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DEPLOYABLE GSM BASESTATION FOR DISASTER MANAGEMENT

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ABSTRACT

Cellular networks are often paralyzed after a disaster, as damage to fixed infrastructure, loss of power, and increased demand degrade the coverage and quality of service. Unexpected disasters, both naturally occurring like earthquakes ,tsunami, flood and those caused through human actions, result in severe damage to communication infrastructure. Communication play an important role during public-safety operations. The current communication technologies heavily rely on the backbone network, the failure of the base station due to natural disaster or malevolent attacks cause communication difficulties for public safety and emergency communication. There will also be sharp spikes in the usage of commercially licensed spectrum. To overcome all these difficulties, we propose that backup infrastructure is kept within reach of the disaster area to create a emergency network so that victims can be able to communicate with themselves and with the outside world. A sensor node is installed to predict drop in power levels and GSM base station is connected to one or more base substation to identify the disaster sensor zone via antenna. In this paper we study the performance during hand off to neighboring tower, when the tower serving the particular area fails and an additional GSM base station is kept standby when the backbone network fails.

I. INTRODUCTION

Cellular telephony is the most widely adopted communication technology on the planet. Every year, the number of mobile users increases. In 2017, the number of users rose to around 730.7 million in India. In many developing areas, cellular networks have leapfrogged traditional landline telephone and Internet infrastructure due to the comparative ease of deployment. Similarly, on the other hand events like earthquake, tsunamis and large scale man-made disasters pose unforeseen challenges. These disasters can often result in uprooting of existing infrastructure so it becomes very difficult for the personnel to carry out the emergency work in those area due to lack of communication between the affected area and those with the outside world. In addition to this, even if the communication is restored there is large increase in bandwidth usage that over whelm the transmission capabilities of the network. To carry out necessary rescue operation after the disaster, a emergency network should be created with in the affected area as early as possible. The heart of the cellular communication is GSM base transceiver station. The backup infrastructure should be kept within reach of disaster area. The components required are GSM Base station ,power supply and antenna. The GSM basestation can be created using pc having linux operating system and a open source software known as OPENBTS. It will provide a um interface to GSM compatible mobile phones. The radio frequency and signal processing functions can be performed using SDR. Using these components, a network can be created. In this paper, we study the performance of such emergency network using network simulator. In addition to creating a network, handoff can also be done to the neighboring antenna which is very close to the disaster area. Different scenarios for establishing communication is made and their performance is analysed.

II. GENERAL WORKING OF CELL TOWER

In principle, a cellular tower and base station that enable voice and data services for different phones aren't much different. Except, of course, that they are built to withstand the elements,cover a far greater geographic area than your home, simultaneously support hundreds ofhandsets, operate in different radio frequencies, and allow users to maintain their connectionswhile traveling from one base station to another, even while driving at highway speeds.

Towers, cells andhexes are key building blocks for thedesign and operation of wirelesscommunications networks.

In the wireless world, a cell is thegeographic coverage area enabled by atower. Locations are carefully selected to

ensure that individual cells form a tightlyknit mesh without coverage holes or overlapping. The different tower types are micro cells, macro cells, pico cells and femto cells. Tower failure also occurs as a result of high traffic over a limited bandwidth channel.

The main components in cellular architecture are basestation, mobile switching centre and mobile equipment.

The mobile equipment is user's mobile phone which initiates the call request process. There will be two channel, one is forward channel and the other is reverse channel between the user equipment and base station. These channels are used to carry control and data information. Basestation is the fixed infrastructure network device which provide radio frequency access and channel to the network devices. Routing and switching function are performed by mobile switching centre.

The maximum distance between a cell phone and a cell tower depends on the technology, landscape features, the power of the transmitter in the tower, the size of the cellphone network cell and the design capacity of the network. A typical cellphone has enough power to reach a cell tower upto 45 miles away.

III. AFTERMATH OF DISASTER

The most common cause of communication failure during disaster is the physical damage to the devices or components that make up the network infrastructure. Hurricanes, floodwater and seismic activity can all create physical disturbance that have the power to do significant damage to cities and the vulnerable communication equipment that is responsible for supporting these areas. Wireless links are also susceptible to disruption or damage during disaster, as different wavelength signals can be cut off by heavy rain, snow, or fog. The transmitter itself can also receive damage or being knocked out of alignment with its receiver. The other cause of communication failure is network congestion. When disaster strikes, the channels that make the communication networks often become congested with exceptionally high levels of data traffic, as those impacted seek to contact family and friends, emergency personnel work to coordinate relief efforts.

Following a disaster, when network connections are limited or unavailable, effective coordination becomes complicated, and the lack of an overarching command structure can create miscommunication and delays in action. In time sensitive situation such as these, even though few minutes lost can mean the difference between life and death for victims in need of rescue.

IV. METHODOLOGY

Using network simulator, we create different coverage area served by individual tower. There will be central base station connected to antenna and server. In different cell site, a sensor node will be present which constantly send the power levels of all the node to the corresponding access point. When the power level falls below the threshold level or when the access point serving the particular cell site fails, handoff process is initiated. The access point which is closer to the failed access point is determined and all the nodes in the affected area will be connected to the neighboring access point. The challenge here is to provide quality of service both to the users of the disaster area and to the users corresponding to this access point.

The performance is measured when the handoff is initiated and compared with the actual measures when the access point is not affected. The parameter like throughput, latency, data rate are measured. The other scenario is also considered like when the nodes move from one cell site to another cell site and when the access point is considered as mobile node to provide services when the user is far away from the tower or if the user location is at the end of the cell site. In the present communication network, if the backbone network fails, then there will be no connectivity between the users. To overcome this, additional GSM basestation is kept in place which will be used one and only if the existing system fails. There will be no data loss since all the information will be stored in the server and backups can be used.

All the above mentioned scenarios will be created in the network simulator tool and performance of each cases is studied and comparisons is made to determine which will be best way to establish emergency communication network over the disaster area

The future improvement of the project is to establish deployable basestation using hardware in real time. Creating a emergency ad-hoc network will provide only inbound communication to the users within the

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network. The challenge is to create both inbound and outbound communication and improve the capacity and coverage area of the network

To create the basestation the necessary components include Base transceiver system, SDR to carry out Rf and signal processing functions. OpenBts a open source software which will provide air interface(um) to the standard compatible mobile phones.

V. FIGURES

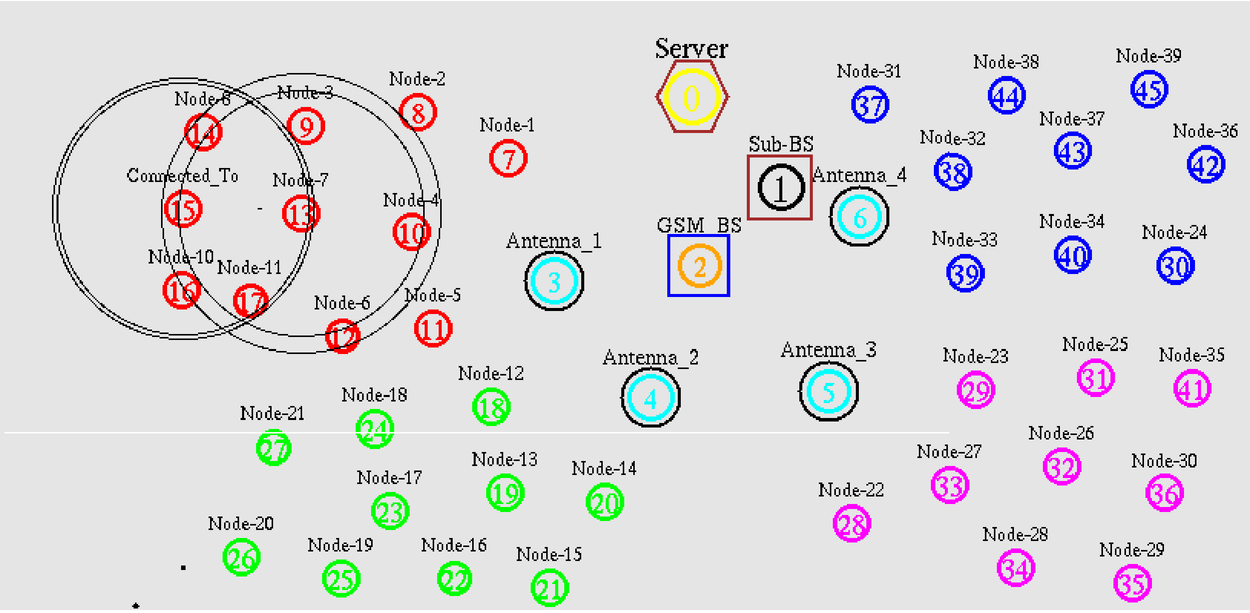

Fig.1

Using Network Simulator 2, the network is created as shown in Fig,1. It consists of four regions each served by individual antenna. The antennas are connected to GSM base station and server. For simplicity, we have only considered minimum number of nodes in each region. The sensor node (GH in Fig.2) in each region is selected based upon the minimum cost to reach the other nodes. The sensor node will detect energy information from each node and sends it to the corresponding access point.

In simulation , occurrence of disaster is identified by measuring the energy of each node separately. If it is found to be less than the threshold value then the access point corresponding to the disaster zone is mentioned as DISASTER as shown in Fig.2 The base station to be deployed is named as sub-BS. As a result of antenna failure in disaster zone the mobiles nodes in that area are to be hand-offed to the neighboring antenna. To maintain quality of the service in both the zone, antenna is considered to be mobile so that unused spectrum is allocated efficiently in both the zones. In addition to the mobility of tower, the mobility of nodes from one zone

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to another zone is also considered and the performance characteristics like data rate, throughput, efficiency are measured.

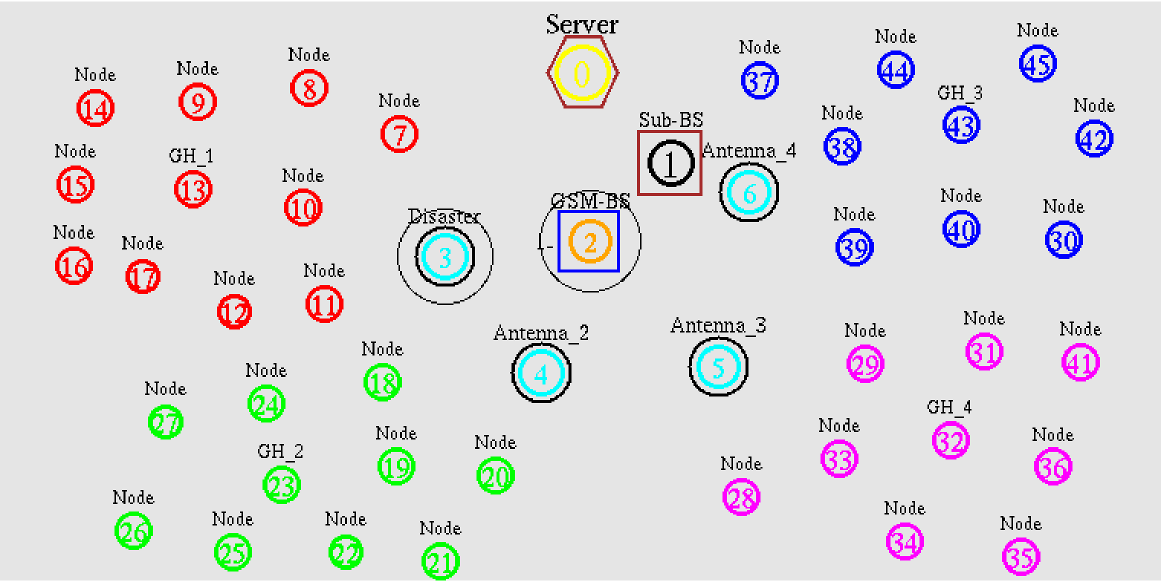


Fig.2

All the information from the antenna are stored in the server. After disaster, the information of the nodes in that area are updated to the new sub basestation from the server. Now the communication in the normal area are routed through the main basestation while the nodes in the disaster zones are communicated with the outside zone through the sub-base station. The main advantage of this deployable sub basestation is to reduce the network congestion that actually occurs after the disaster as all the victims try to reach the emergency personnel.

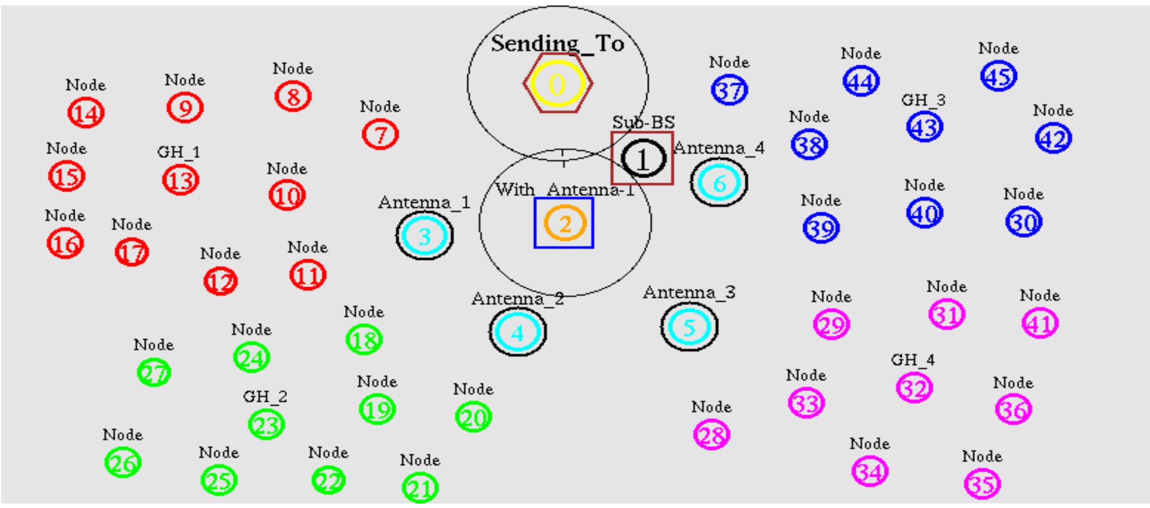
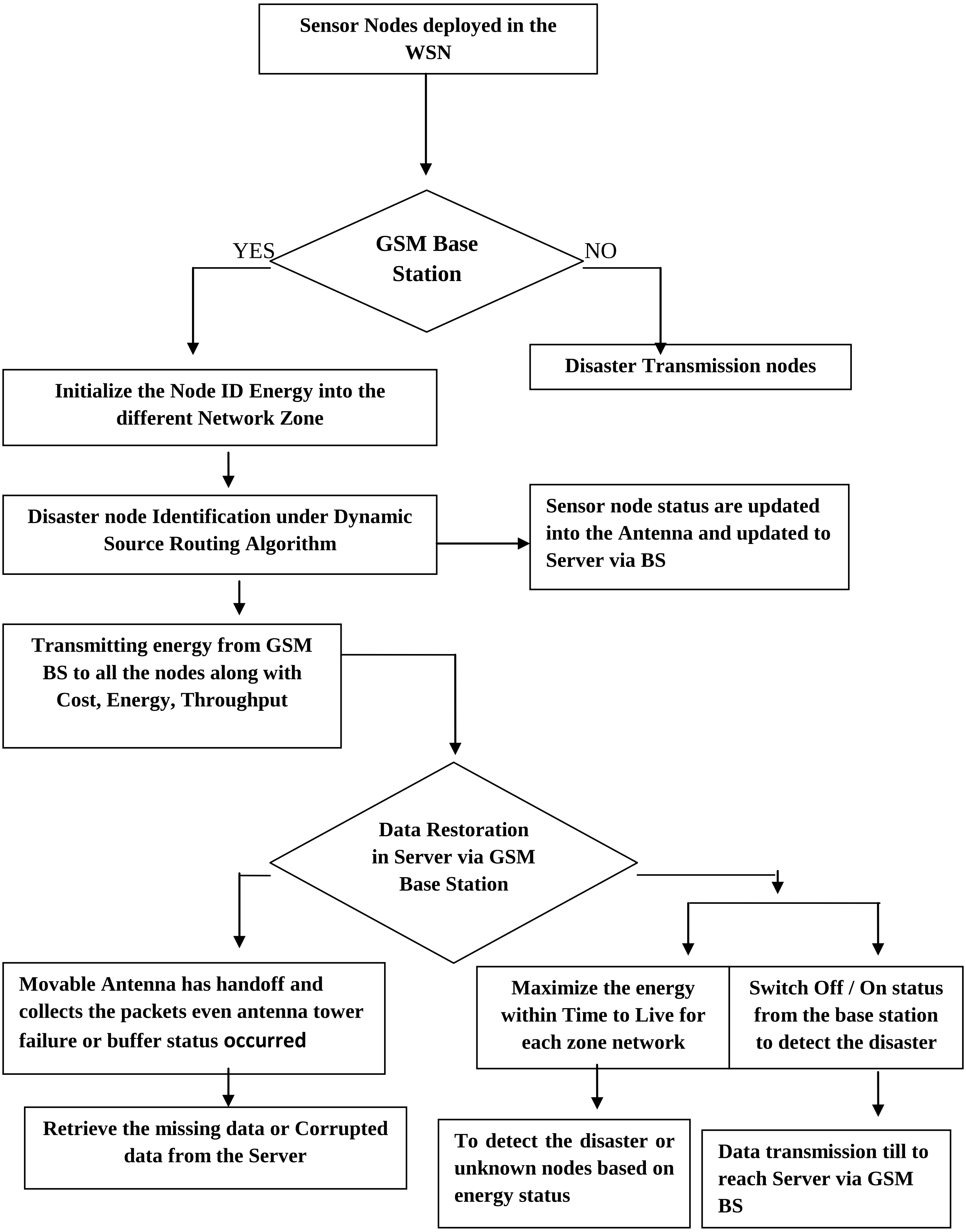


Fig.3

VI. ARCHITECTURE DIAGRAM



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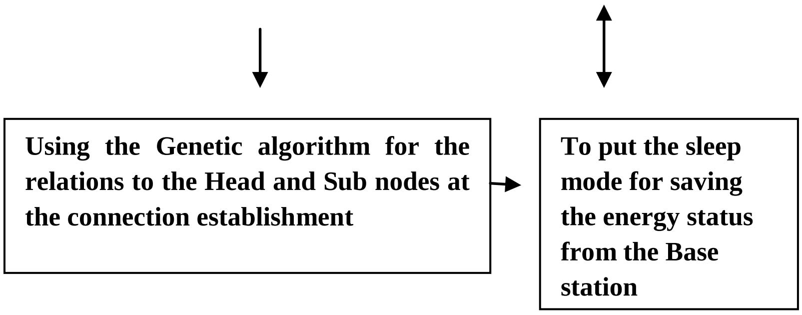
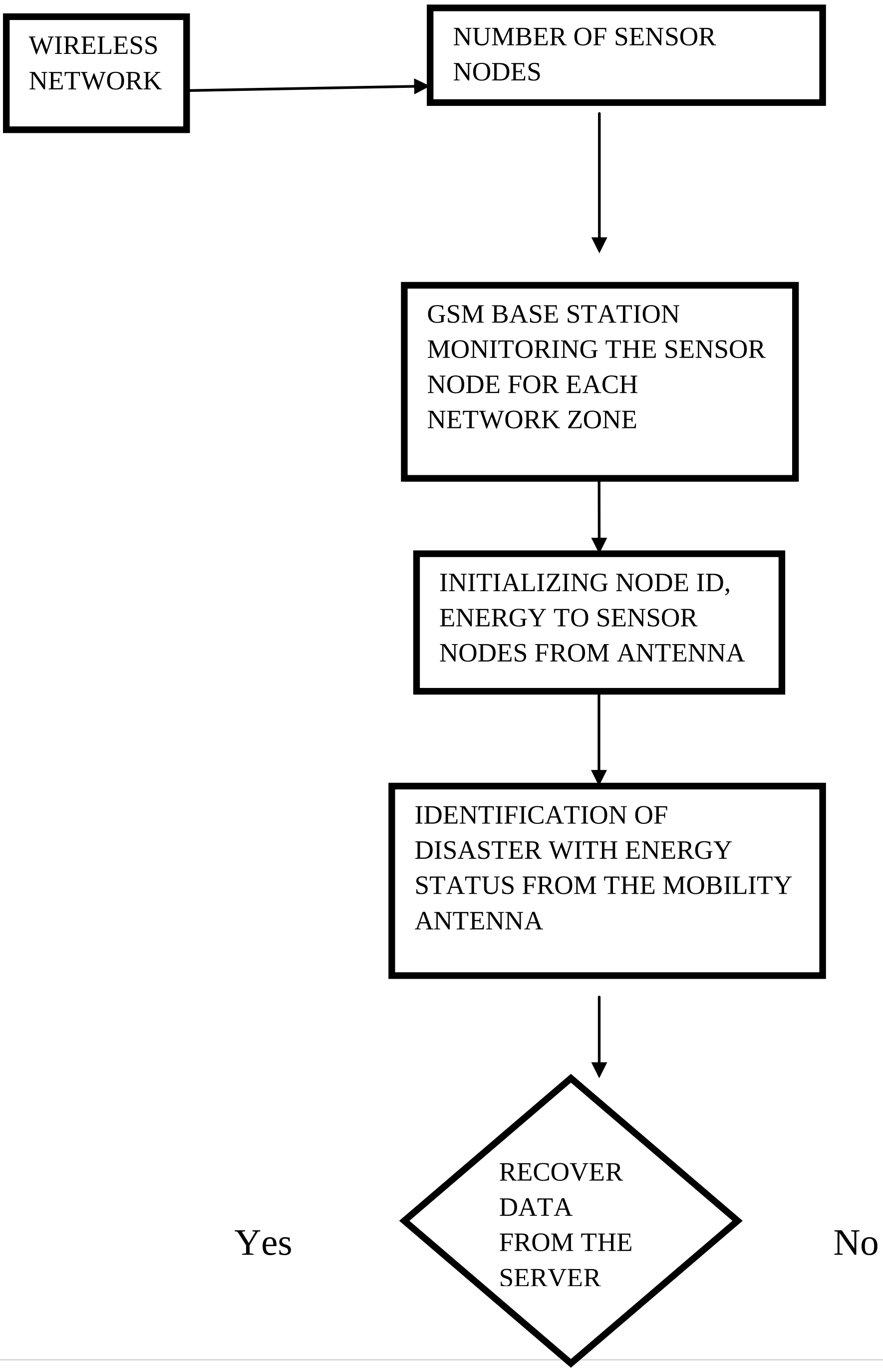


VII. BLOCK DIAGRAM:



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TO PREDICT THE DISASTER NODE BASEED ON THE ENERGY

TO SWITCH OFF/ON STATUS FOR THE GSM BASE STATION FOR IDENTIFY THE DISASTER NODE

VIII. SYSTEM SPECIFICATION

Hardware Requirements

• Processor	:	Core i3/i5/i7
• RAM	:	2-4GB
• HDD	:	500 GB

Software Requirements

• Platform:	:	Ubuntu
• Front End	:	NS 2 - 2.34

IX. ADVANTAGES

- High data security
- High data transmission rate
- Strong and secured transmission path
- Missed data will be recovered easily
- Handoff the antenna tower data with or without mobility

X. CONCLUSION

The main idea of our work is to establish communication over the disaster stricken area. The communication system not only fails during natural disasters but also when the traffic over the channel is higher than bandwidth capacity. The communication is very important between the victims and the first responders. The future study of our work is to implement the base station using hardware components using SDR, OpenBts, Antenna to create a emergency network in more disaster prone area. The emergency network is not only used to establish communication but also can be used in rural area where there is no existing network infrastructure available. The backup infrastructure is always available to establish communication over the limited area and to further advance the coverage to a maximum distance.

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