IMPLEMENTATION OF LAWS & POLICIES ON MOBILE TOWERS & MOBILE PHONE RADIATION LEVELS IN INDIA: A CASE STUDY OF BATHINDA CITY

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BY

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CERTIFICATE

I declare that the dissertation entitled “IMPLEMENTATION OF LAWS & POLICIES ON MOBILE TOWERS & MOBILE PHONE RADIATION LEVELS IN INDIA: A CASE STUDY OF BATHINDA CITY” has been prepared by me under the guidance of Dr. Deepak Kumar Chauhan, Associate Professor, Department of Law, School of Legal Studies and Governance, Central University of Punjab. No part of this dissertation has formed the basis for the award of any degree or fellowship previously.

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ABSTRACT

Implementation of Laws & Policies on Mobile Towers & Mobile Phone Radiation Levels in India: A Case Study of Bathinda City

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Mobile phones are now an inevitable part of our day to day life. Besides being a communication device it is also being used for information and entertainment purposes. With the advancement in the telecommunication sector, the number of mobile towers and base transceiver stations has also increased significantly. This increase introduced the society to an unwanted evil i.e. radiation being emitted from the antennas of the mobile towers. Numerous studies show the ill effects of the radiation emitted from the mobile towers on the health of human beings as well as animals. The present study is an attempt to check the implementation of Laws & Policies available in India regarding the radiation from the mobile towers and infrastructural guidelines relating to the same. The study concludes that all the mobile towers situated in Bathinda City are radiating within the limits prescribed by the Department of Telecommunications (DoT). The study further shows that all the mobile towers taken as a sample are also in compliance with the infrastructure guidelines issued by the DoT. It is observed during the study that a large number of towers were operator certified towers. It is suggested that all the towers should be certified based on the tests carried out by the DoT rather than on the basis of the self-compliance certificate submitted by the operators. If due to certain procedural of financial issues it is tough to implement then it is further suggested that the certification done by the operator shall be cross-checked by the DoT at least once in a year to verify the authenticity of certificates submitted by the telecom operators.

Akashdeep Garg Dr. Deepak Kumar Chauhan

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Akashdeep Garg

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LIST OF ABBREVIATIONS

Sr.No	Full Form	Abbreviation
1	Base Transceiver Stations	BTS
2	Bharat Sanchar Nigam Limited	BSNL
3	Body Mass Index	BMI
4	Cabinet Committee of Infrastructure	CCI
5	Central Pollution Control Board	CPCB
6	Department of Telecommunications	DoT
7	Digital Subscriber Line	DSL
8	Electrocardiography	ECG
9	Electromagnetic Field	EMF
10	Electromagnetic Radiation	EMR
11	Global System for Mobile Communication	GSM
12	Heart Rate	HR
13	Heart Rate Variability	HRV
14	Indian Council for Medical Research	ICMR
15	International Commission on Non-Ionizing Radiation Protection	ICNIRP
16	International Mobile Equipment Identity	IMEI
17	Long Term Evolution	LTE
18	Mobile Service Provider	MSP
19	Mobile Tower Base Stations	MTBS

20	National Green Tribunal	NGT
21	Press Trust of India	PTI
22	Radio Frequency	RF
23	Respiratory Rate	RR
24	Specific Absorption Rate	SAR
25	State Pollution Control Board	SPCB
26	Telecom Enforcement Resource & Monitoring	TERM
27	Telecom Regulatory Authority of India	TRAI
28	Telecom Service Provider	TSP
29	Tower and Infrastructure Providers Association	TAIPA
30	Wideband Code Division Multiple Access	WCDMA
31	World Health Organization	WHO
32	Worldwide Interoperability for Microwave Access	WiMax

Chapter - I

Introduction

Mobile phones are now an inevitable part of our day to day life. Besides being a communication device it is also being used for information and entertainment purposes. In the last decade, the Indian telecommunications sector in general and mobile phone communication, in particular, have experienced a great growth. As per the data released by Telecom Regulatory Authority of India (TRAI), in the year 2017 out of total 1,198.89 million telecom subscription in the country 1,174.60 million are wireless connections.

Telecommunication services nowadays have become so advanced that it connected the people living in different parts of the world with each other. Today by spending a nominal amount of money we can communicate over the mobile phone with our friends and relatives easily. With the advancement in the telecommunication sector, the number of mobile towers and mobile tower base stations has also increased significantly. This increase introduced the society to an evil i.e. radiation which is emitted by the antennas of the mobile towers.

Due to the Electromagnetic Field (EMF) radiation emitted from the mobile towers there is a growing public concern about its possible adverse health effects. In recent years a number of health activists and resident organizations have begun to oppose the establishment of mobile towers on rooftops of the buildings situated in densely populated areas, claiming that the radiation of these facilities presents serious health risks.

The present study deals with the implementation aspect of the existing laws & policies relating to the radiation from the mobile towers and mobile phones in India. Before moving further there is a need to understand about certain terms, relevant facts and the working mechanism of the mobile phones which is discussed in detail in the coming paragraphs.

1.1 COMMUNICATION

In Nature, almost all the living beings are connected by way of communication. They communicate with each other and the world around them by the way of sounds for example frogs croak, whales sing, birds tweet and chirp and wolves howl. But the sound is not the only way in which they communicate. Like human beings, they also

communicate in both verbal and non-verbal ways. Examples of non-verbal communication by animals are like many different animals mark their territory with their scent which indicates other animals to stay away from the place and when a pet animal licks you a couple of times when you reach home it means he is happy to see you etc.

Human beings are considered to be the most intelligent beings among all the living beings and they can communicate over the long distances with the help of certain devices which any other living being cannot do. Communication is one of the most important device for the development of humanity. The word communication is derived from Latin term 'communicare' which means 'to share'[1]. It is an act by which intended meaning is conveyed by one person to another by way of sending and receiving information. The person who is sending the information is called sender and the person who receives the information is known as a receiver. The information which is conveyed can be facts, opinions, ideas, concepts, instructions, attitude or emotions. There are different types of communication like verbal, written and by way of body language. Here we are concerned mainly with the verbal form of communication. Verbal communication means sending a message through spoken language which is understood by both the sender and the receiver for example face to face talking and listening. Communication by way of the mobile phone is also included in the verbal communication. The first type of communication was by way of sounds and symbols. Symbols also included the art and crafting which was done on stones and in caves. Then came the writing. Writing made it easy to communicate with each other. It was with the help of the writing that the human being learned to read and speak. Pigeons were used as a carrier to send long distance messages and smoke signals were used as an alert on the arrival of enemies.

The first advanced system of communication was the telegraph it was used to send signals over wires from one location to another which was then translated into a message and translating these signals into a message was the task of an expert. The basic components used for operating a telegraph include a direct current source, a length of cable and a current pointing device such as a relay, a bell or a light bulb. The term telegraph comes from the Greek words "Tele" which means "at

[1]Communication defined, *available at:* http://www.communicationtoolbox.com/communication-definition.html (Visited on January 10, 2017).

a distance" and "graphien" which means "to write"[2]. An advancement over telegraph was a landline phone which was also a wired system of communication[3]. A landline is a telephone which transmits signals transferred from audio data through physical means such as a wire or fiber optic cables. Its functioning depends upon a dedicated line which is a permanent connection between two locations. These phones were fixed at a specific place in the house and its movement depended upon the length of the wire of the phone.

The first wireless communication[4] device was a mobile phone which was invented by Martin copper in 1973 who was a Motorola company employee. It is a telephone with access to a cellular radio system so that it can be used over a wide area without a physical connection to any network.[5] It contains radio transmitter and receiver for sending and receiving radio signals from other phones. The mobile phone is used to communicate over long distances without wires. But it cannot send signals very far so it works by communicating to a nearby base station (also called a "cell site") which connects it to the main phone network. Keeping in view the title of the research a detailed study is being done in this research including informative steps and implementation mechanism on the issue involved.

1.2 TELECOMMUNICATION

Telecommunication means the exchange of information over a significant distance by electronic and electrical means. The information is in the form of images, words, sounds etc., which is transmitted in the form of electromagnetic signals. For sending

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[2] Telegraph, *available at:* https://searchunifiedcommunications.techtarget.com/definition/telegraph (Visited on January 13, 2017).

[3] A wired communication means the transmission of data over a wire-based communication technology. Examples are cable television or internet access, and fiber-optic communication. Also waveguide (electromagnetism), used for high-power applications, is considered as wired line. Local telephone networks often form the basis for wired communications that are used by both residential and business customers in the area. Most of the networks today rely on the use of fiber-optic communication technology as a means of providing clear signalling for both inbound and outbound transmissions.

[4] A wireless communication is the transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors. The distance of transmission can be anywhere from a few meters (for example, television's remote control) and thousands of kilometres (for example, radio communication).The term wireless communication was introduced in the 19th century for the first time, and wireless communication technology has developed over the time. It is one of the most important medium of transmission of information from one device to another device. By this technology, the information can be transmitted through the air without any cable or wires or other electronic conductors, with the help of electromagnetic waves.

[5] Mobile Phone, *available at*: https://en.oxforddictionaries.com/definition/mobile_phone (Visited on January 14, 2017).

and receiving information a proper set up of two or more stations is needed which are equipped with transmitters and receivers. Telecommunication is a broad term and it covers a wide range of information transfer technologies such as telephones including both wired and wireless, microwave communications, fiber optic, satellites, radio & television, Internet, and telegraph.

1.3 RELEVANT FACTS ABOUT TELECOMMUNICATION

1.3.1 Telecom Infrastructure

A telecom infrastructure consists of two type of infrastructure i.e. electronic infrastructure and non-electronic infrastructure.

- Electronic infrastructure includes base tower station, antennas, transceivers for signal processing and transmission, microwave radio equipment and switches.
- Non-electronic infrastructure includes shelter, tower, electrical supply, air-conditioning equipment, diesel electric generator, battery and technical premise.

Base Transceiver Stations (BTS) or Mobile Tower Base Stations (MTBS) are an inevitable part of the telecom infrastructure system for a good quality wireless communication.

1.3.2 Mobile Tower

A Mobile Tower is a triangular/cone-shaped metal structure. It is more than nine meter in height which has three or more antennas fixed to it. Its structural height depends upon whether it is fixed on land or building. The height of the Ground-based towers varies from 30-200 meters however most of the towers are of 40 meters, and roof-top towers vary from 9-30 meters.

The mobile tower contains cellular communication equipment with an antenna to support cellular communications in the network. A cellular tower is usually a tall structure with the antenna, transmitters, and receivers at the top[6]. The source of Electromagnetic Radiation (EMR) from the mobile tower is its transmitting antenna

[6] Cell Tower, *available at*: https://www.techopedia.com/definition/6408/cell-tower (Visited on March 18, 2017).

because the Electromagnetic Field (EMF) distribution in the vicinity of the mobile tower is determined by the transmitting antenna itself.

Figure 1.1 Mobile Tower

Source: Department of Telecommunications

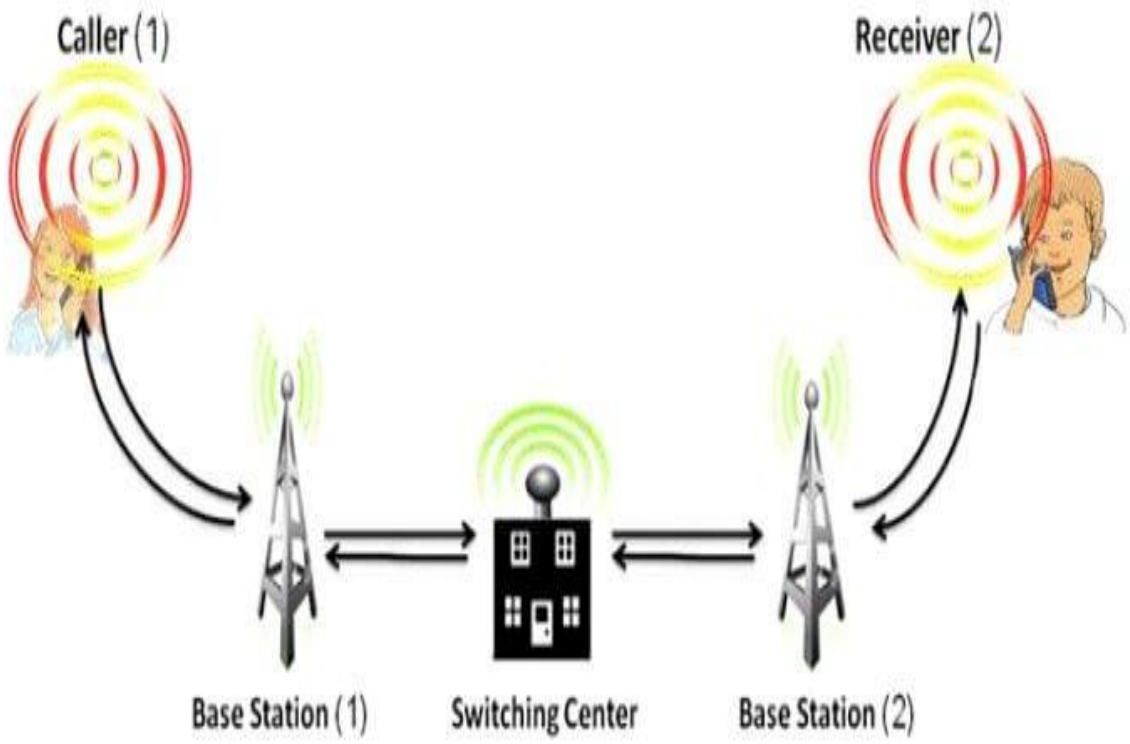
Figure 1.1 is showing a mobile tower having multiple antennas fixed to it. As the figure depicts that the antennas on the mobile tower are installed facing the different directions. It is done for providing the proper coverage of the network in the area near the mobile tower. More the number of antennas on a mobile tower greater is its power density in the neighborhood. The energy levels near the towers are more and minimize with distance. It is reduced to 1/4 when the distance from the mobile tower is doubled and when the distance from the mobile tower is tripled the power intensity reduces to 1/9 and so on.

There are primarily two sources of EMF radiation in the Mobile services. First one is the radiation from the mobile tower base station and second is the radiation from the mobile phone. Both of these fall under the non-ionizing radiation category as the chemical bonds in the molecules cannot be broken by the energy which is carried by them.

1.3.3 Working of Mobile Phone

Before knowing the issues of the use of mobile phone it is necessary to know the working mechanism of Mobile Phone. A brief of this is mentioned in the below-given paragraph.

Figure 1.2 Working of Mobile Phone[7]



Mobile phone operators divide a region into a large number of cells, and each cell is divided into a number of sectors. The base stations are normally configured to transmit different signals to each sector. There may be three sectors with equal angular coverage of 120 degrees in the horizontal direction as this is a convenient method to divide a hexagonal cell. If a number of users are distributed unevenly in the surrounding area, then the sectors may be uneven. These base stations are normally connected to directional antennas that are mounted on the roofs of buildings or free-standing masts. The antennas may have electrical or mechanical down-tilt so that the signals are directed towards ground level. Mobile Tower Antennas are the source of radiation in a mobile tower. When a call is made to a

[7] Working of Mobile Phone, *available at*: https://www.niftyhomestead.com/blog/cell-phone-radiation-in-images/ (Visited on October 20, 2017).

cell phone, a signal is sent by phone to the nearest telecom tower cell site. Phones and cell sites have a certain range and this range is affected by certain factors like tower placement, geographical area, the height of buildings and other things. The phone sends a signal to the top of the cell tower which then gets piped down into the service provider's underground cables. The signal shoots through the cables, eventually reaching the cell tower which is nearest to the person on the other end. It travels up from the ground to the top of the telecom tower, and it is sent to the phone held by the person we are talking to. Moreover, it is happening in the other direction too, so the phones are constantly sending and receiving information from the nearest cell towers to their respective locations and it all happens instantly. Mobile phones use the radio frequency electromagnetic field to communicate.

1.3.4 Electromagnetic Field (EMF)

EMF stands for the electromagnetic field which is created by electric power charges. It is the result of the interaction between the Electric field and the Magnetic field. The electric field is created by the strength of the charge, i.e. voltage and the magnetic field is created by the motion of the charge, i.e. amperage. When electric and magnetic fields interact with each other, the electromagnetic field is produced.

Electromagnetic field radiation is the flow of photons through space. A certain amount of energy is contained in each photon. It is the amount of energy contained in the photons that define the different type of radiations. The range of all types of electromagnetic radiation is the electromagnetic spectrum. This spectrum includes X-rays and the radio waves.

Besides the use of electromagnetic radiation in telephony, there are several other works in our day to day life in which it is used. Some of the important uses of the electromagnetic radiation in our daily life are as follows:-

- Electromagnetic radiation from Sun which is solar energy is used by plants by way of conversion into chemical energy to prepare food. This process is known as photosynthesis.
- Hospitals use X-rays for imaging the bone structure.
- X-rays are used in Airports and shopping malls in their security scanners.
- Microwave ovens and radars use microwaves in their functioning.
- Radio and television use radio waves for their broadcasts.

- Remote control of televisions and night vision goggles use Infra-red waves in their functioning.

Radio, Television transmission, Mobile networks (GSM, CDMA, and WLAN), Wi-Fi and WiMAX technologies are the most common source of exposure to electromagnetic radiation.

EMF radiations are divided into two categories, ionizing and non-ionizing, depending on its frequency and the power level.

Ionizing radiation is the electromagnetic radiation whose waves are containing the sufficient energy to create ions by overcoming the binding energy of electrons in atoms or molecules. E.g. Ultraviolet rays, X-rays, gamma rays and cosmic rays.

Non-ionizing radiation refers to electromagnetic radiation of any type whose waves does not carry enough energy per quantum to ionize the atoms or molecules. E.g. low-frequency radiations like radio waves, microwaves, and infrared radiations.

Ionizing radiation does not affect the living organisms adversely. But it can break chemical bonds and can cause the damage of vital molecules. The cells are able to repair themselves if the damage is minor but in case of major damage, the dead cells cannot be repaired very quickly.

There are two ways in which the effect of EMF radiation on human health can be studied which are bio-effects and health effects. Bio-effects refers to the responses to a change in the atmosphere. It is not necessary that bio-effects are harmful to our health. But on the other hand health effects of EMF radiation may be harmful to human health. These effects put a stress on the internal system and this stress causes short-term or long-term changes in the internal system of the body. Biological effects are further divided into two categories i.e. Thermal and Non-thermal effects.

1.3.5 Growing Tele-density

Telecom sector is growing at a very fast rate. Mobile voice and data traffic have increased tremendously. To cope up with the need of growing cellular traffic more and more mobile towers are being erected every year. According to the information provided by Department of Telecommunication on their EMF portal Tarang Sanchar there are total 4, 62,328 Cell Sites and 17, 20,765 Base Transceiver Station (BTS).

1.3.6 Telecom Subscription in India

Table 1.1 represents the Data of Telecom Subscription in India as per the press release (43/2017) issued by Telecom Regulatory Authority of India (TRAI) on 30 April 2017. It depicts that the number of telephone subscribers at the end of April 2017 in India was 1,198.89 million. From which the urban subscription is 695.99 million, and the rural subscription increased to 502.90 million during the same period.

Table 1.1 Telecom Subscription in India

Particulars	Wireless	Wireline	Total (Wireless+Wireline)
Urban Telephone Subscribers (In Million)	675.48 (97.05)	20.52 (2.95)	695.99 (100)
Rural Telephone Subscribers (In Million)	499.12 (99.24)	3.78 (0.76)	502.90 (100)
Total Telecom Subscribers (In Million)	1,174.60 (97.97)	24.30 (2.03)	1,198.89 (100)

Source: Telecom Regulatory Authority of India, 2017.

Further, it represents that the share of wireline connection in comparison to a wireless connection is meager. As table shows in case of urban telecom subscription-only 2.95 percent population has wireline subscription and rest has a wireless subscription. In case of the rural population, the share of wireline subscription is lesser that is only 0.76 percent. Overall, 2.03 percent population has wireline subscription. The table concludes that majority of the population has wireless telecom connections.

1.3.7 Tele-density

Teledensity means the number of the telephone connections in an area for every 100 Individuals. The telephone connections are of two types i.e. wireless and telephones connected with a wire. The trend of wireless telephone connections is increasing day by day.

Table 1.2 Tele-density in India

Particulars	**Tele-density (in %)**
Wireless	91.34
Wireline	1.89
Total	93.23

Source: Telecom Regulatory Authority of India, 2017.

Table 1.2 shows that the overall Tele-density in India at the end of Apr-17 was 93.23%. Overall Tele-density rate is an average of the Tele-density of different States. From which wireless Tele-density is 91.34% and wireline Tele-density is only 1.89%.

It is clear from the table that the wireless Tele-density is very much high with a comparison to wireline Tele-density. The reason for this much difference is modernization and technological development. The new technology that is mobile is also compact and easy to take anywhere which make it more popular.

The Urban Tele-density increased by 172.28% and the Rural Tele-density also increased by 57.02% till Apr-17. The mobile phones are now within the reach of poor people due to their low prices which is the result of the technological advancement. This is the main reason for the sharp increase in Tele-density rate both in urban and rural areas.

In the totality of telephone subscribers, the share of urban subscribers and rural subscribers till Apr-17 was 58.05% and 41.95% respectively.

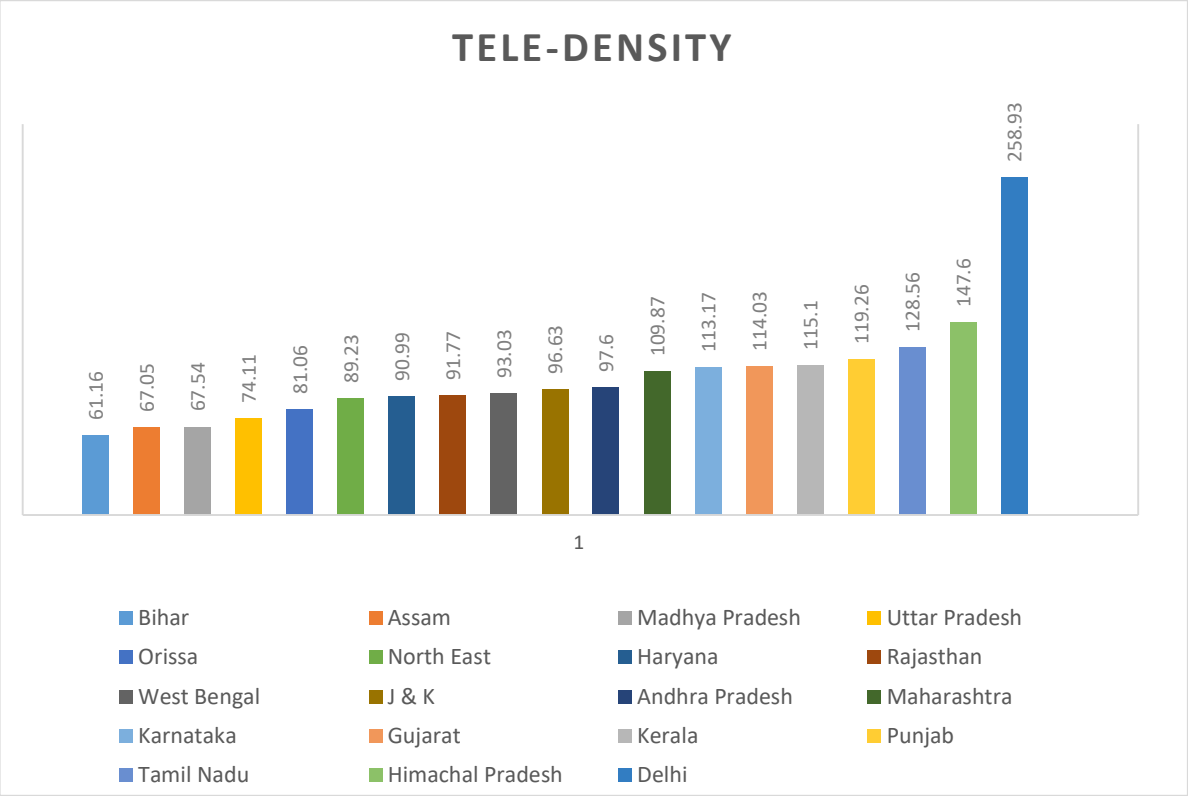
Table 1.3 depicts the state wise percentage of teledensity. It shows that the State of Bihar has the lowest Tele-density rate which is 61.16 percent and Delhi have the highest Tele-density rate that is 258.93 percent. It further represents that the state of Maharashtra, Karnataka, Gujrat, Kerala, Punjab, Tamilnadu and Himachal Pradesh have more than hundred percent teledensity rate. Which is 109.87 percent, 113.17 percent, 114.03 percent, 115.1 percent, 119.23 percent, 128.56 percent and 147.6 percent respectively.

Table 1.3 State wise Tele-Density

State	% of Tele-density
Bihar	61.16
Assam	67.05
Madhya Pradesh	67.54
Uttar Pradesh	74.11
Orissa	81.06
North East	89.23
Haryana	90.99
Rajasthan	91.77
West Bengal	93.03
J & K	96.63
Andhra Pradesh	97.6
Maharashtra	109.87
Karnataka	113.17
Gujarat	114.03
Kerala	115.1
Punjab	119.26
Tamil Nadu	128.56
Himachal Pradesh	147.6
Delhi	258.93

Source: Telecom Regulatory Authority of India, 2017.

Figure 1.3 State wise Tele-Density



Source: Telecom Regulatory Authority of India, 2017.

Figure 1.3 is the diagrammatical representation of Tele-density rate of different States in the ascending order. It represents that from given 18 states and 1 union territory Delhi, 11 states have less than 100 percent Tel- density rate and the remaining 8 states and Delhi has more than 100 percent Tele-density rate.

As per the recent data released by TRAI vide Press Release No. 56 of 2018 (Dated 23 May 2018). The Indian telecommunications network at present is the second largest network in the world in terms of a number of telephone users after China including both the landline and mobile telephones with 1,206.22 million subscribers as of March 31, 2018. The same trend is in the case of the internet subscribers as India has the second largest Internet user base after China in the world with 412.60 million Internet subscribers in the country[8]. Out of the total wireless subscription the private companies are having 90.55 percent of market share and Public Sector Undertaking which are MTNL and BSNL are having only 9.45 percent market share.

[8] Press Release, *available at*: http://www.trai.gov.in/sites/default/files/PRNo56Eng23052018.pdf (Visited on May 26, 2018).

1.4 MOBILE PHONE USE & HEALTH ISSUES: MYTH OR REALITY

After knowing the working of mobile phone now there is need to elaborate and analyze the myth to reality aspect of the effects of radiation from the mobile phone and Mobile Tower Base Stations on the health of its users. According to the various studies conducted at International and National level, it is clear that the Mobile Phone and Mobile Tower Base Station radiation has a significant effect on the health of its users and the people living in the area near the Mobile Tower Base Stations. It is evident from a study by Bhat, M. and Kumar, V.[9] that if the mobile phone is used for 45 minutes than the heating of area near the ear skull is caused and the amount of this heating is different in different types of Mobile Phones. The Phones having external antenna cause more heating than the phone having an internal antenna. People living near the Mobile Tower Base Stations are having issues like skin disease and hair loss and also unwanted nerve stimulation, cancer, heating effects, and many other unwanted effects. But according to the report submitted to the Department of Telecommunications (DoT) in 2012 by 13 member panel[10], there is no effect of the radiation on human beings and further stated that the radiation caused by the Mobile Phones and Mobile Tower Base Station is safe. Mobile Towers were given the status of infrastructure in 2012 and area restrictions were also removed. According to Prof. Girish Kumar in his report submitted to DoT in 2010[11] he stated that radiation is like cigarette smoking whose effects are visible in the long term. Here it is to be mentioned that Prof. Girish Kumar was one of the panelists of the report submitted in 2012. He was of contrary opinion and said that he does not agree with the report of panel submitted to DoT and according to him if we want to know that whether the effect of radiation from Mobile Phone and Mobile Tower Base Station is a Myth or Reality, there is need to conduct more studies on the issue.

1.5 PROBLEM PROFILE

The title in issue for research work basically focuses on the implementation aspects of laws as well as policies dealing with the radiation from mobile towers and mobile phones during its mechanism. The problem in the study is basically to know about

[9] M. Bhat, & V. Kumar, "Calculation of SAR and Measurement of Temperature Change of Human Head Due To The Mobile Phone Waves At Frequencies 900 MHz and 1800 MHz" 16 IISTE 54-63 (2013).
[10] News, *available at*: http://indianexpress.com/article/cities/mumbai/radiation-from-cell-towers-in-india-not-harmful-panel/ (Visited on June 13, 2017).
[11] Report on Cell Tower Radiation, *available at*: https://www.ee.iitb.ac.in/~mwave/GK-cell-tower-rad-report-DOT-Dec2010.pdf (Visited on June 15, 2017).

the mechanism working for implementation and monitoring and also the tuff procedure to know the actual value of radiation from the mobile towers. VM Katoch, Director General of Indian Council for Medical Research (ICMR) explained regarding the impact of radiation emitted from the mobile towers that "We need not blame technology just for the sake of it. But given divergent views coming from various sections of society, air must be cleared by unbiased surveys." A user nowadays is becomes more and more dependent on electronic gadgets such as microwave, television and cell phones, so their impact on the health must be assessed.

It is clear that the antennas installed on the mobile tower emit radiation and this radiation is harmful to the human beings. The Supreme Court on March 30, 2017, has issued closure of a Mobile Tower of Bharat Sanchar Nigam Limited (BSNL) located in a residential area in Gwalior on suspicion of its causing cancer to the petitioner Harish Chand Tiwari a domestic help[12]. During the audit which was carried out by Telecom Enforcement Resource and Monitoring (TERM) Cell as on June 30, 2017 total 284 number of mobile towers have been found exceeding the Electro Magnetic Field (EMF) radiation limits.[13] So this shows that the radiation emitted by the mobile towers is exceeding the prescribed limits. Therefore with the help of this research, the researcher aims to analyze all the issues discussed above and to find out a solution to the problem of non-implementation of laws relating to the radiation and infrastructure due to the various reasons.

The area of study under consideration is Bathinda city as no EMF audit of the mobile tower/mobile tower base station has been conducted in the city by the Department of Telecommunication after the year 2015-16.

1.6 OBJECTIVES OF THE STUDY

Keeping in view the concept of radiation of mobile phones from health aspect to legal aspect. The main general objectives of the present study are to understand the basic concept of mobile phone radiation, identification of major issues, and legal

[12]Supreme Court order, *available at*: http://www.livelaw.in/sc-directs-deactivation-bsnls-mobile-tower-complaint-cancer-patient/ (Visited on April 14, 2017).

[13] Towers exceeding radiation limits, *available at*: http://economictimes.indiatimes.com/news/politics-and-nation/airtel-vodafone-top-in-list-of-towers-exceeding-radiation-limit/articleshow/59989221.cms (Visited on August 10, 2017).

perspectives in Indian system and to analyze all these issues in the light of the radiation laws. A brief of objectives of the study are as follows:

- To study the Laws and Regulations adopted in India relating to the Mobile Phone/Mobile Tower Radiation.
- To know about the compliance of radiation emission norms w.r.t. the mobile towers situated in the Bathinda City.
- To know about the implementation level of the infrastructural laws/guidelines in relation to the Mobile Towers situated in the Bathinda City.

Specifically, the research would try to analyze the implementation of Mobile Phone/Tower radiation and infrastructural laws with its existing mechanism.

1.7 IMPORTANCE OF THE STUDY

The study is specifically based on radiation from the mobile phone and mobile tower base stations. This research will help the public to know about the emission level of the mobile tower in their locality. This study will also try to check the adequacy and implementation of laws and regulations relating to emission of radiation from mobile towers as well as infrastructural law in India. The study will help in curing the existing loopholes and will also facilitate the government in strengthening the existing laws and in formulating the new policies (if required) regarding the mobile tower radiation and also to provide valuable information to users regarding the emission levels of the mobile towers erected in the area concerned. People will know that whether the mobile towers in the city are compliant with the EMF norms or not. This research is not only being conducted for getting the award of LL.M. Degree but it is being conducted to facilitate the public at large and to contribute in the area for public welfare.

1.8 HYPOTHESIS OF THE STUDY

Keeping in view the objectives of this research, information collected from various resources and also on the basis of literature review, the following hypothesis has been framed:

i. The very first issue as taken in this research is about the sufficiency and accurate implementation of laws and policies related to radiation from the devices used and the same is testified during the discourse of this work:

a) The sufficiency of laws relating to Mobile Phone/Mobile Tower radiation it is hypothesized that laws are available but not in sufficient number;

b) The capacity of implementation of existing laws relating to Mobile Phone/Mobile Tower radiation, it is hypothesized that it is not up to accurate implementation level.

But the results are on the basis of Research Area i.e. Bathinda City.

ii. On the second issue as taken in this research is related to the first one as the compliance of laws and policies in respect to the infrastructure required to provide the services and which will also be tested during the discourse of the work simultaneously with the first hypothesis, which is as follows:

a) The sufficiency of infrastructural laws of Mobile Tower Base Station it is hypothesized primarily that laws are available but not in sufficient number;

b) Secondly the capacity of implementation of existing infrastructure laws, it is hypothesized that it is not up to accurate implementation level.

But the results are on the basis of Research Area i.e. Bathinda City.

Both the above issues are under Hypothecation and Testification under the purview of laws and norms relating to Mobile tower radiation and infrastructural laws.

1.9 CHAPTERISATION OF THE STUDY

The work is divided into six chapters namely, Introduction, Review of Literature, Laws, and Norms relating to Mobile Tower Radiation and Infrastructural Laws, Research Methodology, Data Analysis and Survey Report, Conclusion and Suggestions.

The First chapter introduces the title, theme, and idea of the work. It also focuses on the problem profile, relevancy, objectives, hypothesis etc. about the work.

The second Chapter of research deals with the analysis of Literature Review on the specific objectives of research and takes into consideration of analysis on research gap.

The third chapter covers Research Methodology in detail.

The fourth chapter deals with the Laws and Norms relating to Mobile Tower Radiation and Infrastructural Laws.

The fifth chapter covers the implementation level of Mobile Tower Radiation emission norms and infrastructural laws based on the analysis of data collected by way of Survey conducted in Bathinda City.

Chapter sixth of the work leads to Conclusion based on the objectives of the study and some suggestions are also made in this section

Chapter - II

Review of Literature

The issue of radiation from mobile towers is not a new phenomenon and it always remained in the light. Penalties imposed on various telecom service providers for floating radiation norms and a recent order of the Honorable Supreme Court for the closure of a Mobile Tower on suspicion of causing cancer to the petitioner attracted the researcher towards the issue. It shows that there may be a lack of proper implementation of laws relating to radiation emitted from mobile towers. An extensive literature review is incorporated into this chapter keeping in view the problem of radiation from mobile towers and laws and regulations related to the issue.

The researcher gives proper respect to the works of previous researchers and all the associated works related to the topic. The coming paragraphs are the efforts to review the relevant literature in a periodical form covering the literature published from the year 2003 to 2018. The review of literature is divided into four categories namely review of books, review of research papers, review of news articles and review of case laws. An endeavor has been made by the researcher for consolidating the important works related to the topic at one place.

2.1 REVIEW OF BOOKS

Peter Stavroulakis edited book titled "Biological Effects of Electromagnetic Fields"[14] published in 2003 explains that the biological effect of electromagnetic fields is dielectric heating which varies with the power and the frequency of the electromagnetic energy. If a small amount of the heat is generated, the body's thermoregulatory mechanism can dissipate it without causing adverse effects. If the temperature exceeds this capacity, about one to two degree Celsius, tissue damage may occur. Electromagnetic fields can be considered harmful to the health. Different devices such as radio, television broadcast stations, computers, microwave ovens, cellular phones, surveillance systems and communications satellites and navigational aids radiate electromagnetic energy during their use. The pollution from

[14]Peter Stavroulakis (Ed.), *Biological Effects of Electromagnetic Fields* (Springer Verlag Berlin Heidelberg, 2003).

man-made electromagnetic fields has increased so rapidly that the biological consequences have paced up even at a faster rate.

Alasdiar Philips and Jean Philips book titled “The Powerwatch Handbook: Simple Ways to Make Your Environment Safer”[15] published in 2006 is a simple and logical guide to electromagnetic fields and how to reduce its harmful effect. It provides information in an easy-to-follow manual. EMF levels are classified using a star rating system, high-level elements are highlighted and practical advice is given in a step-by-step format. Electrical devices, electrical cables, power lines, machinery, cameras, cell phones, radios, televisions, tube trains, X-rays, and lasers are among the hundreds of everyday items that are now known to provide high levels of radiation. The book further explains that Electromagnetic fields (EMF) can be biologically active and capable of altering the structure of human and animal cells exposed to them. It is further stated in the book that It is believed by a growing number of scientists and specialists in environmental protection that long-term exposure to electromagnetic fields is linked to tumors, fertility problems, behavior and changing mood, concentration and memory loss, as well as the impact in the production of melatonin and weaken the reform mechanisms of the immune system.

Jonathan Halpern in “Electromagnetic Radiation Survival Guide: Step by Step Solutions -Protect Yourself & Family NOW!”[16] published in 2014 gives step by step complete Electromagnetic fields (EMF) or Electromagnetic Radiation (EMR) detection and reference manual. The book covers the most important EMF/EMR issues including cell phone & telecommunication towers, smart meters, cell phones, tablets, laptops, Wi-Fi, Blue-tooth, hi voltage power cables, electrical appliances, and wiring. In this book, the author states that wireless technology and the electrical power have caused a great increase in electromagnetic fields in our environment. He further states that there is substantial scientific evidence that Electromagnetic Radiation exposure below the existing safety standards may also cause a range of bio-effects that increase the risk of serious diseases including cancer, neurodegenerative disorders, sleep and behavioral disorders. At last, the author

[15]Alasdiar Philips and Jean Philips, *The Powerwatch Handbook: Simple Ways to Make Your Environment Safer* (Little Brown Book Group, 2006).
[16]Jonathan Halpern, *Electromagnetic Radiation Survival Guide: Step by Step Solutions -Protect Yourself & Family NOW!* (CreateSpace Independent Publishing Platform, 1st edn., 2014).

concludes stating that EMF has become one of the greatest health hazards of our times.

Girish Kumar and Neha Kumar's report named "Report on Cell Tower Radiation"[17] published in 2016 is a compilation of more than two hundred scientific peer-reviewed references on a cell phone and cell tower radiation hazards. It mentions the advantages and disadvantages of mobile phone technology. It also discusses the radiation pattern of cell tower antenna, the norms adopted by various countries, theoretical and measured radiation power at various locations, biological effects on humans - the brain, eye, ear, skin, nervous system, heart, cognitive issues, infertility, cancer, etc. Not only humans but several birds like sparrows, insects like butterflies and bees, and plants and animals have been affected by high power cell tower radiation. At the end of the report, suggestions are offered as a balanced approach to solve problems from this invisible hazardous radiation.

2.2 REVIEW OF RESEARCH PAPERS

D.R.Cox in a research paper titled "The Communication of risk: health hazards from mobile phones"[18] published in 2003 states that mobile phones provide an interesting example of a source of risk to health which may non-existent but which cannot be dismissed. Their effects might not be visible in the short term but can be seen in long-term. He further states that there is appreciable evidence that uses of mobile phones while driving is hazardous. He differentiates the effect of the mobile base station from mobile phones. He is of the view that mobile base stations are not to be set up near sensitive areas like schools. He has divided the effects of the use of mobile phones in two categories that is one is short-term effect and other is a long-term effect. He is of the view that if specific energy absorption rate SAR value is high, it may adversely affect in the long term.

Ryszard Andrzejak, Rafal Poreba, et al. research paper titled "The influence of call with a mobile on Heart rate variability parameters in healthy volunteers"[19] published in 2008 demonstrated that the call with a mobile phone might influence heart rate

[17]Girish Kumar and Neha Kumar, *Report on Cell Tower Radiation* (LAMBERT Academic Publishing, 2016).
[18]D. R. Cox, "Communication of risk: health hazards from mobile phones" 166(2) J R Stat Soc Ser A Stat Soc, 241-246 (2003).
[19]Ryszard Andrzejak, Rafal Poreba, et.al., "The influence of call with a mobile on Heart rate variability parameters in healthy volunteers" 46(4) Ind Health 409-417 (2008).

variability and change the autonomic balance. The increase in the parasympathetic tone concomitant with the decrease in the sympathetic tone measured indirectly by analysis of heart rate variability was observed during the mobile telephone call. It had been interpreted that changes in heart rate variability during the call with a mobile phone could be affected by an electromagnetic field.

Surita Maini, Amanpreet Singh, et al. research titled "Biological Effects and Therapeutic Applications of Electromagnetic Radiations"[20] published in 2009 explains that it is known the Electromagnetic fields penetrate deep inside the living tissue and consequently the biological system gets affected. It is believed that association of electromagnetic fields increases health problems and behavioral changes. Such as epilepsy, leukemia, cancer, brain tumor, Parkinson's disease, fatigue, headache, and loss of appetite, decreased blood pressure, itching, and alteration in the gene expression etc. Many scientists and physicians suggest a link between these disorders and long-term exposure to EMF.

Blake Levitt and Henry Lai's research article titled "Biological effects from exposure to electromagnetic radiation emitted by cell tower base station and other antenna arrays"[21] published in 2010. In this article, they stated that the sitting of cellular phone base stations and other cellular infrastructure such as roof-mounted antenna arrays, especially in residential neighborhoods, is a contentious subject in land-use regulation. Local resistance from nearby residents and land owners is often based on fears of adverse health effects. Despite reassurances from telecommunications service providers that international exposure standards will be followed, the resistance does not diminish. The reports and some epidemiology studies have found headaches, skin rashes, sleep disturbances, depression, decreased libido, increased rates of suicide, concentration problems, dizziness, memory changes, an increased risk of cancer, tremors, and other neurophysiological effects in populations near base stations. Symptoms reported today may be classic microwave sickness, first described in 1978. Non-ionising electromagnetic fields are among the fastest growing forms of environmental pollution. Some extrapolations

[20]Surita Maini, Amanpreet Singh, et.al., "Biological Effects and Therapeutic Applications of Electromagnetic Radiations" COMSOL (2009).
[21]Blake Levitt & Henry Lai, "Biological effects from exposure to electromagnetic radiation emitted by cell tower base station and other antenna arrays" 18 Environ. Rev. 369–395 (2010).

can be made from research other than epidemiology regarding biological effects from exposures at levels far below current exposure guidelines

A.A. Ayeni, K.T. Braimoh, et al. in the study titled “Effect of GSM Phone Radiation on Human Pulse Rate (Heartbeat Rate)”[22] published in 2011 collected the data on the effect of mobile phone radiation on health, especially in connection with a human heart in Nigeria. In the analysis carried out, it has been found that the old ones of age forty years and above, showed a slight decrease of 1.4 percent in the pulse rate after exposure. Even though this is just barely above one percent, they advised that people of this age group should avoid keeping phone anywhere close to their heart as this may further put stress on their aging hearts.

Ankur Mahajan and Mandeep Singh’s study titled “Human Health and Electromagnetic Radiation”[23] published in 2012 taken into account the adverse effects of the electromagnetic fields on the human body. This study concluded that electromagnetic fields are harmful and can have an adverse effect on the human body depending upon the intensity and frequency of Electromagnetic field. It is always a good idea to avoid the unnecessary exposure to electromagnetic fields whenever possible. They said that technology makes our life very comfortable but at the expense of our health. It is our first duty to save our lives. Thus we should use technology wisely so that we can save ourselves as well as mother earth.

Bagyalxmi Kodavanji, Venkappa Siddappa, et al., in a study named “A pilot study of long-term effects of mobile phone usage on HR variability in healthy young adult male”[24] published in 2012 stated that they selected thirty-seven healthy male volunteers of ten to twenty-four years age group. Their consent was taken before the experiment. Their physical examination including Blood pressure, Body Mass Index (BMI), Heart Rate (HR) and Respiratory Rate (RR) was done. They were divided into two groups of mobile users for more than one year and non-mobile users. The autonomic activity was assessed by recording Electrocardiography (ECG) and calculating heart rate. The Heart Rate Variability (HRV) was analyzed both by time domain and frequency domain. Statistical analysis was performed

[22]A.A. Ayeni, K.T. Braimoh, et.al., “Effect of GSM Phone Radiation on Human Pulse Rate (Heartbeat Rate)” 2(11) JETCIS 580-587 (2011).
[23]Ankur Mahajan & Mandeep Singh, “Human health and electromagnetic radiation” 1(6) IJEIT 95-97 (2012).
[24]Bagyalxmi Kodavanji, Venkappa Siddappa, et.al., “A pilot study of long term effects of mobile phone usage on HR variability in healthy young adult male” 6(3) JCDR 346-349 (2012).

using data from student's unpaired t-test. In time domain analysis HRV showed no statistically significant difference between two groups. But in the frequency domain, a significant difference is observed concluding that mobile users had a higher sympathetic tone and lower parasympathetic tone as compared to mobile non-user.

Chandran et al**.** in the study titled "A Survey on the Impact of Radiation Emitted by the Cell Phone Tower on Human Subjects"[25] conducted in 2012 designed the survey to identify the common diseases prevailing among the people dwelling in different zones near the cell phone tower. The subjects had been divided into two groups as zone I subject dwelling in proximity up to fifty meters from the cell phone tower and zone II subjects dwelling in proximity up to hundred meters from the cell phone tower. It is evident from the study that skin disease and hair loss was common among the subjects living in zone II when compared to the subjects living in zone I. It is also evident from the study that diabetic, cardiac, and respiratory patients were markedly higher in the subjects living in zone I when compared to the subjects living in zone II. The study further shows that regarding the problem of cancer, epileptic, and insomnia the number of patients was insignificant. These results were same in people living in both zones I and zone II.

Kaushal and Kumar**'**s study titled "Effects of Mobile Tower Radiations & Case Studies from different Countries Pertaining the Issue"[26] published in 2012 have explored that mobile phone usage has been rapidly spreading globally and to provide proper signal strength the numbers of cell towers are also increasing worldwide. The harmful effects of Mobile Tower Radiations are seen in many countries. Many people are not aware of mobile phone and mobile tower radiations which are very harmful due to electromagnetic radiation (EMR) exposure. Pertaining this issue, the researchers have discussed case studies from different countries in their paper which concludes that one should be aware of mobile tower radiations. People living near cell tower receive strong signal strength but at the expense of health. So, they suggest, little bit poor connectivity is better than having health problems.

[25]M. Chandran, S. B. Hariram, et.al., "A Survey on the Impact of Radiation Emitted by the Cell Phone Tower on Human Subjects" 1(3) IJLBPR 171-173 (2012).
[26]M. Kaushal, A. Kumar, et.al., "Effects of Mobile Tower Radiations & Case Studies from different Countries Pertaining the Issue" 7(11) IJAER (2012).

Monika Atudori and Magurel Rotariu's study titled "Electromagnetic radiation field near tower line and its impact"[27] published in 2012 studied how electromagnetic map of three-phase power line impact over the human body, electrical equipment, and the surrounding environment. The research concerning to the effect of the electromagnetic field on the living organism has shown that these influences had a different impact on the intracellular phenomenon, cells, organs and the organism itself. This research elaborated new formalities of the pollution sources and implemented new criterion techniques of the human body against electromagnetic field influence.

M. Bhat and V. Kumar's research paper titled "Calculation of SAR and Measurement of Temperature Change of Human Head Due To The Mobile Phone Waves At Frequencies 900 MHz and 1800 MHz"[28] published in 2013. It discussed the result of thermal distribution generated by hand-held mobile phone towards the human head by the collection of the image with the help of the thermal imaging camera. The analysis conducted in an anechoic chamber with an average of forty-five minutes talking with two different types of mobile phones having internal and external antenna serving different radio frequency range of 900 MHz and 1800 MHz. The results showed an increase of heat at the place near the ear skull after forty-five minutes of use of mobile phone. When comparing the different types of mobile phone, a mobile phone with external antenna produce more heat compared to a mobile phone with internal antenna.

Yuvarani and Latha's study titled, "Cell Phone Tower: A Gift or Curse" [29] published in 2013 explained that cell phone towers pave the way for hazardous effects from radio frequency waves to the human health. Further, they explained that the human body is an electrical system. It will be and is affected by outside radio frequency energy fields that can promote unwanted nerve stimulation, cancer, heating effects, and many other unwanted effects. They concluded by stating that a cell phone tower will be a gift if we are following the safeguard systems and if not it will become a curse to our life.

[27]Monika Atudori & Magurel Rotariu, "Electromagnetic radiation field near tower line and its impact" 74(1) U.P.B. Sci Bull 231-238 (2012).
[28]M. Bhat, & V. Kumar, "Calculation of SAR and Measurement of Temperature Change of Human Head Due To The Mobile Phone Waves At Frequencies 900 MHz and 1800 MHz" 16 IISTE 54-63 (2013).
[29]A. Yuvarani, & R. Latha, "Cell Phone Tower: A Gift or Curse" 2(4) IJSR 70-73 (2013).

Jain et al. in a study entitled “Mobile tower radiation– Affects, Assessments and Monitoring of IIT Roorkee Campus” [30] conducted a field study in 2014 at Indian Institute of Technology (IIT) Roorkee campus aimed to examine and analyze the mobile tower radiation levels in the campus. Experiments had been performed and power levels were recorded at selected sites. According to the research, the study area i.e IIT Roorkee is safe as per the guidelines adopted in India. However, the health impact of the radiations needs further medical studies specific to the Indian trend. They opine reduction in power density will reduce the radiation effect. So they suggest more stringent guidelines so that health impacts should be minimized by regulating the radiation level.

Lalrinthara Pachuau and Zaithanzauva Pachuau in the research paper titled “Study of Cell Tower Radiation and its Health Hazards on human body”[31] published in 2014 studied the effect of Radio Frequency radiation on human body. In this study Power density of Radio Frequency radiation from a mobile tower near the mobile base station at the selected locality in Aizawl of Mizoram in India was measured. It was found that different health symptoms of Radio Frequency (RF) exposure was faced by the inhabitants within fifty meters and outside fifty meters from the tower. The inhabitants living within fifty meters were having more health complaints than those living outside fifty meters. It was also found that females were having more complaints than males. The study concluded by stating that mobile tower should not be erected in populated areas and also suggested that human dwelling should be avoided within fifty meters from the site of the tower.

Suchetha Vijay, Asha Hegde et al., research titled “Study on Electromagnetic Radiation from Cell Phone Towers and Their Effects on Animals, Plants and Environment”[32] published in 2014 explains that Electromagnetic radiation from Cell phone and cell tower affects the birds, animals, plants, and environment. When birds are exposed to weak electromagnetic fields, they disorient and fly in all directions which harm their natural navigational abilities. A large number of birds like pigeons,

[30]A. Jain, K. Jain, et.al., “Mobile tower radiation–Affects, Assessments and Monitoring of IIT Roorkee Campus” 3(7) IJARCET 2313-2316 (2014).
[31]Lalrinthara Pachuau and Zaithanzauva Pachuau, “Study of Cell Tower Radiation and its Health Hazards on human body” 6(1) IOSR-JAP 1-6 (2014).
[32]Suchetha Vijay, Asha Hegde, et.al.,“Study on Electromagnetic Radiation from Cell Phone Towers and Their Effects on Animals, Plants and Environment” 3(7) IJIRCCE 370-374 (2015).

sparrows, and swans are getting lost due to interference from the “unseen enemy” i.e. mobile phone masts. Animals near mobile towers are prone to various dangers and threats to life including stillbirths, spontaneous abortions, birth deformities, behavioral problems and a general decline in overall health. The researchers further pointed out that electromagnetic pollution is a possible cause for deformations and decline of some amphibian populations too. Apart from birds and animals, electromagnetic radiation emanating from cell towers also affect vegetable, crop, and plants in its vicinity.

T.Y.P. Singh and M.L. Chandna’s study titled “An Extensive Study & Impact of Radiation from Mobile Towers to Living Being”[33] published in 2014 assert to provide the mobile network to the countrywide and states that many Service Providers are providing internet services to customer satisfaction. Without caring about the rules, regulations for protection from the towers. This paper is an extensive study of the harmful radiations and their impact on the human being and nature. The study further explains that the radiation from a mobile phone or mobile tower is worse than smoking. One cannot see or smell it and after a long period of exposure its effect is noted. The researchers state that we are exposed to continuous radiation and in addition to the radiation from cell towers, there is radiation from cell phones, wireless phones, computers, laptops, television towers, Frequency Modulation towers, Amplitude Modulation towers, microwave ovens, etc. The author suggested for implementation of strict laws to prevent public from the harmful radiation and further stated that real wealth of a country is the health of its citizens.

Tambe in the study titled “Review of Mobile tower radiation effects on Human and Mitigation techniques”[34] published in 2015 identified that enormous installation of the mobile phone tower throughout the world raised the health concern due to high electromagnetic radiation in the area situated near these towers. The study brings forward that there is need to assess the radiation level and its impact on the public health. It is suggested by the researcher that the techniques for mitigation the radiations should be adopted. The researcher also suggests that the wireless service provider should consider and follow the recommendation given by

[33]T.Y.P. Singh & M.L. Chandna, “An Extensive Study & Impact of Radiation from Mobile Towers to Living Being” 3(3) IJIEASR 7-11 (2014).
[34] K.M. Tambe, “Review of Mobile tower radiation effects on Human and Mitigation techniques” 3(2) IJRITCC 622-625 (2015).

Telecommunication Standardization Sector (ITU-T). The author is of the opinion that long-term studies and research should be carried out on the antenna characteristics and its exposure levels. It is the view of the researcher that one cannot avoid the use of mobile phone, but limited use of mobile phone can limit the health risk. The researcher also suggested revising the guidelines and threshold limits specified by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Hemant Pathak's research paper titled "Effects of mobile tower radiation and its health impacts- a case study" [35] published in 2016 states that mobile usage has rapidly increased in India and to provide proper network coverage the number of cell tower also increased and the amount of radiation from these cell towers is huge due to their dense installation. The researcher further states that people are using cell phones but they are not aware of their health impacts. Increasing radiation levels in public places are causing many health problems. The government has to make any uniform policy for mobile tower installation and research is to be conducted to make mobile radio communication an efficient, secure and convenient system. In the end, the researcher concludes by stating that environment activist, experts, citizens and government must also act against the radiation from cell tower and gadgets besides the conventional sources of pollution.

2.3 REVIEW OF NEWS ARTICLES

Mail Today Bureau in news article titled "Government sets up laboratory at TEC for testing radiation level of mobile phone"[36] published in 2013 stated that new mobile phones manufactured in the country or imported should begin to follow stricter standards before September 1. Telecommunications Engineering Centre (TEC), which measure the level of radiation emitted by mobile phones, were created at a cost of Rs 2.5 crore. Currently, mobile phone manufacturers self-certify or obtain a certificate from accredited international laboratories. SAR is strongly related to the electric field produced within the body tissues during calls. DoT officials said that their TERM cells would be responsible for conducting self-certification checks by service providers. "We have established a laboratory in the country so that mobile

[35]Hemant Pathak, "Effects of Mobile Tower Radiations and Health Impacts: A Case Study" 1(3) IJSRG 115-118 (2016).

[36]Mail Today Bureau, "Government sets up laboratory at TEC for testing radiation level of mobile phone" *India Today*, Jan. 22, 2013.

phones can be tested with electromagnetic radiation and more of these laboratories will be established throughout the country, starting from Mumbai," said Kapil Sibal, communications minister, while inaugurating the SAR laboratory. Further in the news it was stated that the Government is also amending the Indian Telegraph Law of 1885 to ensure that telephones comply with radiological standards. The new rules stipulate that the consumer's manual should require consumers to use a hands-free wireless system with a low-power Bluetooth transmitter to reduce radiation. Buyers should also receive instructions to ensure that their mobile phones have a low SAR

Press Trust of India (PTI) in news article titled “Telecom operators fined Rs 10.80 crore for exceeding radiation limits; Airtel gets maximum penalty”[37] published in 2015 stated that Ravi Shankar Prasad telecom minister said in a written reply given to Rajya Sabha that Government has imposed a penalty of Rs. 10.80 crore on telecom operators till 31 May 2015 for exceeding the Electronic frequency limits (EMF). The maximum penalty imposed was on Bharti Airtel of Rs 2.15 crore followed by Vodafone, Reliance and Tata Teleservices of Rs 1.80, Rs 1.65 and Rs 1.45 crore respectively. A fine of Rs. 95 lakh levied on Idea, Rs 90 lakh on Aircel, Rs 70 lakh on BSNL, Rs 55 lakh on loop, Rs 35 lakh on Uninor, Rs 15 lakh on MTNL, Rs 10 lakh on Videocon and Rs 5 lakh on Sistema Shayam Teleservices. He further stated that action is being taken up to put a penalty of Rs 10 lakh if any Base Transceiver Station is found violating the norms and closure of the same if violation persists.

Dhananjay Mahapatra’s news article titled “Man claims cell tower gave him cancer, Supreme Court shuts it down”[38] published in 2017 stated that a forty-two years old domestic help had made history by persuading Supreme Court to order the shutdown of a mobile tower on the ground that its electromagnetic radiation caused him cancer. Harish Chand Tiwari of Gwalior has moved to the court through his advocate Nivedita Sharma and complained that he was exposed to radiation for last fourteen years emitted from an illegally installed tower of BSNL. Dhananjay further states that the order would fuel the debate over effects of radiation from the Mobile tower. The decision of deactivating the tower within seven days was given by the bench constituting of Justice Ranjan Gogoi and Justice Navin Sinha. But these

[37]PTI, “Telecom operators fined Rs 10.80 crore for exceeding radiation limits; Airtel gets maximum penalty” *The Indian Express*, Aug. 8, 2015.
[38]Dhananjay Mahapatra, “Man claims cell tower gave him cancer, Supreme Court shuts it down” *Times of India*, Apr. 12, 2017.

allegations were denied by Cellular Operators Union of India & the Union Government and it was contended by them that no scientific study shown the conclusive evidence of mobile tower radiation with cancer.

Sukhmeet Bhasin in news article titled “Mobile tower at Police Lines petrol pump violates safety norms”[39] published in 2017 stated that a Mobile tower of Reliance Jio company installed at a petrol pump in Police lines area of Bathinda is violating the safety norms. He further stated that many police officials visit the Police petrol pump daily but none have raised the objection. The tower is installed ignoring the security norms and fire bucket filled with sand is also missing. He says that experts claimed that communication between the phone and the network tower took place through electromagnetic waves that carry so much energy which may ignite gas by causing sparks and huge fire may occur at a gas station.

Press Trust of India’s news report titled “States not aligning mobile tower rules with DoT norms: TAIPA”[40] published in 2018 states that the telecom operators are facing difficulties in installing the mobile towers in states due to tough rules which are not aligned with the Central Government norms. As per the information provided by the Tilak Raj Dua director general of Tower and Infrastructure Providers Association (TAIPA) to PTI only five states Haryana, Jharkhand, Rajasthan, Kerala, and Odisha have aligned their Right of Way rules for telecom infrastructure with the rules so framed by the Department of Telecommunications. No other state except these five states has aligned their rules with the rules framed by DoT. He further told PTI that the mobile tower firms are facing major problems in installing the mobile towers in the states like Maharashtra, Madhya Pradesh, Karnataka, Gujrat, Himachal Pradesh and Punjab. TAIPA’s members like Bharti Infratel, ATC Towers, GTL Infrastructure, Reliance Infratel and Indus Tower and Tower Vision said that they are taking up this issue with Governments of Punjab, Himachal, Karnataka and Madhya Pradesh since 2013, 2014 and 2015 respectively. But there has been no resolution to the problem till the publication of the news.

[39]Sukhmeet Bhasin, “Mobile tower at Police Lines petrol pump violates safety norms” *The Tribune*, May 5, 2017.

[40] PTI, “States not aligning mobile tower rules with DoT norms: TAIPA” *The Economic Times*, Jan. 12, 2018.

2.4 REVIEW OF CASE LAW

In the case of Arvind Gupta v. Union of India[41], it was observed by the National Green Tribunal (NGT) that the radiation from electromagnetic waves caused by the mobile towers is not explicitly covered in any of the scheduled acts to the NGT Act, 2010. The Tribunal further observed that even the definitions given under the relevant provisions of NGT Act, 2010 do not refer to the radiation specifically.

The Hon'ble High Court of Rajasthan in the case of Justice I.S. Israni (Retd.) v. Union of India[42] held that towers on hospitals and school buildings should be avoided as patient and children may be more susceptible to possible harmful effects of electromagnetic radiation. The case was related to the erection of mobile towers in certain high-risk areas like schools, hospitals and high-density residential areas and the validity of bye-laws which prohibited the erection of mobile towers in such areas. The court held the bye-laws of the State Government, made on the recommendation of the Central Government to be valid. Regarding densely populated residential areas, the court directed the State Government and the local authorities to decide on case wise basis about the installation of towers in the densely populated areas in accordance with the law.

In the case of Vijay Verma v. State of Himachal Pradesh[43], a petition was filed for the prohibition of installing mobile towers on the roofs of the petitioners. In this case, the main issue was whether the radiations from the mobile towers cause any health hazard or not. The Hon'ble High Court found out that radiation is something which is not new and it was in existence since the beginning of life on earth. There was no alarm about the possible adverse effect of the electromagnetic field (EMF) from mobile phone towers or the mobile phones. Limits adopted by India will not have any biological effect on the life of the people and Court observed that there was no conclusive evidence or scientific backing that the mobile towers would cause any type of health hazards.

In 2016, in the case of Asha Mishra v. State of UP[44], it has been observed that all studies indicate that presently there appears to be no definitive scientific material or

[41]MANU/GT/0202/2015.
[42]2013(4) CDR 1973(Raj); MANU/RH/1496/2012.
[43]MANU/HP/1116/2015.
[44]MANU/UP/0515/2016.

data which may warrant Electromagnetic Field (EMF) radiation being classified as endangering to the health. The Court further observed that the research can at present be best described as being still nebulous and tenuous. This is the reason for research in the field being continues and ongoing. The Court concluded by stating that the standards adopted by our country are said to be more stringent than those suggested by the World Health Organization (WHO).

The studies reviewed above are related to the radiation from the cell tower and its effect on people living near the areas where the cell phone base stations are situated. All the studies are medical studies in nature and are concerned with the health issues occurring due to the excess use of cell phones or due to the radiation emitted from the mobile tower base stations. None of the studies is talking about the implementation aspect of laws, rules, and regulations relating to the emission limits and infrastructural laws for mobile tower base stations.

The present study is different because it is going to check the implementation of legal aspects of the said topic which is not covered in any of the existing studies. Neither any study has been conducted in the area under consideration for the research, i.e., Bathinda city about the implementation level of the laws and regulations relating to radiation emission limits nor any study has been conducted to check that Mobile Towers in city comply with infrastructural laws or not. It is to be mentioned here that after the year 2015-16 no EMF audit of the mobile tower/mobile tower base station has been conducted in the city by the Department of Telecommunication.

Chapter - III

Research Methodology

The study states the concept of mobile tower radiation and implementation of laws and regulations relating to the same. Certain specific objectives have been taken to achieve the research. Keeping in view these objectives and taking into consideration the hypothesis the researcher tried to testify the idea of the research. The specific procedure set in the research methodology are as follows:

In order to achieve the first objective that is to study the Laws and Regulations related to the Mobile Tower Radiation, the study majorly depends upon the secondary sources. The standard law on Mobile tower radiation is the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines adopted at international level and the revised rules formulated for the same by the Department of Telecommunications (DoT) are studied and compiled. Specific Absorption Rate limits prescribed for the mobile handsets and infrastructural guidelines issued by DoT for setting up a mobile tower are also covered under this section. An extensive reading of the secondary sources is done in the study to compile all the Laws and Regulations which deals with the issue of Radiation from Mobile Towers. For which previous works of different researchers and various websites are used including the official website of the DoT. Further primary sources like various Acts which are dealing with the topic directly or indirectly are also studied.

The second objective of the study is to know the compliance of radiation emission norms w.r.t. the mobile towers situated in the Bathinda City. To achieve this objective forty mobile towers are taken as a sample. The mobile towers are selected from different localities of the City by random sampling method. This method of sampling is used to avoid any type of biases in the results. Data pertaining to selected mobile towers is collected to see whether these mobile towers are radiating within the stipulated radiation limits or not. For collecting the required data official website of the DoT was visited and the Tarang Sanchar Portal was accessed. Data is received in form of computer-generated Emails. The data which is received is secondary data in nature and it relates to the DoT prescribed EMF limit for the tower and the present EMF level of the same.

For fulfilling the third objective which relates to the implementation of infrastructural rules or guidelines relating to the Mobile towers the study completely relies upon the primary data. Firstly a structured schedule is prepared but due to the non-availability of the respondents on the sites, the observation method is adopted. Observations of the researcher are based on the schedule prepared for the purpose of collecting the data. Four sets of ten mobile towers each were made and the data was collected in four field visits at different dates. In these field visits data pertaining to the number of antennas on a mobile tower, the number of antennas in the same direction and if any building is there directly in front of the antennas then its approximate distance from the lowest antenna on the mobile tower is collected.

The study is descriptive in nature and uses both primary and secondary data to meet its end. Samples used in the study are taken from different areas to cover the whole city. Generalizations regarding the actual present situation regarding the issue shall be made on the basis of analysis of the collected data.

Chapter - IV

Laws and Regulations

4.1 Introduction

Here in this chapter, the researcher has consolidated all the Laws and Regulations relating to Mobile Tower Radiation at one place. The standard law regarding radiation from Mobile Towers is the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines which are adopted internationally. ICNIRP is an independent body of scientific experts of various areas like Dosimetry, Biology, Epidemiology and Optical Radiation which also includes a number of consulting experts. Possible adverse effects of non-ionising radiation on human health are studied by this body. The main aim of this body is to disseminate information and to advise on the issue of potential health hazards which are caused due to exposure to non-ionizing radiation.

Department of Telecommunications (DoT), Government of India has formulated various standards based on a revision of the ICNIRP guidelines for radiation from mobile towers. These guidelines were issued by Germany and were adopted by countries like UK, Australia, Korea, Malaysia including India.

An emission limit of radiation from the mobile tower as adopted by India in 2008 based on the guidelines issued by ICNIRP are as following:

Table 4.1 Emission Limits of Radiation from the Mobile Tower 2008[45]

Frequency Range	E - Field Strength {Volt/Meter- (V/M)}	H - Field Strength {Amp/Meter- (A/m)}	Power Density {Watt/Square Meter- W/Sq.M}
400MHz to 2000MHz	1.375 f1/2	0.0037 f1/2	f/200
2GHz to 300GHz	61	0.16	10

(f: is the frequency in MHz)

Table 4.1 depicts the emission limits of radiation prescribed by ICNIRP and adopted by India in 2008. The table shows that at a frequency range of 400MHz to 2000MHz

[45] Journey of EMF, *available at*: http://www.dot.gov.in/journey-emf (Visited on April 14, 2017).

E-Field strength is 1.375 f1/2 V/M, H- Field strength is 0.0037 f1/2 A/M and power density is f/200. The further table shows that at the frequency range of 2GHz to 300GHz E-Field strength, H-Field strength, and power density are 61 V/M, 0.16 A/M and 10 W/Sq.M respectively.

These emission limits were revised by Department of Telecommunications (DoT) in 2012. As a consequence of this revision, Indian Standards for EMF radiation are now ten times more stringent than many countries (like USA, Canada, Japan and Australia) of the world which follow the ICNIRP guidelines.
The present emission limits for the radiation from the mobile towers as prescribed by the DoT is as follows:

Table 4.2 Present Emission Limits[46]

Frequency Range	E - Field Strength {Volt/Meter- (V/M)}	H - Field Strength {Amp/Meter- (A/m)}	Power Density {Watt/Square Meter- W/Sq.M}
400MHz to 2000MHz	0.434 f1/2	0.0011 f1/2	f/2000
2GHz to 300GHz	19.29	0.05	1

(f: is the frequency in MHz)

Table 4.2 is depicting the present emission limits of EMF radiation for the mobile towers. It can be seen here that in the frequency range of 400MHz to 2000MHz, E-Field strength is 0.434 f1/2 V/M, H-Field strength is 0.0011 f1/2 A/M and power density is f/2000. Further, it is clear from the table that for the frequency range of 2GHz to 300GHz, E-Field strength is 19.29 V/M, H-Field strength is 0.05 A/M, and power density is 1 W/Sq.M respectively. The frequency of operation in MHz is denoted by f in the table.

Here from table 4.3, we can see the difference after comparison that huge change took place from 2008 to 2012. ICNIRP radiation norms are the norms which are

[46] *Id*. at 30.

adopted internationally by many countries. In comparison to these norms, the norms of radiation adopted in India are more strict.

Table 4.3 Comparison of ICNIRP Norms and DOT Norms on Mobile Tower Radiation in India.[47]

Frequency	ICNIRP Radiation Norms	Revised DOT Norms effective from 1/9/2012
900 MHz	4.5 Watt/Sq. m	0.45 Watt/Sq. m
1800 MHz	9.0 Watt/Sq. m	0.9 Watt/Sq. m
2100 MHz	10.5 Watt/Sq. m	1.05 Watt/Sq. m

The table depicts the different frequency levels and also shows the radiation limits for those frequency levels respectively. It can be clearly seen from the above table that DoT norms are $1/10^{th}$ of the ICNIRP radiation norms at each of the given frequency level i.e. 900 MHz, 1800 MHz, and 2100 MHz respectively.

4.2 EMF radiation norms for the mobile tower of different Countries

Many countries keeping in view the environmental and physiological factors have specified their own radiation levels. The power density limits are different for various countries. These limits vary from 0.001 Watt/m^2 to 12 Watt/m^2 at 1800 MHz frequency. The permitted radiation limit in India at the frequency level of 1800 MHz is 0.9 Watt/ m^2.

The table 4.4 which is given below depicts the EMF exposure limit of different countries at 1800 MHz in a descending order. USA, Canada, and Japan are having the maximum permitted EMF exposure limit which is 12 Watt/m^2 and Austria is having the minimum EMF exposure limit i.e. 0.001 Watt/m^2 in comparison. Here it can be seen that India has lower EMF exposure limit than many other countries like USA, Canada, Japan, Australia, Belgium, Italy, Israel and ICNIRP guidelines

[47]Climate change, *available at:* https://www.itu.int/en/ITU-T/climatechange/emf.../s2part2p3-RKBhatnagar.pdf (Visited on May 20, 2017).

following countries. But countries like China, Russia, Bulgaria, Poland, Paris, Hungary, Switzerland, and Austria are having less EMF exposure limits than the limits adopted in India.

Table 4.4 International Exposure Limits for EMF (1800 MHz)[48]

Exposure Limit	Name of the Country
12 W/m^2	USA, Canada, and Japan
9.2 W/m^2	ICNIRP and EU recommendation 1998
9 W/m^2	Exposure limit in Australia
2.4 W/m^2	Exposure limit in Belgium
1.0 W/m^2	Exposure limit in Italy, Israel
0.5 W/m^2	Exposure limit in Auckland, New Zealand
0.45 W/m^2	Exposure limit in Luxembourg
0.4 W/m^2	Exposure limit in China
0.2 W/m^2	Exposure limit in Russia, Bulgaria
0.1 W/m^2	Exposure limit in Poland, Paris, Hungary
0.1 W/m^2	Exposure limit in Italy in sensitive areas
0.095 W/m^2	Exposure limit in Switzerland
0.09 W/m^2	ECOLOG 1998 (Germany) Precaution recommendation only
0.001 W/m^2	Exposure limit in Austria

[48]Government of India, Report: Information Paper on Effects of Electromagnetic Field Radiation from Mobile Towers and Handsets (Telecom Regulatory Authority of India, 2014).

4.3 SAR level for Mobile Handsets

Specific Absorption Rate (SAR) is a measure of the rate at which human body absorbs energy when it is exposed to the EMF. It is the power which is absorbed per mass of tissue by the body. SAR value is measured in units of watts per kilogram (W/kg). SAR value refers to the maximum possible transmission of power for a mobile phone. But here it is to be mentioned that these values can only be reached in low coverage areas which are having low field strengths.

SAR value of a mobile phone can be checked by using a quick code which is *#07#. It is the easiest way to check the SAR value[49]. It can also be checked from the official website of the manufacturer as all the manufacturers provide information regarding the safety of their devices on their website.

Table 4.5 Comparison of SAR Limit Prescribed by ICNIRP and DoT[50]

Frequency (10 MHz to 10 GHz)	ICNIRP SAR Limit	Revised SAR Limit effective from 1/09/2012
General Public exposure	2 watt/Kg (averaged over 10 gm tissue)	1.6 watt/Kg (averaged over 1 gm tissue)

As per the ICNIRP guidelines the Specific Absorption Rate limit for the mobile phones was 2 W/kg averaged over 10 gm of tissue but in 2012 Department of Telecommunications revised these limits and adopted SAR limit of 1.6 W/kg averaged over 1 gm of tissue for the mobile phones. The mobile phones compliant with older norms of SAR value were allowed to co-exist till 31/8/2013. But after 1/9/2013 the mobile handsets compliant with the revised norms of SAR value of 1.6 W/kg are permitted for manufacturing and to import in the country for the use in the domestic market. It is now made mandatory for all the manufacturers to display the SAR level on each mobile handset as of International Mobile Equipment Identity

[49] Five ways to check SAR value, *available at*: https://muditalab.com/5-ways-of-checking-the-sar-value-of-your-phone-67c2083301bc (Visited on June 5, 2017).
[50] EMF, *available at*: https://www.trai.gov.in/sites/default/files/EMF_Information_Paper_30.07.2014.pdf (Visited on July 13, 2017).

(IMEI). A laboratory for testing the SAR value of mobile phones has been set up in the Telecom Engineering Center of DoT.

Smartphones available in the market are having different SAR level. It is necessary to check the SAR level before buying a smartphone. An endeavor shall be made to purchase the smartphone which is having low SAR value.

Table 4.6 Smartphones having High SAR level[51]

Manufacturer	Model Specification	SAR Level(Watt/kg)
Xiaomi	Mi A1	1.75
OnePlus	5T	1.68
Huawei	Mate 9	1.64
Nokia	Lumia 630	1.51
Apple	iPhone 7	1.38
Sony	Xperia XZ1 compact	1.36
BlackBerry	DTEK60	1.28
Apple	iPhone 7 Plus	1.24

Table 4.6 is showing SAR level of certain smartphones which are currently available in the global market. It can be seen that Mi A1 smartphone which is manufactured by Xiaomi is having the highest SAR level i.e. 1.75 Watt/kg followed by a 5T model of OnePlus and Mate 9 model of Huawei which are having the SAR level of 1.68 Watt/kg and 1.64 Watt/kg respectively. Here it is to be mentioned that these smartphones are having SAR value in excess of the permitted SAR levels in India. Besides these three smartphones, all other smartphones shown in the table are having the SAR levels within the permitted limits.

[51] Smartphone emit radiation, *available at:* https://www.forbes.com/sites/niallmccarthy/2018/03/01/which-smartphones-emit-the-most-radiation-infographic/#536ed3511b04 (Visited on March 12, 2018).

The smartphones having SAR level more than 1.6 Watt/kg are not sold in India but they are made available for the global market and are sold in the countries having the permitted SAR level of 2 Watt/kg.

SAR limit for the Mobile Handset is different in various countries. The SAR limit permitted by different countries varies from 1.6 Watt/kg over 1 gram of tissue to 2 Watt/kg over 10 gram of tissue. The SAR limit for mobile phones in different countries is as follows:

Table 4.7 SAR value for Mobile Phones of different Countries[52]

Name of Country	SAR limit for Mobile Handset
China	2 W/kg (Averaged over 10gm of tissue)
Singapore	2 W/kg (Averaged over 10gm of tissue)
Ghana	2 W/kg (Averaged over 10gm of tissue)
Brazil	2 W/kg (Averaged over 10gm of tissue)
Nigeria	2 W/kg (Averaged over 10gm of tissue)
Japan	2 W/kg (Averaged over 10gm of tissue)
Korea	2 W/kg (Averaged over 10gm of tissue)
Europe	2 W/kg (Averaged over 10gm of tissue)
Australia	1.6 W/kg (Averaged over 1gm of tissue)
USA	1.6 W/kg (Averaged over 1gm of tissue)
Canada	1.6 W/kg (Averaged over 1gm of tissue)

[52]EMF information paper, *available at:* https://www.trai.gov.in/sites/default/files/EMF_Information_Paper_30.07.2014.pdf (Visited on 16 July, 2017).

Table 4.7 depicts the SAR value for mobile phones adopted by different countries. Indian norms for SAR values are stringent in comparison to the norms adopted by many other countries like China, Singapore, Ghana, Brazil, Nigeria, Japan, Korea and Europe. It is also clear from the table that though India has strict SAR norms than many countries at the same time the norms adopted by India are at par with the norms adopted by countries like Australia, USA, and Canada.

4.4 Legal Aspects of Mobile Tower

The Indian Telegraph Act, 1885 which is amended from time to time governs the laws relating to the telecommunications in India[53]. The Central Government is empowered by section 7 of the Act to make rules for the conduct of all or any of the telegraphs established, worked or maintained by the government or by any other person who is licensed to do so under this Act. Such rules as framed by the Central Government shall have to be consistent with the Act.

Telecommunications falls under the Union list given in Schedule 7 of the Constitution of India. Matters related to telecom and the associated fees are covered under the Entry 31 and 96 of the Union list.

Mobile towers are covered under the definition of the telegraph given in the Indian Telegraph Act, 1885. According to the Act, " 'telegraph' means any instrument, apparatus, appliance or material which is used or is capable of use for reception or transmission of signals, signs, writing, sounds, images and intelligence of any nature by wire or other electromagnetic emissions, Hertzian waves or radio waves, galvanic, electric or magnetic means.**"** [54]

According to the Indian Wireless Telegraphy Act, 1933 " 'Wireless communication' means communication without the use of wires or other continuous electrical conductors between the transmitting and the receiving apparatus by means of any transmission, omission or reception of signs, signals, images and sounds, writing, or we can say intelligence of any nature by means of electricity, magnetism, or Radio waves or Hertzian waves."[55]

[53] TAIPA, *available at*: http://www.trai.gov.in/sites/default/files/TAIPA_07092017.pdf (Visited on 3 March, 2018).
[54] Indian Telegraph Act, 1885 (Act 13 of 1885), s. 3(1AA).
[55] Indian Wireless Telegraphy Act, 1933 (Act XVII of 1933), s. 2(1).

Further, in the Act, it is explained that Hertzian waves or Radio waves are electromagnetic waves having frequencies less than 3,000 gigacycles per second without artificial guide propagated in the space.

According to The Air (Prevention and Control of Pollution) Act, 1981, " 'air pollutant' is defined as any solid, liquid or gaseous substance [(including noise)] which is present in the atmosphere in such concentration as may be or which tend to be injurious to human beings, other living creatures, plants, property or environment."[56]

Here it is to be noted that mobile tower radiation is not covered under the definition of air pollutant, but the noise which is emitted by the generators of the mobile tower base stations is covered under the definition of the air pollutant[57]. Further, it is to be stated that the noise generated by base stations of mobile towers was also not covered under the definition of air pollutant in the original Act, and it was inserted in 1988 by way of amendment.

It is mentioned in the Telecom Regulatory Authority of India Act, 1997 that " 'telecommunication service' means service of any description which includes data services, voice mail, electronic mail, audio text services, videotext services, cellular mobile telephone services and radio paging. This service is made available to users by means of any transmission or reception of writing, signals, signs, images and sounds or intelligence of any nature by wire, radio, visual or other electromagnetic means but which does not include broadcasting services." [58]

4.5 Infrastructural Guidelines

Infrastructural guidelines for setting up a mobile tower and mobile tower base station are issued by the Department of Telecommunications (DoT) and every service provider has to comply with these guidelines which are mandatory in nature. The guidelines regarding the infrastructure for setting up a Mobile tower prescribes that for installing or setting up ground-based towers & rooftop towers no nearby building shall be there right in front of the antenna with the height comparable to the height of adjustment of the total antenna tilt of the lowest antenna on the tower at a distance as specified below:

[56] The Air (Prevention and Control of Pollution) Act, 1981 (Act 14 of 1981), s. 2(a).
[57] Ins. by Act 47 of 1987, s. 2 (w.e.f. 1-4-1988).
[58] Telecom Regulatory Authority of India Act, 1997 (Act 24 of 1997), s. 2(1)(k).

Table 4.8 Safe distance in Case of Multiple Antennas in the Same Direction[59]

Number of Multiple Antennas in the same direction	Building/Structure distance from the Antenna (Safe distance in Meters)
2	35
4	45
6	55

Alternatively, operators need to establish/certify that all General public areas are within safe EMF exposure limits as per actual peak traffic measurements after the antenna(s) start radiating.

For setting up a Wall Mounted or Pole mounted Antenna, if the antenna is mounted on the pole then it should be at least 5 meters above the ground level or road level on flyovers as may be the case. Further, it is stated that there shall be no residential building, office or any other workplace directly in front of the wall mounted or pole mounted antenna at a height comparable to the antenna as given above in the table. Here it is to be Noted that for Calculation of safe distance from the antenna of the tower is based on Maximum 20 Watt RF power radiated from the antenna and the correction factor shall be applicable for low power radio techniques.

4.6 Mobile Tower Certification and Testing in India

In India Department of Telecommunications governs all the telecom service providers (TSPs) / mobile service providers (MSPs). All the TSPs/MSPs have to comply with the Terms & Conditions of Licenses which are issued by Department of Telecom, and they should ensure that radiation from Mobile towers is within the limits which are prescribed. To ensure this, all TSPs/MSPs are bound for submitting a self-compliance certificate of all mobile towers installed by them on a bi-annual basis.

Further, Telecom Enforcement Resource & Monitoring (TERM) Cell which is a field unit of DOT also tests up to 10% of the total BTS's on a sample survey basis which

[59] Advisory Guidelines, *available at*: http://www.auspi.in/policies/Advisory-Guidelines-For-State-Govts-effective-from-01-08-13.pdf (Visited on May 5, 2017).

is in their jurisdiction per year as per guidelines of DOT, this also includes testing the radiation from all the neighboring BTS's. The penalty can be imposed on the non-compliant site, i.e., the site where radiation exceeds the prescribed limits.

In one of such recent audit carried out by Telecom Enforcement Resource & Monitoring cell (TERM) of Department of Telecom total, 284 BTS were found exceeding the electromagnetic field radiation limits as on June 30, 2017. All these non-compliant sites are of different Telecom Service Providers(TSP's).

The breakdown of the non- compliant sites per service provider out of the total 284 is shown in table 4.9.

Table 4.9 List of Non-Compliant Sites Per Service Provider[60]

S.NO	Name of Telecom Service Provider	Number of Non-compliant Sites
1	Airtel	69
2	Vodafone	62
3	Tata Teleservices and its subsidiaries	34
4	Reliance Communications	32
5	Idea Cellular	22
6	Aircel	20
7	Loop Mobile	11
8	Reliance Jio	10
9	BSNL	10
10	Telenor	8
11	MTNL	3
12	Videocon Telecom	2
13	Sistema Shyam Teleservices	1

[60]Non-compliant sites, *available at*: http://www.bgr.in/news/airtel-vodafone-top-in-list-of-mobile-towers-exceeding-radiation-limit/ (Visited on May 7, 2017).

In the year 2015 also 205 BTS of various telecom operators were fined Rs 10.80 crore for exceeding the radiation limits. This fact was disclosed from the written reply filed in the Rajya Sabha by then Telecom minister Ravi Shankar Prasad and he stated that this fine was sum total of the fine imposed till 31 May 2015.

Table 4.10 The Fine Imposed on Various Telecom Service Providers[61]

S.No	Name of Telecom Service Provider	Amount of Fine Imposed (Rs.)
1	Airtel	2.15 crore
2	Vodafone	1.80 crore
3	Reliance	1.65 crore
4	Tata Teleservices	1.45 crore
5	Idea	95 lakh
6	Aircel	90 lakh
7	BSNL	70 lakh
8	Loop	55 lakh
9	Uninor	35 lakh
10	MTNL	15 lakh
11	Videocon	10 lakh
12	Sistema Shyam Teleservices	5 lakh

Table 4.10 shows the breakup of the fine imposed on various Telecom Service Providers till 31/5/2015.

Here from the above table, it can be seen that Airtel and Vodafone are the Telecom Service Providers which were imposed the highest penalty followed by Reliance and

[61] Telcos fined, *available at*: http://indianexpress.com/article/technology/tech-news-technology/telcos-fined-rs-10-80-crore-for-exceeding-radiation-limits-airtel-fined-maximum/ (Visited on May 7, 2017).

Videocon and Sistema Shyam Teleservices are the Telecom Service Providers on which the least amount of Penalty was imposed. Further, it is to be stated that BSNL which is State-owned telecommunications company and MTNL which is State-owned telecommunications service provider in metro cities were imposed with a penalty of Rs 70 lakh and Rs 15 lakh respectively.

From the comparison of tables 4.9 and 4.10, it is clear that all the non-compliant sites except two in the year 2015 & 2017 are of the same Telecom Service Providers. There is only one additional entry in the year 2017 which is of Reliance Jio and it is because Reliance Jio was commercially launched in the year 2016. A further difference is of Telenor and Uninor as in the year 2017 it was Telenor whose sites were found non-compliant to EMF norms and in the year 2015, it was Uninor upon which penalty was imposed. It shall not be wrong to state that Uninor substituted Telenor in the year 2017.

The government has recognized the importance of the mobile towers. The status of 'infrastructure' has been granted to mobile towers by the Cabinet Committee of Infrastructure (CCI) vide gazette notification published on 27 March 2012. Department of Telecommunications has issued guidelines for issuing of clearance for installation of Mobile Towers. As per those guidelines, Telecom installations are a critical infrastructure and are lifeline installations in mobile communication. Mobile communication is an essential service and to avoid any disruption in this service a BTS tower cannot be sealed or its electricity may not be disconnected without the prior permission or consent of the respective TERM cell of DoT. Further, it is to be stated here that the regulatory agencies like CPCB & SPCB do not have any authority to dismantle any Mobile Tower or to disconnect any telecommunication service.

Chapter - V

Data Analysis and Survey Report

In this chapter for achieving the research objectives the data pertaining to the implementation level of EMF radiation limits for the BTS and infrastructural guidelines for the Mobile towers situated in the research area i.e. Bathinda City is compiled and discussed in detail. Keeping in view the research objectives and taking into consideration the hypothesis of the study an endeavor is being made to testify the idea of the research.

5.1 Terminology in Data Analysis

Before data analysis, it is necessary to understand about certain terms which are incorporated in the data which have been collected. Below written are the terms which have been used in the data and knowledge of which is necessary for the interpretation of the data.

5.1.1 GSM Technology

GSM network standard has several generations. GSM means Global System for Mobile Communication[62]. This digital system of mobile communication is used widely in Europe and other parts of the world. The several generations of GSM network in mobile technology are 2G, 3G, and 4G. 2G is commonly known as GSM, 3G as WCDMA and 4G as LTE service. Here G denotes the generation, WCDMA stands for Wideband Code Division Multiple Access[63] and LTE stands for Long Term Evolution[64]. Higher is the generation high is its uploading and downloading speed.

5.1.2 WiMax

WiMax stands for Worldwide Interoperability for Microwave Access[65]. It is a long-range wireless network for both mobile and fixed connection. It is used for the purpose of internet communication. WiMax is envisioned as leading form of internet communication which is an alternative to the Cable and Digital Subscriber Line

[62] GSM Technology, *available at*: https://www.gsma.com/aboutus/gsm-technology/3gwcdma (Visited on September 5, 2017).
[63] Ibid.
[64] LTE, *available at*: https://www.digitaltrends.com/mobile/4g-vs-lte/ (Visited on September 5, 2017).
[65] WiMax, *available at*: https://www.lifewire.com/wimax-wireless-networking-818321 (Visited on September 6, 2017).

(DSL) form used for providing internet services. For providing internet service through WiMax two equipment's are needed. One is the base station which is installed by the service provider to deploy the technology in the coverage area and another equipment which is needed is the receivers which are installed at the residential or working place of the client.

5.1.3 Frequency Band

The frequency band is a key part of mobile phone specification and it's operating. It is determined by the supported frequency bands that a handset is compatible with certain network carrier and it also determines the region in which it can be used or operated.

Table 5.1 GSM bands Information of India[66]

Service Provider	Network Type	Frequency Bands
All	2G	900/1800 MHz
Airtel	3G	1900/2100 MHz
Aircel		2100 MHz
BSNL		2100 MHz
MTNL		2100 MHz
Reliance		2100 MHz
Tata Docomo		2100 MHz
Vodafone		2100 MHz
Aircel	4G	2300 MHz
Bharti Airtel		2300 MHz
Reliance Jio		800/1800/2300 MHz
BSNL	WiMax	2500 MHz

Table 5.1 depicts that different service providers use different frequency bands at different network types. Telecom service providers in India use 800 to 2300 MHz frequency bands to provide telecommunication services. The frequency band of 2500 MHz is used for providing the WiMAX services which are used for providing the internet services.

[66]Frequency bands, *available at*: https://www.gearbest.com/blog/how-to/country-based-mobile-phone-network-frequency-bands-coverage-guide-1144 (Visited on February 5, 2018).

Table 5.2 Data relating to the compliance of the EMF radiation norms

S.No	Site Details	Name of Operator/s	Frequency Bands (MHz)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site (W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
1	SCF-12 Model Town phase-3	Vodafone	1800	2G	0.91665	0.01232	1.34%	Operator Certified	29-04-17
2	Friends Plaza Sco-37, Urban Estate	Airtel	900 1800 2300	2G 3G 4G	0.4707	0.1522	32.33%	Operator Certified	13-04-17
3	Sukhraj Singh, Model Town Phase-3	Reliance Jio	800 1800 2300	4G	0.43835	0.0112	2.56%	Operator Certified	12-08-17
4	Street No. 4/9 Jujhar Singh Nagar	Reliance Jio Vodafone Idea	800 900 1800 2100 2300	2G 3G 4G	0.43835	0.07072	16.13%	Operator Certified	17-04-17
5	Pritam Singh Dhillon, #20062/A-2	Vodafone Reliance Jio Airtel	800 900 1800 2300	2G 3G 4G	0.43835	0.01044	2.38%	Operator Certified	26-04-17
6	100 Feet Road, Near Clock Tower and ICICI	Idea Vodafone	900 1800 2100	2G 3G 4G	0.4676	0.01212	2.59%	Operator Certified	30-10-17

Contd….

S.No	Site Details	Name of Operator/s	Frequency Bands (MHz)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site (W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
7	Model Town Phase 3 Jujhar Singh Nagar	BSNL	900 2100	2G 3G	0.4751	0.090626	19.08%	Operator Certified	23-05-17
8	Rajvinder Kaur W/O Manwinder Singh, Sky Hight 100 FT Road	Reliance Jio	800 1800 2300	4G	0.43835	0.01087	2.48%	Operator Certified	24-07-17
9	Rajpal Hospital vide Property No. 2853-B	Reliance Jio Vodafone Idea	800 900 1800 2100 2300	2G 3G 4G	0.43835	0.01585	3.62%	Operator Certified	03-11-17
10	Hotel Silver Star, Nai Basti	Airtel Idea	900 1800 2100 2300	2G 3G 4G	0.4676	0.0438	9.37%	Operator Certified	12-05-17
11	Mr. Ashwani Kumar, Near A.T Telecom, Ahata Mar Mohammad Gali	BSNL	2100	3G	1	0.060338	6.03%	Operator Certified	06-03-18
12	LG Center Amrik Singh Road	Reliance Jio	800 1800 2300	4G	0.43835	0.01839	4.20%	Operator Certified	26-04-17

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S.No	Site Details	Name of Operator/s	Frequency Bands (MHZ)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site (W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
13	Mandir Wali Gali, Near Fire Brigade, Above Manu Skin & amp; Homeo Clinic	Airtel	900 1800 2300	2G 3G 4G	0.4707	0.03416	7.26%	Operator Certified	13-04-17
14	BSNL Exchange Back Side of City Centre Mall, Civil Lines	Vodafone BSNL Reliance Jio	800 900 1800 2100 2300 2500	2G 3G 4G Wimax	0.4396	0.01328	3.02%	DoT Tested	25-10-17
15	AmarjeetKaur, No 421-B, Dhobian Road	Vodafone Reliance Jio	800 1800 2300	2G 4G	0.43835	0.01078	2.46%	Operator Certified	01-05-17
16	Jaswant Singh Deep Complex GT Road	Reliance Jio	800 1800 2300	4G	0.43835	0.002469	0.56%	Operator Certified	29-04-17
17	Nai Basti, Auto Market, Near Pukhraj Cinema	Vodafone Reliance Jio Airtel	800 900 1800 2100 2300	2G 3G 4G	0.43835	0.03441	7.85%	Operator Certified	30-10-17
18	Mr. Mittal, Paradise Glass House	BSNL Idea	900 1800 2100	2G 3G 4G	0.4676	0.01163	2.49%	Operator Certified	22-05-17

Contd….

S.No	Site Details	Name of Operator/s	Frequency Bands (MHz)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site(W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
19	City Centre, Goniana Road, Parjapat Colony, Mata Jivi Nagar	Airtel	900 1800 2300	2G 3G 4G	0.44268	0.01377	3.11%	Operator Certified	11-04-17
20	Punjab National Bank, Near Reliance World and State Bank of India	Reliance Jio Idea	800 900 1800 2100 2300	2G 3G 4G	0.43835	0.006418	1.46%	Operator Certified	20-05-17
21	Rose Garden Shopping Complex	BSNL	900 2100	2G 3G	0.4751	0.081230	17.10%	Operator Certified	23-05-17
22	SCF-85, Improvement Trust Shopping Complex	Airtel Vodafone	900 1800 2100 2300	2G 3G 4G	0.4707	0.01117	2.37%	Operator Certified	05-11-17
23	Vishal Nagar	BSNL	2100	3G	0.4756	0.101304	21.30%	Operator Certified	23-05-17
24	Rakesh Maheswari, Opp S D Girls College, Subhiksha Store	Reliance Jio	800 1800 2300	4G	0.43835	0.01097	2.50%	Operator Certified	25-04-17

Contd….

S.No	Site Details	Name of Operator/s	Frequency Bands (MHz)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site (W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
25	Property bearing MCB No- 22286, Dhobiana Road	BSNL Idea	900 2100	2G 3G	0.4396	0.01637	3.72%	Operator Certified	28-02-18
26	Dr. Mehboob Sra Punjab and Sind Bank Building, Model Town Main Road	Airtel	900 1800	2G 3G 4G	0.4707	0.03958	8.41%	Operator Certified	13-07-17
27	Chandigarh Labortories, Mall Road, Opp Hotel Suncity	Idea	900 1800 2100	2G 3G 4G	0.4676	0.03633	7.77%	Operator Certified	20-05-17
28	Whole Sale Market Shop No-1, 2089A, Opp Cloth Market	Vodafone	1800 2100	2G 3G 4G	0.9162	0.218308	23.83%	Operator Certified	02-11-17
29	No. 3133 Civil Secretarial Road	Vodafone	1800 2100	2G 3G 4G	0.4676	0.02666	5.70%	Operator Certified	09-11-17
30	Gulfam Hotel and Restaurents, Mansa Road	Idea BSNL	900 1800 2100	2G 3G 4G	0.4676	0.0983	21.02%	Operator Certified	20-05-17

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S.No	Site Details	Name of Operator/s	Frequency Bands (MHz)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site (W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
31	Jagjeet Singh H.No-430 Model Town Phase 2	Vodafone	1800 2100	2G 3G 4G	0.9164	0.115312	12.58%	Operator Certified	22-12-17
32	Mrs. Bansal, C/O H.No-73 State Bank of India	Reliance Jio BSNL	800 900 1800 2100 2300	2G 3G 4G	0.4396	0.01751	3.98%	DoT Tested	24-10-17
33	SCF 11 and 12 Urban Estate	Vodafone	1800	2G	0.43835	0.007595	1.73%	Operator Certified	14-05-17
34	Baljit Kaur & Rajinder Kaur Brar, Sareen Financers, 2711, Old Bus Stand	Reliance Jio Vodafone Airtel	800 900 1800 2100 2300	2G 3G 4G	0.43835	0.04591	10.47%	Operator Certified	02-11-17
35	Gol Diggi BSNL Exchange	BSNL Reliance Jio	800 900 1800 2100 2300 2500	2G 3G 4G Wimax	0.4396	0.0181	4.12%	DoT Tested	27-10-17

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S.No	Site Details	Name of Operator/s	Frequency Bands (MHz)	Technology	DoT Prescribed EMF limit for the site (W/m²)	Latest EMF level for the site (W/m²)	EMF level as a percentage of DoT prescribed level	Basis of Compliance	Date of Certification
36	BSNL Telecom Station, Near TV Tower, ITI	BSNL Reliance Jio	800 900 1800 2100 2300 2500	2G 3G 4G Wimax	0.4396	0.00715	1.63%	DoT Tested	24-10-17
37	Inside Park, Under ITI flyover, Industrial Area	Reliance Jio	800 1800 2300	4G	0.43835	0.159180	36.31%	Operator Certified	06-06-17
38	Max Super Speciality Hospital	Airtel	900 1800 2300	3G 4G	0.4725	0.01748	3.70%	Operator Certified	13-04-17
39	NH 64, Near Civil Hospital, Mansa Road	Vodafone	1800	2G 4G	0.9164	0.030709	3.35%	Operator Certified	17-07-17
40	Paramjeet Kaur, SCF 15, Phase 1, Model Town	Vodafone Reliance Jio Idea	800 900 1800 2100 2300	2G 3G 4G	0.43835	0.01157	2.64%	Operator Certified	30-04-17

Source: Department of Telecommunications

Table 5.2 depicts the data of 40 mobile towers which have been collected by the way of the random sampling method. It can be seen from the details of the sites that data covers nearly every area of Bathinda City. It can be further seen from the table that there is more than one service provider on some mobile towers and these towers are shared by different service providers to provide mobile services. Every service provider which is active in the area to provide telecom service is covered in the data. These service providers are Vodafone, Idea, Airtel, Reliance Jio and BSNL. Services of 2G, 3G & 4G technology are provided by various service provider. But Reliance Jio provides only 4G service and it does not deal with 2G or 3G services. The WiMax service is exclusively provided by the BSNL which is a state-owned telecom service provider in the area. All the service providers operate at the frequency bands which vary from 800 MHz to 2300 MHz at different technologies as explained in detail in Table 5.1 given above. The frequency band of 2500 MHz is used by the BSNL for WiMax technology which is used to provide internet services in the area. Reliance Jio operates at three different frequency bands i.e. 800/1800/2300 MHz to provide only the 4G service. In relation to the radiation emission limit for the towers prescribed by the Department of Telecommunications, it can be seen from the table that emission limit is not same for all the towers. Every mobile tower is having its own prescribe emission limit and these limits vary from 0.43835 W/m^2 to 1 W/m^2. Further, the table depicts that all the mobile towers are emitting the radiation within the prescribed EMF limits as prescribed by DoT. At present, the mobile towers situated in the city are emitting the radiation which is less than 50 percent of their DoT prescribed limit and all the mobile towers are well within the limits. Present emission level for all the mobile towers is different and no two towers are emitting the same amount of radiation at present. Compliance of the EMF level of the towers as depicted in the table is based upon the self-certification of the tower by the operator itself which is submitted to the DoT and another is based upon the Tests which are conducted by the DoT. It can be seen from the table that DoT tested mobile towers are less in the number than the number of operator certified mobile towers. Lastly, the table depicts the date on which the tower has been certified for the EMF exposure level.

Table 5.2.1 Number of Service Providers per Mobile Tower

No. of Service Providers	No. of Towers	Percentage Share
One	22	55
Two	11	27.5
Three	7	17.5
Total	40	100

The table 5.2.1 depicts the number of service providers per mobile tower and it is shown in the table that out of a total sample of forty towers, twenty-two mobile towers are having only one service provider, eleven mobile towers are having two different service providers on the same tower and seven mobile towers are having three service providers. It is clear from the table that eighteen mobile towers are shared by two or more service providers to provide telecommunication services. Majority of the towers i.e. twenty-two out of forty are having only one service provider operating on them.

Figure: 5.1 Percentage Share of Service Providers per Tower.

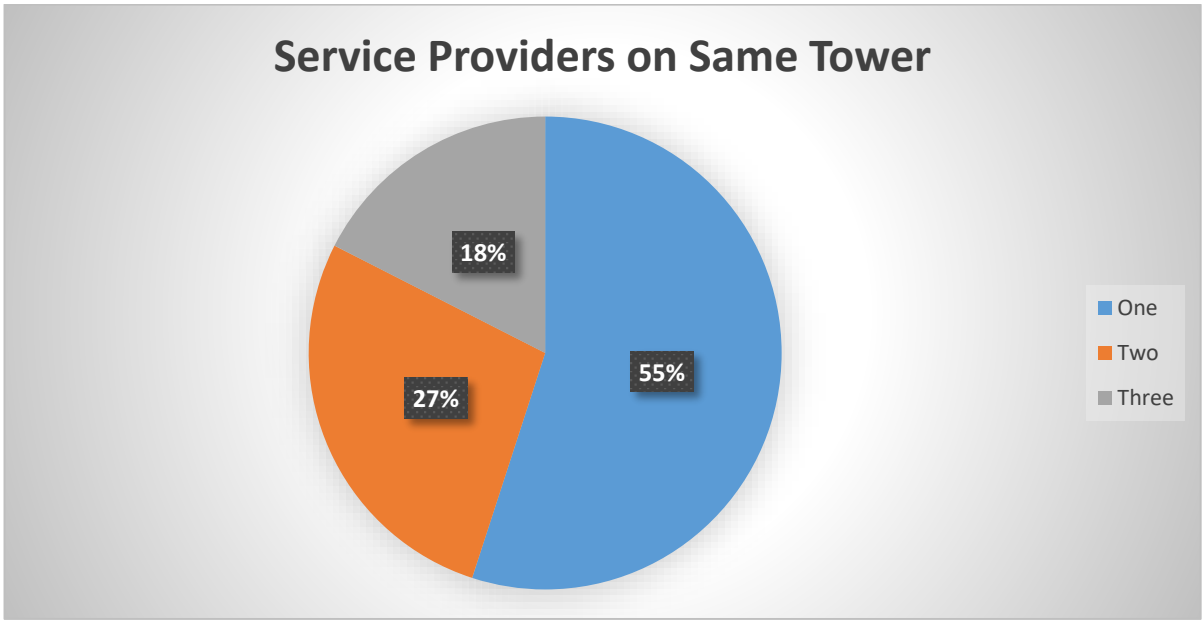


Figure 5.1 is a diagrammatical representation of the percentage share of the tower according to the number of service providers operating from the same tower to provide telecommunication service. It is clear from the figure that majority of the

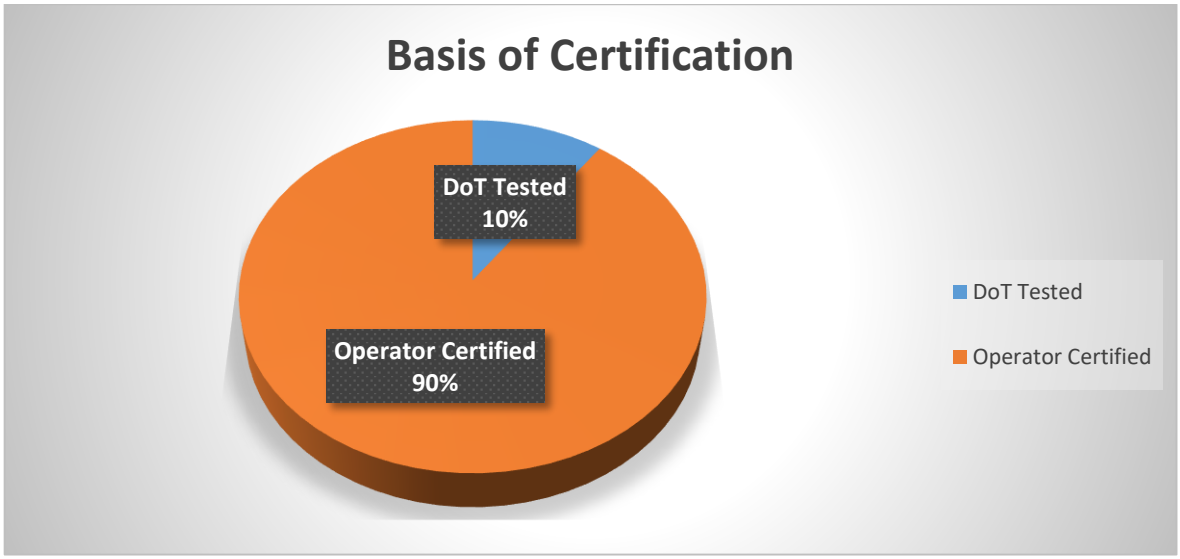
tower i.e. 55 percent are having only one service provider and remaining 45 percent are shared by two or more service providers. It can be seen further that out of the remaining 45 percent, 27 percent of towers are having two service providers and 18 percent towers are shared by three service providers.

Table 5.2.2 Number of Towers on the Basis of the Certification

Certification Basis	No. of Towers	Percentage Share
DoT Tested	4	10
Operator Certified	36	90
Total	40	100

The table 5.2.2 is derived from the data which is collected from DoT. It depicts the basis upon which the towers are certified for their EMF level. It can be seen from the table that out of the total sample of forty mobile towers majority of the towers i.e. thirty-six are the operator certified towers. Operator certified towers are the towers which are self-certified by the operators that the radiation emission from the tower is within the prescribed limits. Further, it can be seen that only four mobile towers form the sample are DoT tested. It means that these four towers are checked by the field unit of the DoT which is TERM cell and it is certified by them after inspection that the radiation emission from the tower is within its prescribed limit.

Figure 5.2 Percentage Share on Basis of Certification



The figure 5.2 shows the percentage share of DoT tested mobile towers and operator certified mobile towers. It can be seen that 90 percent of mobile towers are operator certified for their emission level and remaining 10 percent are tested by DoT for their emission level. The percentage of DoT tested mobile towers is too less in comparison to the percentage of the towers which are operator certified.

It is appropriate to discuss here that very few towers are tested by DoT and majority of the towers are certified by the operators themselves. In the opinion of the researcher, the operator certified mobile towers shall be cross-checked by the DoT so that it can be made sure that they are actually emitting the radiation within the prescribed limits.

Table 5.2.3 Number of Towers in Compliance to Emission Levels

Emission Level	No. of Towers	Percentage Share
Emission within Prescribed Limits	40	100
Emission exceeding Prescribed Limits	0	0
Total	40	100

The table 5.2.3 shows the number of towers whose radiation emission is within the prescribed limits and towers whose radiation emission is exceeding the prescribed limits. It is clear from the table that all the forty mobile towers radiation is within the prescribed limits and none of them is radiating in excess to its prescribed limit.

Figure 5.3 Percentage Share of the Towers in Compliance to the Emission Level

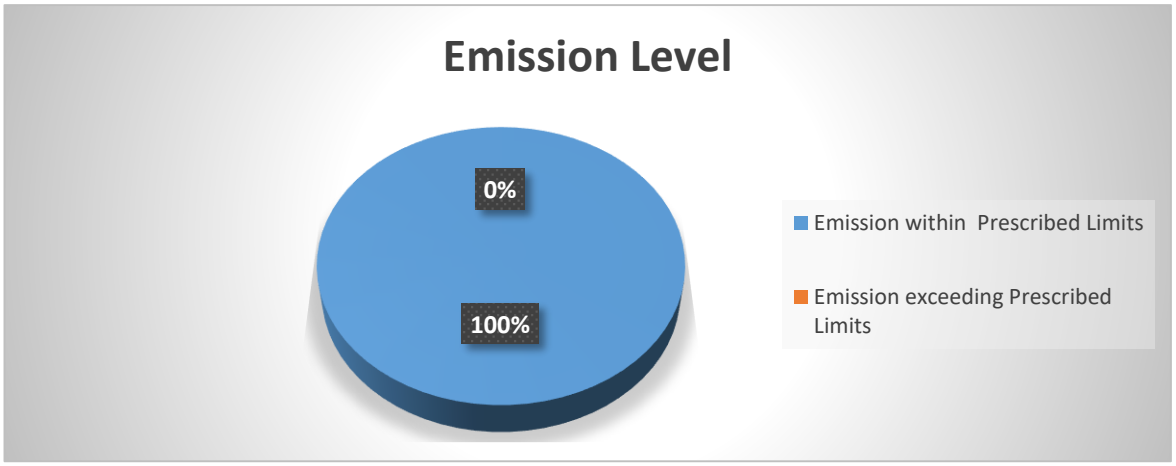


Table 5.3 Data Relating to the Implementation Level of the Infrastructural Guidelines

S.No	Site Details	Type of Tower	Total Number of Antennas	Number of Antennas in same Direction	Building Directly in Proportionate to Total Antenna Tilt
1	SCF-12 Model Town phase-3	Roof Top	1	0	No
2	Friends Plaza Sco-37, Urban Estate	Roof Top	5	0	No
3	Sukhraj Singh, Model Town Phase-3	Roof Top	1	0	No
4	Street No. 4/9 Jujhar Singh Nagar	Roof Top	8	0	No
5	Pritam Singh Dhillon, #20062/A-2	Roof Top	3	0	No
6	100 Feet Road, Near Clock Tower and ICICI	Roof Top	4	0	No
7	Model Town Phase 3 Jujhar Singh Nagar	Roof Top	1	0	No
8	Rajvinder Kaur W/O Manwinder Singh, Sky Hight 100 FT Road	Roof Top	1	0	No
9	Rajpal Hospital vide Property No. 2853-B	Roof Top	5	0	No
10	Hotel Silver Star, Nai Basti	Roof Top	8	0	No

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S.No	Site Details	Type of Tower	Total Number of Antennas	Number of Antennas in same direction	Building Directly in Proportionate to Total Antenna Tilt
11	Mr. Ashwani Kumar, Near A.T Telecom, Ahata Mar Mohammad Gali	Roof Top	3	0	No
12	LG Center Amrik Singh Road	Roof Top	2	0	No
13	Mandir Wali Gali, Near Fire Brigade, Above Manu Skin & Homeo Clinic	Roof Top	6	0	No
14	BSNL ExchangeBack Side of City Centre Mall, Civil Lines	Roof Top	14	0	No
15	AmarjeetKaur, No 421-B, Dhobian Road	Roof Top	3	0	No
16	Jaswant Singh Deep Complex GT Road	Roof Top	7	0	No
17	Nai Basti, Auto Market, Near Pukhraj Cinema	Roof Top	6	0	No
18	Mr. Mittal, Paradise Glass House	Roof Top	4	0	No
19	City Centre, Goniana Road, Parjapat Colony, Mata Jivi Nagar	Roof Top	5	0	No
20	Punjab National Bank, Near Reliance World and State Bank of India	Roof Top	5	0	No

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S.No	Site Details	Type of Tower	Total Number of Antennas	Number of Antennas in same direction	Building Directly in Proportionate to Total Antenna Tilt
21	Rose Garden Shopping Complex	Roof Top	1	0	No
22	SCF-85, Improvement Trust Shopping Complex	Roof Top	5	0	No
23	Vishal Nagar	Roof Top	1	0	No
24	Rakesh Maheswari, Opp S D Girls College, Subhiksha Store	Roof Top	2	0	No
25	Property bearing MCB No- 22286, Dhobiana Road	Roof Top	6	0	No
26	Dr. Mehboob Sra Punjab and Sind Bank Building, Model Town Main Road	Roof Top	2	0	No
27	Chandigarh Laboratories, Mall Road, Opp Hotel Suncity	Roof Top	6	0	No
28	Whole Sale Market Shop No-1, 2089A, Opp Cloth Market	Roof Top	15	0	No
29	No. 3133 Civil Secretarial Road	Roof Top	3	0	No
30	Gulfam Hotel and Restaurants, Mansa Road	Roof Top	6	0	No

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S.No	Site Details	Type of Tower	Total Number of Antennas	Number of Antennas in same direction	Building Directly Proportionate to Total Antenna Tilt
31	Jagjeet Singh H.No-430 Model Town Phase 2	Roof Top	2	0	No
32	Mrs. Bansal, C/O H.No-73 State Bank of India	Roof Top	4	0	No
33	SCF 11 and 12 Urban Estate	Roof Top	1	0	No
34	Baljit Kaur & Rajinder Kaur Brar, Sareen Financers, 2711, Old Bus Stand	Roof Top	11	0	No
35	Gol Diggi BSNL Exchange	Roof Top	8	0	No
36	BSNL Telecom Station, Near TV Tower, ITI	Ground Base	10	0	No
37	Inside Park, Under ITI flyover, Industrial Area	Ground Base	2	0	No
38	Max Super Speciality Hospital	Roof Top	2	0	No
39	NH 64, Near Civil Hospital, Mansa Road	Roof Top	5	0	No
40	Paramjeet Kaur, SCF 15, Phase 1, Model Town	Roof Top	9	0	No

Source: Field Survey.

Table 5.3 describes the data of 40 mobile towers collected through the primary survey. Data relates to the implementation of infrastructural guidelines issued for the mobile towers. The facts like the type of the tower, number of antennas on the tower, number of antennas in the same direction, and is there any building directly proportionate to the total antenna tilt of lowest antenna are depicted by the table. The collected data is based on the observation of the researcher himself as there was no one available at the sites. Towers are generally of three types i.e. Ground Base, Roof Top, and Pole Mounted but it can be seen from the table that data relates to first two types only. The number of antennas on the tower varies between the ranges of 1 to 15.

Further, the table depicts that no tower is having two or more antennas in the same direction and no building is situated directly in proportion to the total tilt of the lowest antenna installed on the tower.

Table 5.3.1 Number of Towers According to its Type

Tower Type	No. of Tower	Percentage Share
Ground Base	2	5
Roof Top	38	95
Total	40	100

The table 5.3.1 depicts the division of towers according to their types. It is clearly shown in the table that out of the total forty mobile towers majority of the towers i.e. thirty-eight are the roof top towers and very few i.e. only two towers are ground base towers. It is to be mentioned here that out of the total forty towers which were taken as a sample no tower was found to be the pole mounted tower.

Figure 5.4 given on the next page is the diagrammatical presentation of the percentage share of the towers according to their type. It can be clearly seen that ninety-five percent of the towers are the roof top towers and only five percent of the towers are ground base towers. So the share of the ground base towers in comparison to the roof top towers is very less.

Figure 5.4 Percentage Share of the Different Type of Towers

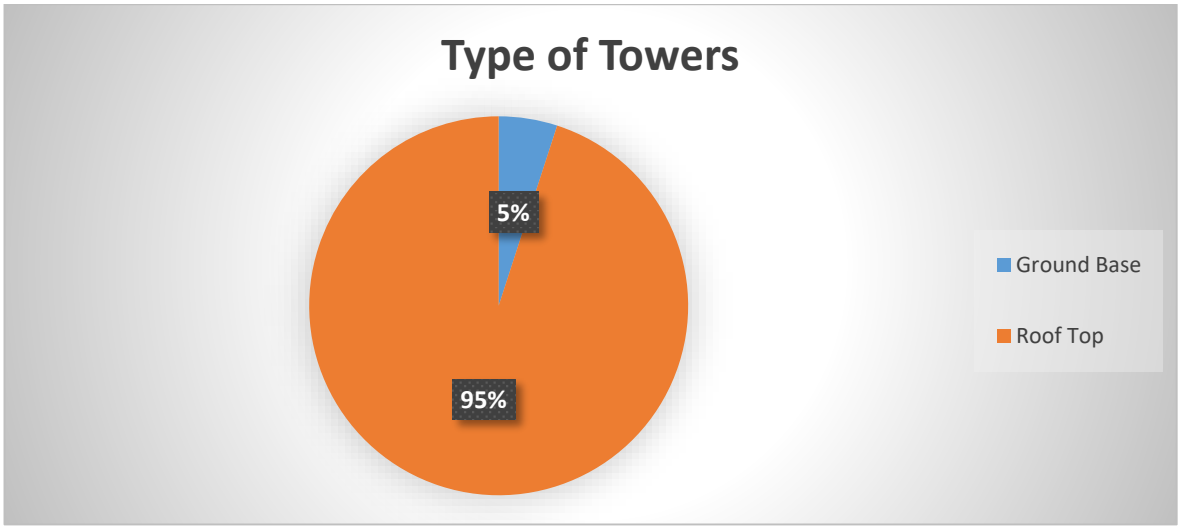

Table 5.3.2 Number of towers as per the number of antennas

No. of Antennas	No. of Tower	Percentage Share
1	7	17.5
2	6	15
3	4	10
4	3	7.5
5	6	15
6	5	12.5
7	1	2.5
8	3	7.5
9	1	2.5
10	1	2.5
11	1	2.5
14	1	2.5
15	1	2.5
Total	40	100

The table 5.3.2 shows the data of towers according to the number of antennas and its percentage share. It can be seen from the table that seven towers are having one antenna, six towers are having two and five antennas respectively, five towers are having six antennas, four towers are having three antennas and three towers are having four and eight antennas respectively. Further, it can be seen from the table that there are seven, nine, ten, eleven, fourteen and fifteen antennas on one tower each. Maximum percentage is of the towers having one antenna 17.5 percent followed by 15 percent towers each having two & five antennas, 12.5 percent towers having six antennas, 10 percent of towers having three antennas and 7.5 percent towers each having four & eight antennas respectively. Minimum percentage share i.e. 2.5 percent each is of the towers having seven, nine, ten, eleven, fourteen, and fifteen antennas respectively.

Figure 5.5 Percentage Share of Towers According to Antennas

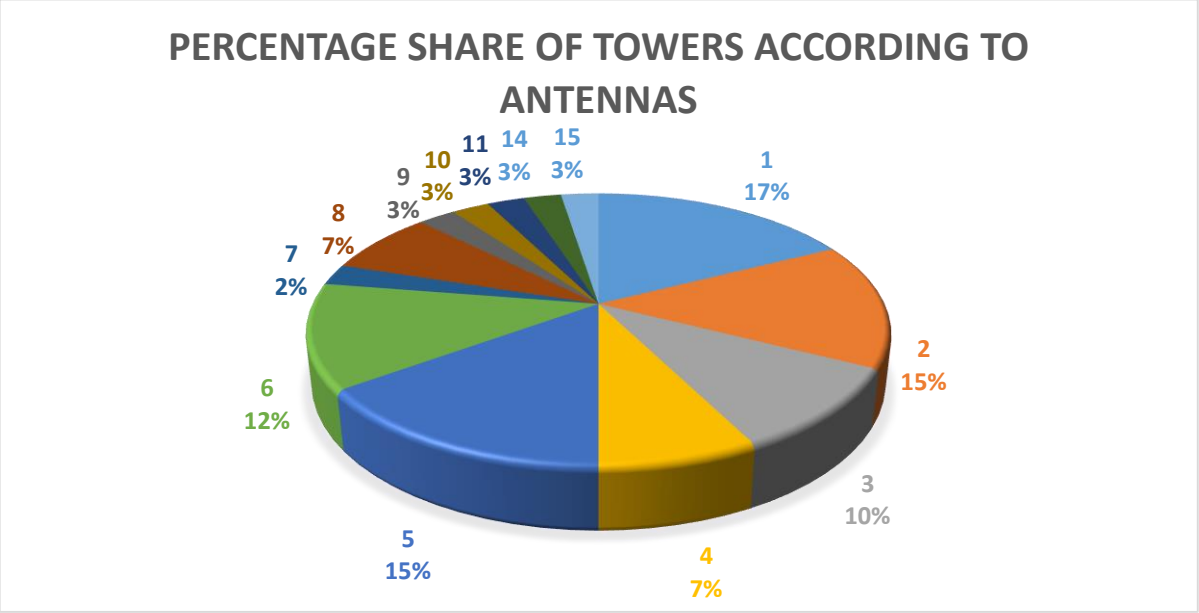

Figure 5.5 diagrammatically presents the share of the towers according to the antennas installed upon them. The numerical numbers represent the antennas and percentage represents the share of the towers from the sample. It is to be noted here that the pie chart shows the round off figures of percentage ignoring the point values as shown in the table above.

It is clear from the table 5.3 that no mobile tower situated in the city is having two or more antennas in the same direction. During the field visit there were three towers which seemed to have two antennas each in the same direction but from the close

observation, it was seen that there was a difference in the tilt angles of the antennas which shows that the area of exposure from the antennas is different. Further, it is clearly depicted in the table that no tower is having any building directly in proportion to the total tilt of its lowest antenna. All the buildings situated in the city near the mobile towers are compliant to their infrastructural law and are having the safe distance as prescribed in the infrastructural guidelines as issued by the DoT.

Chapter - VI

Conclusions and Suggestions

The research work in issue has been divided into six parts and keeping in view the importance of the study the title “Implementation of Laws & Policies on Mobile Towers & Mobile Phone Radiation Levels in India: A Case Study of Bathinda City” was chosen to find out the basic foundation of the use of modern communication device i.e. Mobile Phone.

As per the policy of the research work, the first part of the study is the introductory part which covers the introduction of the topic, objectives of the study, the importance of the study, hypothesis etc. This part introduces the title of the study and defines & discuss the terms such as communication, telecommunication, and other relevant facts about the telecommunication. It is depicted in this part that telecom sector in India is growing at a very fast rate. Out of the total telecom subscription, more than ninety-seven percent is the wireless subscription and wireline subscription is limited to only two to three percent. Major share in the Tele-density of our country is of the wireless connections and wireline connections are having a very nominal share. At present, there are total 4, 62,328 Cell Sites and 17, 20,765 Base Transceiver Stations in India.

The second part of the study is covering the literature review. This part includes the review of the books, research articles, news articles, and the case laws. From the literature review, it is seen that the electromagnetic waves emitted from the mobile towers affect both the human beings and the animals. People living near the mobile towers are prone to the different type of health risks such as diabetes, cardiac & respiratory problems, skin diseases, hair loss and increased risk of cancer etc. Excessive use of mobile phone is also harmful as it increases the temperature of the body. If a mobile phone is used for a longer duration i.e. more than 45 minutes than it causes heating of the area near the ear skull. It is pertinent here to state that all the studies which are reviewed in this part relate to the radiation from the mobile towers and its effect on the people living near the mobile towers base stations. None of the study reviewed in this part deals with the implementation aspect of laws, rules, and regulations regarding the emission limits and infrastructural laws relating to the mobile towers.

The third part of the study covers the research methodology. The study is a descriptive study of nature and uses both primary and secondary data for achieving its ends. Forty mobile towers are selected as a sample from different localities of the research area i.e. Bathinda City. The mobile towers are selected by way of the random sampling method. Data pertaining to the compliance of the EMF radiation limits of the mobile towers is collected from the DoT which is received in the form of a computer generated emails. The survey method is used for collecting the data pertaining to the implementation of infrastructural guidelines relating to the mobile towers. The results regarding the same are based on the observation of the researcher as no respondents were available at the sites during the field visits.

The fourth part of the study covers all the Laws and regulation available in India relating to the mobile phone & mobile tower radiation including the infrastructural guidelines issued by the DoT for setting up a mobile tower. The standard law regarding the mobile tower radiation is the guidelines of the ICNIRP which were issued by Germany and adopted by many countries including India. The radiation emission limits prescribed by the ICNIRP were adopted by India in the year 2008. But in the year 2012 DoT revised the EMF radiation limits for the mobile towers and adopted the limits which are 1/10 of the limits prescribed by the ICNIRP. As a consequence of this revision, the Indian norms regarding the mobile tower radiation are the strictest norms in comparison to the norms adopted by other countries of the world. At present India is having the strictest EMF exposure norms. SAR limits for the mobile handsets as prescribed by the ICNIRP were also revised by India in the year 2012. The present SAR limit for the mobile handsets adopted by India is 1.6 Watt/Kg averaged over 1 gram of the tissue. The SAR limits adopted by India are also strict than the limits adopted by many countries but are at par with the limits adopted by Australia, USA, and Canada. The laws relating to the telecommunications in India are governed by Indian Telegraph Act, 1885 which is amended from time to time. The mobile towers are covered under the definition of the ‘Telegraph’ given in the Indian Telegraph Act, 1885. Telecommunications falls under the Union list given in Schedule 7 of the Constitution of India. Matters related to telecom and the associated fees are covered under the Entry 31 and 96 of the Union list. The radiation from the mobile towers is not covered under the definition of ‘air pollutant’ given in the Air (Prevention and Control of Pollution) Act, 1981, but

the noise which is emitted by the generators of the mobile tower base stations is covered under this definition. Further, it is to be stated that the noise generated by base stations of mobile towers was also not covered under the definition of air pollutant in the original Act, and it was inserted in 1988 by way of amendment. Infrastructural guidelines for setting up a mobile tower and mobile tower base station are issued by the Department of Telecommunications and every service provider has to comply with these guidelines as these are mandatory in nature. Now the status of 'infrastructure' has been granted to the mobile towers by the Cabinet Committee of Infrastructure (CCI) vide gazette notification published on 27 March 2012. Telecom installations are a critical infrastructure and are lifeline installations in mobile communication. Mobile communication is an essential service and to avoid any disruption in this service a BTS tower cannot be sealed or its electricity may not be disconnected without the prior permission or consent of the respective TERM cell of DoT. Further, it is to be stated here that the regulatory agencies like CPCB & SPCB do not have any authority to dismantle any Mobile Tower or to disconnect any telecommunication service.

The fifth part of the study covers the analysis of the data collected during the research. Data analysis is divided in to two parts i.e., i) the analysis of the data relating to the compliance of radiation emission norms of the mobile towers situated in the Bathinda City and ii) the analysis of the data relating to the implementation level of the infrastructural guidelines for the mobile towers issued by the DoT with reference to the mobile towers situated in the Bathinda City. Regarding the compliance of radiation emission norms of the mobile towers, it is seen from the analysis of the data that out of the forty mobile towers, twenty-two mobile towers are having one telecom service provider, eleven mobile towers are having two telecom service providers, and seven mobile towers are shared by three telecom service providers. Regarding the basis of the compliance of the EMF limits, it shows that out of the forty mobile towers, thirty-six mobile towers are certified by the operators itself and only four mobile towers are certified on the basis of the test conducted by the DoT. It is clear from the data provided by the DoT that all the forty mobile towers situated in the Bathinda City are compliant to the EMF radiation limits as all the mobile towers are emitting the radiation within the limits prescribed by the DoT. Both the hypothesis formulated in this regard are rejected. Because India is one of the

countries which is having the strictest rules regarding the mobile tower radiation and it is clear that in India the laws relating to the mobile tower radiation are available in sufficient number. In regard to the capacity of the implementation of the existing laws relating to the mobile phone/mobile tower radiation, it is to be stated that the implementation of these laws is up to the accurate level as no mobile tower is found to be emitting the radiation in excess to the prescribed EMF exposure limits. Further in this part data relating to the implementation level of the infrastructural guidelines issued by DoT regarding the setting up of the mobile towers is discussed. It contains the data pertaining to the site details, type of tower, number of antenna on the tower, number of antennas in the same direction, and distance of the building from the mobile tower if any building is situated directly proportionate to the total tilt of the lowest antenna installed on the tower. From the analysis of the data, it is seen that out of the forty towers thirty-eight towers are the roof top towers and only two towers were found to be the ground base towers. Though some towers are having a large number of antennas installed upon them but no tower is found having two or more antennas in the same direction. All the buildings situated near the mobile tower are within the safe limits as prescribed in the infrastructural guidelines and no building was found to be directly proportionate to the total tilt of the lowest antenna installed on the tower. The mobile towers situated in the Bathinda City are in compliance with the infrastructural guidelines issued by the DoT. Both the hypothesis formulated in this regard are also rejected. In regard to the sufficiency of the infrastructural laws/guidelines relating to the mobile towers, it is to be stated that they are available in the sufficient number. In regard to the implementation of these infrastructural guidelines, it is to be stated that the implementation of the same is up to the accurate level and the guidelines are mandatory in nature and all the telecom service providers have to comply with these guidelines.

Suggestions

It is seen from the analysis of the data that basis of compliance to the EMF exposure limits of a large number of the mobile towers is the certification done by the operator(s) itself. The certificate of compliance is submitted by the operator to the DoT on a bi-annual basis. But as shown earlier in the preceding chapters that in an audit carried out by the TERM cell of the DoT many towers were found exceeding their radiation exposure limits and penalties were imposed upon them. So it is

suggested that all the towers should be certified based on the tests carried out by the DoT only. If it is tough to implement the suggestion given above due to certain procedural of financial issues then it is suggested that the certification done by the operator at its level shall be cross-checked by the DoT to verify the authenticity of certificates submitted by the operator at least once in a year. Secondly, if any mobile tower is found emitting the radiation in excess to the prescribed limits after submitting the self-compliance certificate then it is suggested that the signatory to the self-compliance certificate shall also be made liable personally along with the telecom service provider. Lastly, though the area restrictions for installing a mobile tower were removed in the year 2012 after the mobile towers were given the status of infrastructure. But as depicted in many studies that the radiation emitted from the mobile tower is harmful to the health. It is suggested that as a precautionary measure installation of the mobile towers on the roofs of the hospitals and schools should be avoided as children's and patients are more vulnerable to the harmful rays emitted by the mobile towers.

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