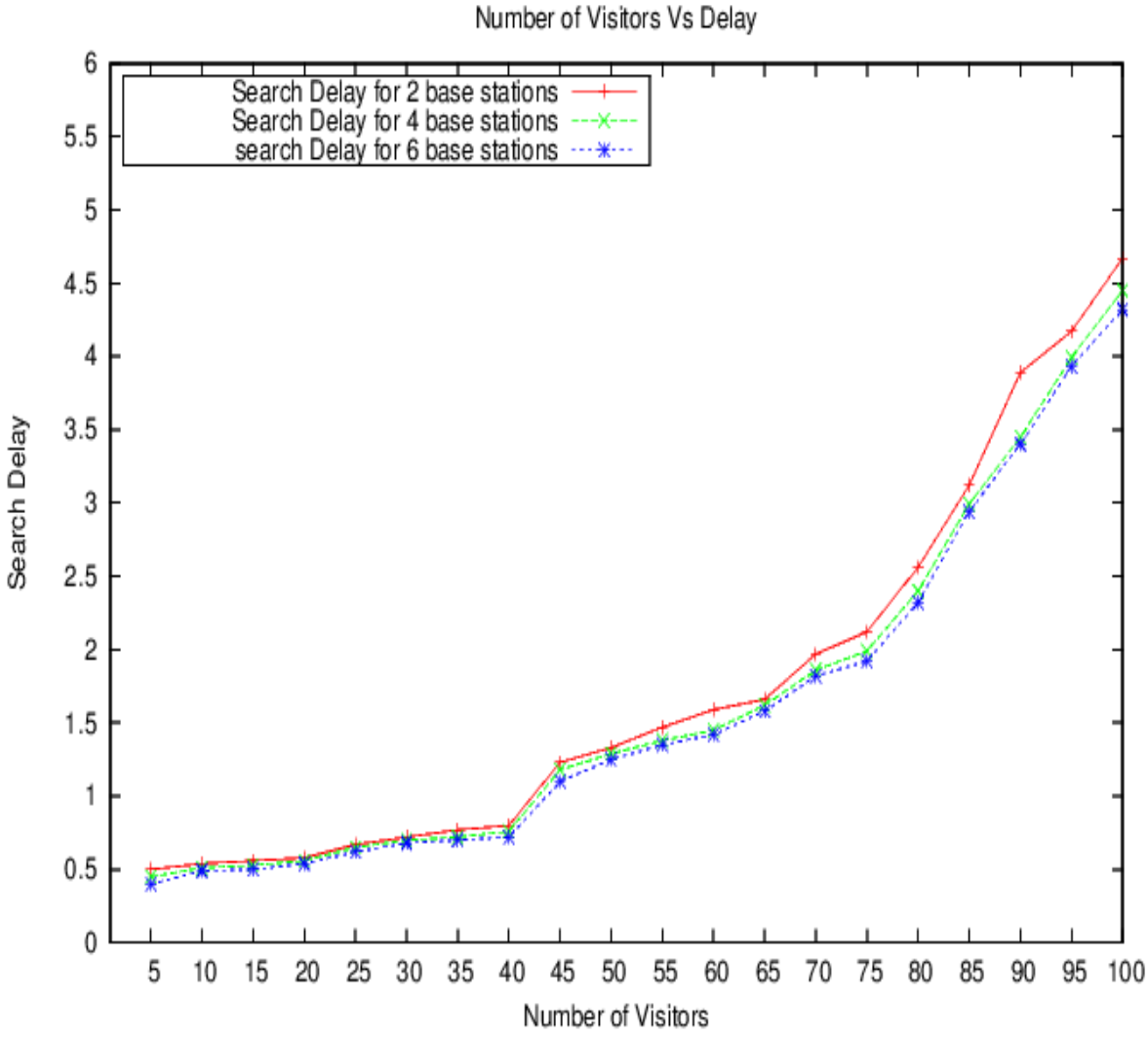

Figure 6.3: Number of visitors Vs search delay

Graph in Figure 6.4 represents the effect of area on the budget.The budget includes the number of visitor RFID tags, number of base stations and number of RFID readers. As area increases, the budget required to establish the network also increases linearly.

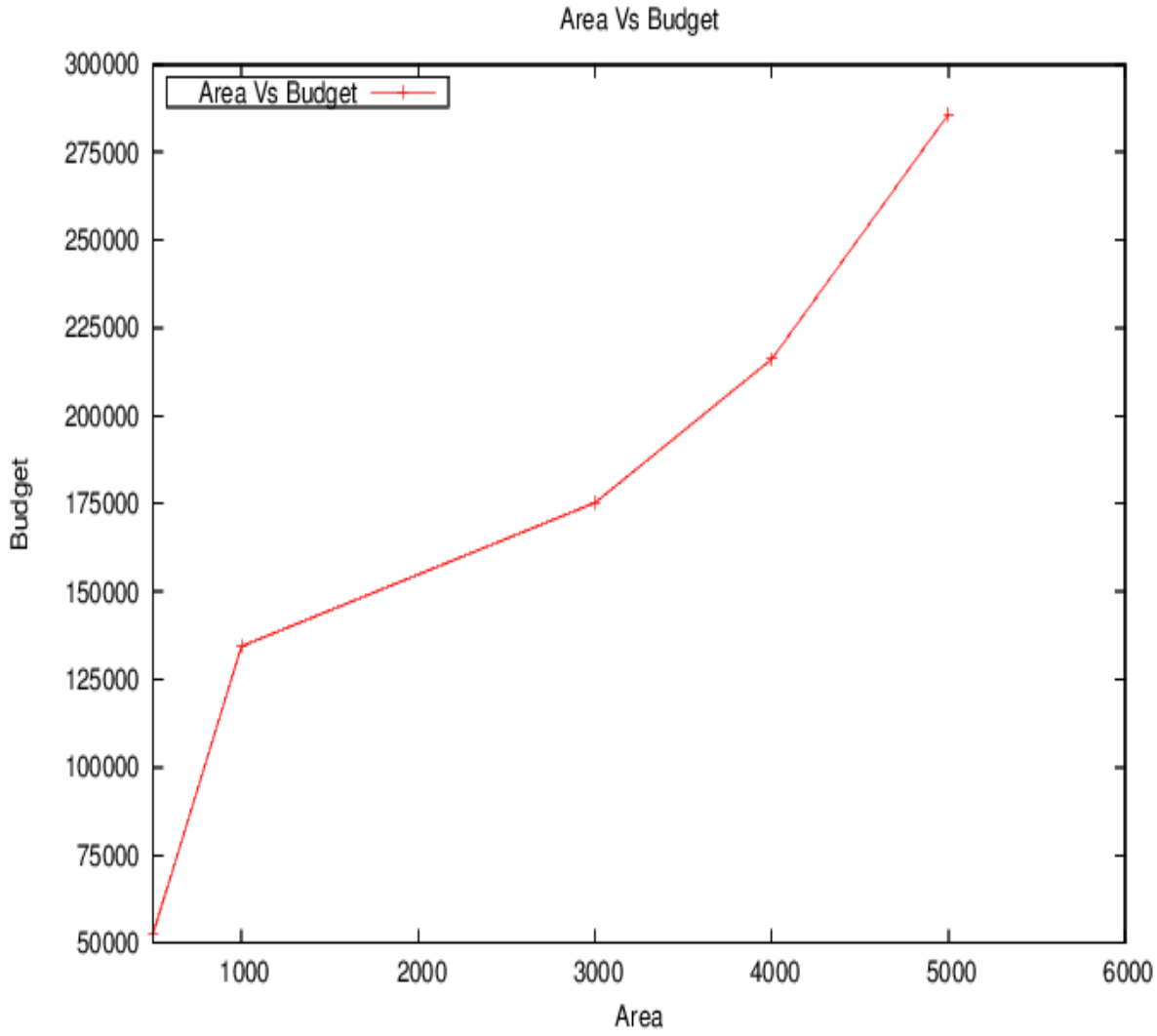

Figure 6.4: Area Vs Budget

Graph in Figure 6.5 represents the effect of number of base stations on search delay.As the number of base stations increasing the search delay decreases. When the number of base stations increases, the vicinity area also increases. So search delay comparatively decreases as shown into the graph.

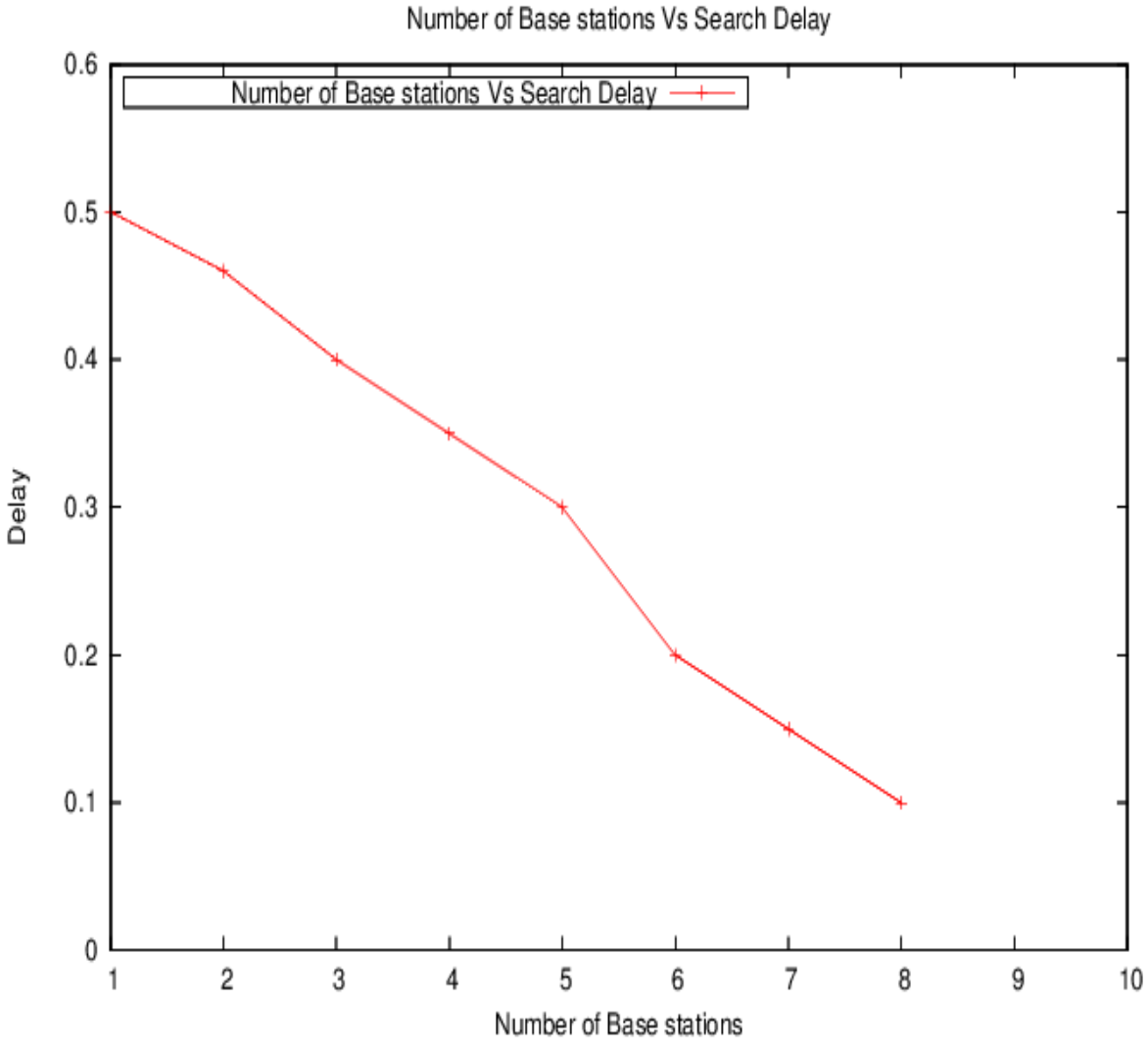

Figure 6.5: Number of Base station Vs Search Delay

Chapter 7

Conclusion:

In this system the approach for tracking the visitors and transmitting the location information in the small scale fixed scene is developed. The quantity of the fixed nodes participating in tracking the location in network setup process is limited to reduce the network overhead and the bandwidth of the system location by taking the advantage of the location information of the located nodes is optimized. During the process of uploading the location information the moving nodes to the infrastructure unit, the quantity of the request package gets transferred and the node location information is also properly controlled. The effectiveness of the algorithm has been verified by the simulation results.

7.1 Future Work:

In the visitor tracking system there is good future scope. The main focus of the system is to get the response to track the visitors after the occurrence of the disaster. In future, the algorithm can be improved by adding Quality of service parameters and also by adding security parameters to enhance the security features.

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