GEOGRAPHIC INFORMATION SYSTEM - A TOOL FOR SUSTAINABLE DEVELOPMENT OF THE NIGERIA ENVIRONMENT: GLOBAL SYSTEM FOR MOBILE COMMUNICATION MASK PERSPECTIVE

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ABSTRACT

The emergence of Global System for Mobile communication mask in the nation since its introduction to this country in the year 2001 has becomes worrisome has it constitute environmental hazard in our society. The paper is aimed at examining the regulation of Nigeria Communication Commission (NCC) of 5m radius of GSM mask to demised property in Bida Local Government Area of Niger State. The study adopted the primary method of data collection using Global Position System (GPS) to pick point locations of GSM mask within Bida Local Government Area and the nearest building north, south, east and west of the GSM mask. The data were then uploaded to Arc GIS 9.3; buffer line of 5m radius were created round the mask which is to be query to determine the building that will fall within the buffer zone, which will enable the author to determine which GSM mask and operator has spatially violated the regulatory laws of NCC and the probable impact of the violation inform of noise pollution on the immediate environment, thereby making recommendations from findings to the appropriate authority.

Key Words: Mask, Buffer, Query, Pollution, Noise

INTRODUCTION

Nigeria as a nation joined the league of Global System for Communication (GSM) user since 2001 when it was introduced to the country. Ever since then number of user has tremendously increase which make the nation the fastest growing GSM user in Africa. Telecommunication is a major player as the world is generally referred to as a global village. A major breakthrough in this sector is the wireless telephone system, which comes in either fixed wireless lines or the Global System for Mobile communication (GSM).\(^1\) GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the Three Digital Wireless Telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot and it’s operates at either the 900 MHz or 1800 MHz frequency band.\(^2\)

Rouse,\(^2\) explained that mobile services based on GSM technology were first launched in Finland in 1991, but today more than 690 mobile networks provide GSM services across 213 countries and GSM represents 82.4% of all global mobile connections. According to GSM World as reported by Rouse, there are now more than 2 billion GSM mobile phone users worldwide. GSM World references China as the largest single GSM market, with more than 370 million users, followed by Russia with 145 million, India with 83 million and the USA with 78 million users. GSM, together with other technologies, is part of the evolution of wireless mobile telecommunications that includes High-Speed Circuit-Switched Data (HSCSD), General Packet Radio System (GPRS), Enhanced Data GSM Environment (EDGE), and Universal Mobile Telecommunications Service (UMTS).
According to Josiah et al., GSM today covers over 1.2 billion users on 630 networks in over 210 countries, and is the fastest growing technology of all time. The initial release of GSM was called GSM Phase I, and it is commonly referred to as the 1st generation. This release made provision for the basic voice, SMS and Circuit Switched Date (CSD) services. CSD allow a maximum data rate of 9.6kbs and was capable of fax transmission as well. Supplementary services at that point were very basic consisting of call forward and called barring capabilities. The second generation (GSM Phase 2) was released in 1995 and provided enhanced supplementary services, amongst which were Calling Line Identity (CLI), all waiting and multi-party services. Data services however remained limited to 9.6kbs. GSM Phase 2+ was an enhancement to GSM Phase 2 and was released two years later in 1997. Realizing the need for enhanced data service, Phase 2+ address this requirement by making provision for High Speed Circuit Switched Date (HSCSD) and General Packet Radio Services (GPRS). HSCSD and GPRS allowed maximum data rates of 48kbs and 177kbs respectively.

Josiah et al. emphasised that communication is a major driver of any economy and Nigeria is not left out in the race for rapid developments, as the years of economic reversal via mismanagement have had adverse effects on its rate of growth and development. The Nigerian telecommunications sector was grossly under-developed and mismanaged before the sector was deregulated under the military regime in 1992 with the establishment of a regulatory body, the Nigerian Communication Commission (NCC). The telecommunications industry in Nigeria also witnessed the deregulation of telecommunications services in 1992 through the promulga-tion of Nigerian Communications Commission (NCC) Decree, No. 75 of 1992, introducing private participation in the provision of telecommunications services in Nigeria, thus ending the state-owned NITEL’s monopoly of the sector and ushering in competition. Nigeria Communication Commission issued various licences to private telephone operators. These licences allow Private Telephone Operators (PTOS) to roll out both fixed wireless telephone lines and analogue mobile phones. Nigeria returned to democracy in 1999 paved way for the granting of GSM licences to three service providers, MTN, ECOPNET (which is now Airtel) and NITEL plc in 2001; and GLOBACOM in 2003. The Nigerian Communications Act 2003 was signed into law by President Olusegun Obasanjo on the 8th of July 2003 after being passed by both Houses of the National Assembly. The Act strengthens the capacity of the Nigerian Communications Commission to properly carry out its activities as the independent regulator of the telecommunications industry in Nigeria.

Josiah et al. considered the journey to success in Nigeria telecommunication milieu has been long and tortuous, as telecommunication facilities in Nigeria were first established in 1886 by the colonial administration, at independence in 1960 with a population of roughly 40 million people, the country only had about 18,724 phone lines for use which translated to a tele-density about 0.5 telephone line per 1,000 people. The telephone network consisted of 121 exchanges of which were of the manual type and only 5 were automatic. Between the year 1960 and 1985 the telecommunication sector consisted of the department of posts and telecommunication (PandT) which is in-charge of the internal network and a limited liability company, while the Nigerian External Telecommunication (NET) limited, responsible for the external telecommunication provided the gateway to the outside world. The installed switching capacity at the end of 1985 was about 200,000 lines as against the planned target of about 460,000, all the exchanges were analogue with 1 phone line to 440 inhabitants, well below the target of 1 phone line to 100 inhabitants recommended by ITU for developing countries. The quality of service was not good enough, phone was undependable, congested, expensive and customer unfriendly. Josiah et al. further explained that, in January 1985, the erstwhile posts and telecommunications department was split into postal and telecommunication divisions, which was later merged with NET to form Nigeria
Telecommunication Limited (NITEL), a limited liability company. The main objective of establishing NITEL was to harmonise the planning and coordination of the internal and external telecommunications services, rationalize investments in telecommunications development and provide accessible, efficient and affordable services. However, almost 43 years down the line, the Nigeria telecommunication, NITEL had roughly half a million lines available to over 100 million Nigerians. NITEL, the only national carrier had a monopoly on the sector and was synonymous with epileptic services and bad management. On assumption of office on May 29, 1999, the President Olusegun Obasanjo administration swung into action to make it a reality the complete deregulation of the telecom sector, most especially the much touted granting of licences to GSM services providers and setting in motion the privatization of NITEL. This practice approach by the government to the telecom sector has made it possible for over 2.5 million Nigeria to clutch GSM phones today.4

**GSM Architecture**

According to Marc5 and Mohammed6 GSM network can be divided into three groups (Fig.1): The Mobile Station (MS), the Base Station Subsystem (BSS) and the network subsystem. They are characterized as follows:

![GSM Network Architecture Diagram](http://gmsserver.com/articles/articles.jpg)

**Fig 1 : General architecture of GSM network**

**The Mobile Station (MS)**

This may refers to handset, a mobile, a portable terminal or Mobile Equipment (ME). It also includes a Subscriber Identity Module (SIM) that is normally removable and comes in two sizes. Each SIM card has a unique identification number called IMSI (International Mobile Subscriber Identity). In addition, each MS is assigned a unique hardware identification called IMEI (International Mobile Equipment Identity).

**The Base Station Subsystem (BSS)**

(BSS) is made up of the Base Station Controller (BSC) and the Base Transceiver Station (BTS). The Base Transceiver Station (BTS): GSM uses a series of radio transmitters called BTSs to connect the mobiles to a cellular network. Their tasks include channel coding/decoding and encryption/decryption. A BTS is comprised of radio transmitters and receivers, antennas, the interface to the PCM facility, etc. The BTS may contain one or more transceivers to provide the required call handling capacity. A cell site may be omnidirectional or split into typically three directional cells. The Base Station Controller (BSC): A group of BTSs are connected to a particular BSC which manages the radio resources for them. Today’s new and intelligent BTSs have taken over many tasks that were
previously handled by the BSCs. The primary function of the BSC is call maintenance. The mobile stations normally use the services of the BSC to give information regarding the signal strength to the BS. Every received signal strength is 480ms. With this information the BSC decides to initiate a handover to other cells, change the BTS transmitter power, etc.\(^5\)

**The network subsystem**

This consists of the Mobile Switching Center (MSC): which acts like a standard exchange in a fixed network and additionally provides all the functionality needed to handle a mobile subscriber. The main functions are registration, authentication, location updating, handovers and call routing to a roaming subscriber. Secondly the Home Location Registers (HLR): A database used for management of mobile subscribers. It stores the International Mobile Subscriber Identity (IMSI), Mobile Station ISDN Number (MSISDN) and current Visitor Location Register (VLR) address. The main information stored there concerns the location of each mobile station in order to be able to route calls to the mobile subscribers managed by each HLR. Thirdly, the Visitor Location Register (VLR): this contains the current location of the MS and selected administrative information from the HLR, necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR. The authentication center (AuC): A protected database that holds a copy of the secret key stored in each subscriber's SIM card, which is used for authentication and encryption over the radio channel. The AuC provides additional security against fraud. It is normally located close to each HLR within a GSM network. The Equipment Identity Register (EIR): The EIR is a database that contains a list of all valid mobile station equipment within the network, where each mobile station is identified by its International Mobile Equipment Identity (IMEI). The EIR has three databases; White list: for all known, good IMEIs, Blacklist: for bad or stolen handsets and Grey list: for handsets/IMEIs that are uncertain.

**Impact of GSM base station on health**

Elaine\(^7\) reporting, Royal Society of Canada, Stewart Report, Independent Expert Group on Mobile Phones in the U.K., Institute of Electrical and Electronics Engineers (IEEE, 2001), Australian Radiation Protection and Nuclear Safety Agency (ARPANSA, 2002), U.K., Advisory Group on Non-Ionizing Radiation (2003), and NRPB (2004), concluded that there is little evidence for any adverse health effects that can be attributed to mobile phone base-stations. However, the following researchers have a contrary view as Abdel-Rassoul et. al.\(^5\) states that, inhabitants living nearby mobile phone base stations are at risk for developing neuropsychiatric problems and some changes in the performance of neurobehavioral functions either by facilitation or inhibition, neuropsychiatric complaints such as headache, memory change, dizziness, tremors, depressive symptoms, and sleep disturbance were significantly higher among exposed inhabitants. Blettner, M. et al\(^9\) explained that, those living in the vicinity of a mobile phone base station (500m) reported slightly more health complaints than others. Dode, A. et al\(^10\) concluded that, the mortality rates and the relative risk were higher for the residents inside a radius of 500m from the BS, compared to the average mortality rate of the entire city, and a decreased dose-response gradient was observed for residents who lived farther away from the BS. Eger, H et.al\(^11\) "In the years 1999-2004, i.e. after five years operation of the transmitting installation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the installation compared to the inhabitants of Naila outside the area". Gadzicka, E. et. al.\(^12\) reported that, a significant relationship was found to occur between the frequency of some symptoms and the distance from the base station that everyday headaches were most frequent in respondents living at the distance 100-150m from the base station in comparison with subjects living in farther distances.

**Base station as a source of air and noise pollution in Nigeria**

WHO defined air pollution as limited to situation in which the outer ambient atmosphere contains materials in concentrations which are harmful to man and his environment. Obajimi see it as the imbalance in the quality of air capable of
causing adverse effects on living organism. Olawepo explained that the activities of man have degraded the quality of the lower atmosphere. Nigerian is faced with the challenge of base station, emission and noise from generating set used to powered the base station 24hours a day as a result of epileptic power supply situation of the country which is a source of air and noise pollution. The Nigeria power system is so inadequate and is grinding economic progress and social well beings. Daily Trust (2007), actual daily generation fell less than 2000 megawatts (MW) in 1999, generation went down from installed capacity of about 5200 to 1750 megawatts (MW), as compared to a load demand of 6000 megawatts. This according to Gana J. and Amodu M., explained that the continuous reliance of people on fire wood and generators have serious and adverse health implication and they concluded that the use of fire wood, charcoal and generators causes air pollution, noise pollution, deforestation and soil erosion. This corroborates the findings of WHO, that smoke from biomass fuels tend to cause acute respiratory diseases in children and chronic lung disease in adults while smoke and heat may cause eye diseases. In Nigeria, several rural towns that had in the past enjoyed fresh and dry air are currently experiencing severe air pollution problems. Olawepo attributed this to industrialization process and expansion in human activities (Table 1).

Table 1: Common air pollutants, their sources and pathological effect on man

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Source</th>
<th>Pathological effects on man</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur dioxide</td>
<td>Coal and oil combustion</td>
<td>Causes chest constriction, headaches, vomiting and death from respiratory ailment.</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>Soft coal, automobile exhausts</td>
<td>Inhibit cilia action so that soot and dust penetrate far into the lungs.</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>Refineries, chemical industries and bituminous fuels</td>
<td>Causes nausea, irritate eyes and throat.</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Burning of coal, gasoline, motor exhausts</td>
<td>Reduces oxygen carrying capacity of blood.</td>
</tr>
<tr>
<td>Hydrogen cyanides</td>
<td>Blast furnace, fumigation, chemical manufacturing, metal plating.</td>
<td>Inference with nerve cells, produce dry throat, indistinct vision headache etc.</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Explosives, dye making, fertilizer plants and lacquers.</td>
<td>Inflames supper respiratory passages.</td>
</tr>
<tr>
<td>Phosgene or Carbonyl chloride</td>
<td>Chemical and dye making.</td>
<td>Induce coughing, irritation and fatal pulmonary edema.</td>
</tr>
<tr>
<td>Aldehydes</td>
<td>Thermal decomposition of oils, fats or glycerol.</td>
<td>Irritate nasal and respiratory tracks.</td>
</tr>
<tr>
<td>Arsines</td>
<td>Processes involving metal cracks containing arsenic soldering.</td>
<td>Damage red cells in blood, kidneys and causes jaundice.</td>
</tr>
<tr>
<td>Suspended particles</td>
<td>Incinerators and almost every manufacturing process.</td>
<td>Cause emphysema, eye irritation and possibly cancer.</td>
</tr>
</tbody>
</table>

Source: Obajimi

Location, position and size

Bida town in Niger State is located in Niger valley within Latitudes 9°0’ and 9°9’ North of the equator and Longitudes 5°56’ and 6°4’ East of Greenwich meridian. The town which share common boundaries with Gbako Local
Government Area Northward and Westward, Lavun Local Government in the South and Katcha Local Government Area Northward and Westward, Lavun Local Government in the South and Katcha Local Government in the East, has a population of 118,181, (NPC, 2006) occupying a total land area of 37.545346 sq/km (Fig. 2 to Fig. 5).

Fig. 2 : Map of Niger state showing LGA’S (Inset map of Nigeria showing Niger state)

Fig. 3 : Map of Bida local government area inset Niger state
Source: Author’s field work 2012

**Fig. 4**: Map of Bida local government area showing spatial location of GSM mask

Source: Author’s field work 2012

**Fig. 5**: Map of Bida local government area showing structures N.S.E & W of GSM masks

Source: Author’s field work 2012
AIMS AND OBJECTIVES
The aim of this research work is to determine the network operator that spatially violated the NCC guideline of 5m radius to the nearest demised property.\textsuperscript{22,23} Specifically however, the study seeks to:

1. Determine the spatial location of the GSM mask within the Local Government Area
2. Determine the spatial location of the nearest demised property north, south, east and west of each GSM masks.
3. Create a 5m radius buffer around each GSM mask and
4. Create a map query to determine property that falls within the 5m radius buffer

METHODOLOGY
Types of data required for the study and their sources
Data required for the study can be categorized into two, these are primary and secondary data sets. The primary data to be used include: coordinates and elevation points of GSM masks in Bida Local Government Area, The coordinates of the nearest structures north, south, east and west of each GSM masks, the address of each GSM mask, the GSM network operators and the Secondary data to be used includes base maps, journals and textbooks.

Sample frame
The study covered the entire GSM mask within Bida Local Government Area, which is presently thirty three (33) in number.

Sampling techniques
The coordinate points of the GSM mask and the nearest structures north, south, east and west of the GSM mast were collected with the aid of Hand held Global Positioning System Promark 100.

Data format
For this paper work vector data format was used. Daramola\textsuperscript{24,25} reporting state that, vector data records spatial information as arc (lines), polygon (traversed areas), points (labeled nodes), nodes (intersection points) as x, y, coordinates system. Line features including the outlines of polygon, are recorded as an ordered series of x, y, coordinates.

Data pre-processing
Scanning and Georeferencing
Maps were scanned and Geo-referenced in order to pick control point to show the actual representation of a paper map on ground surface using pairs of coordinates x,y, obtained from the grid information on the map.

Digitizing
The relevant geographical spatial features on maps were digitized using on-screen (called heads-up digitizing), by tracing a scanned image on the computer screen in a similar manner.

Feature extraction
The following spatial features from field survey and maps were captured and developed into digital database in Arc GIS 9.3 (Table 2).

<table>
<thead>
<tr>
<th>S/N</th>
<th>Geographic features/layers</th>
<th>Feature class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GSM mask points</td>
<td>Point</td>
</tr>
<tr>
<td>2</td>
<td>Nearest structure(s) north, south, east and west of GSM mask.</td>
<td>point</td>
</tr>
<tr>
<td>3</td>
<td>Federal roads</td>
<td>Line</td>
</tr>
<tr>
<td>4</td>
<td>State roads.</td>
<td>Line</td>
</tr>
<tr>
<td>5</td>
<td>Local roads</td>
<td>lin</td>
</tr>
<tr>
<td>6</td>
<td>Drainage system.</td>
<td>Line</td>
</tr>
</tbody>
</table>

Source: Author field work 2012
Cartographic modelling
This is the way of expressing and organizing the method by which spatial variables and spatial operations are selected and used to develop a GIS data model. The final stage in a cartographic modelling process is to annotate the flow chart with the appropriate commands from GIS package in which it is intended to perform analysis.

Hardware selection
The following computer hardware was used for this work. HP Pavilion dm4 laptop, HP DeskJet F4200 series scanner, HP DeskJet printer F4200 and Promark 100 Global Positioning System (GPS).

Software selection
PC based GIS software system was used. ArcGIS 9.3 the choice of the system was made in order to exploit some of the efficient qualities of the spatial analysis of vector based GIS of the software.

RESULTS AND DISCUSSION
Data manipulation, analysis and presentation of results.
The data manipulation and spatial analysis capabilities of Geographic information systems distinguishes it from other comparable systems. Fig. 6 Shows the cartographic model, which is a graphic representation of the data and analytical procedures used in this study.

Buffer operation
Buffer is the area of influence of equal radius around a feature. A 5M radius buffer was carried out to determine the risk zone (Fig 7).

Map query
The GSM masks point of the study area was query to derive structure that falls within the 5m radius of the GSM mask point and added as a subset to the view as violated mask (Fig. 8 and Fig. 9).

Source: Author’s field work 2012

Fig. 6 : Cartographic model of violated GSM mask
Fig. 7: Map of Bida local government area showing 5m radius buffer of GSM masks

Source: Author's field work 2012

Fig. 8: Map of Bida local government area showing violated GSM mask

Source: Author's field work 2012
Findings
The analysis result shows that the NCC 5m setback guidelines to any demised property were violated at nine (9) different locations within Bida local government area as follows (Table 3).

Table 3: Mask with structure(s) within the 5m radius

<table>
<thead>
<tr>
<th>S/N</th>
<th>Mask location</th>
<th>GSM operator</th>
<th>Address</th>
<th>Structure type</th>
<th>Distance and cardinal point to mask</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Easting</td>
<td>Northing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>170590</td>
<td>1002939</td>
<td>Airtel</td>
<td>Poly Junction</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.6m North</td>
</tr>
<tr>
<td>2.</td>
<td>170590</td>
<td>1002939</td>
<td>Airtel</td>
<td>Poly Junction</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.8 East</td>
</tr>
<tr>
<td>3.</td>
<td>171239</td>
<td>1004917</td>
<td>Airtel/Mtn</td>
<td>State Library</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.2m East</td>
</tr>
<tr>
<td>4.</td>
<td>171584</td>
<td>1005233</td>
<td>Mtn</td>
<td>Takotafa</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.9m North</td>
</tr>
<tr>
<td>5.</td>
<td>171584</td>
<td>1005233</td>
<td>Mtn</td>
<td>Takotafa</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 West</td>
</tr>
<tr>
<td>6.</td>
<td>171311</td>
<td>1005829</td>
<td>Airtel</td>
<td>Mokola</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.1m North</td>
</tr>
<tr>
<td>7.</td>
<td>176660</td>
<td>1004423</td>
<td>Glo</td>
<td>Ndawanga II</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.2m South</td>
</tr>
<tr>
<td>8.</td>
<td>829070</td>
<td>1005835</td>
<td>Glo</td>
<td>Sen. I. Moh’D Rd</td>
<td>Residential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.4m West</td>
</tr>
<tr>
<td>9.</td>
<td>171333</td>
<td>1006705</td>
<td>Airtel</td>
<td>Esso Junction</td>
<td>Business</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.3 East</td>
</tr>
</tbody>
</table>

Source: Author’s field work 2012.
Summaries
The aim of this research work is to determine the GSM network operator that spatially violated the NCC guideline of 5m radius to the nearest demised property. This aim was accurately achieved using Geography Information System (GIS) which is a vital tool for sustainable development of any nation. GIS safe time, energy, money and give accurate information that can assist Government, Agencies, Policy maker etc. on environment issues which can bring about sustainable development of the environment.

CONCLUSION
The Nigerian Communications Commission (the Commission) pursuant to the powers conferred on it by Sections 70, 71, 72, 130, 134, 135 and 136 of the Nigerian Communications Act, 2003 came up with a guideline on Technical Specifications for the Installation of Telecommunications Masts and Towers: Environmental requirement setback (9c) (1) state that, a mask shall be 5 metres from any demised property excluding the fence and General matter (6a andd) Permissible Generator setback, sound level, smoke and vibration state that “All generators within a base station must be sited 5 meters away from all demised properties excluding the fence and the exhaust of all generators must not be directed towards any demised property”. However, the analysis result shows that the above guidelines were violated at nine (9) different locations within the Local Government Area which represent 27% non compliance on the part of GSM operators and this is a treat to sustainable environmental development.

RECOMMENDATIONS
The following recommendations are hereby suggested:
1. The network operators should with immediate effect relocate the affected masts and follow the specified NCC guideline on mast and generator setback.
2. The network operator to adequately compensate the people which their environmental right has been encroached upon.
3. NCC to setup a monitoring group to check the compliance level of the GSM operators and sanction violator.
4. Enlightenments campaigns to keep the people inform on the advantages, disadvantage and safety measures of GSM base station and generator emission.

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