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TELECOM REGULATORY AUTHORITY OF INDIA

Recommendations

on

Telecommunications Infrastructure Policy

April 12, 2011

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Preface

Telecommunications in India is witnessing a very rapid growth. Having registered over 825 million connections at the end of February, 2011, the country is poised to soon cross the one billion mark. With the growth in Broadband services and applications, the nature of telecommunications too is fast evolving. Telecommunications having effectively reached the level of a basic need, the importance of ubiquitous and effective coverage, both outdoor and indoors, through an efficient infrastructure cannot be overemphasised.

Such infrastructure cannot, however, develop without a clear policy framework. As of now, there is no detailed policy for telecom infrastructure. Keeping in view the need to formulate a policy that can subserve the country's growing requirements, TRAI has, *suo motu*, issued a consultation paper in January, 2011. The recommendations contained in this document are an outcome of the consultation process.

The recommendations contained herein cover important issues such as incentives for infrastructure providers, right of way, tower design and standardisation, distributed antenna systems and indoor building solutions, mobile virtual network operators and migration to IPv6. In the process, some of the earlier recommendations given by TRAI have also been reviewed in the context of recent developments. Certain related policy issues such as equipment manufacturing and renewal energy source etc., have been separately dealt with in the Authority's recommendations on Telecom Equipment Manufacturing policy and Green Telecommunications.

These recommendations are being given in the expectation that they would form part of the telecom policy that is under formulation.

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INTRODUCTION

1. The telecom services have been recognised the world over as an important tool for the socioeconomic development of a nation. In addition to fulfilling the basic need of communicating with each other, telecommunication is a prime support sector for rapid growth and modernisation of various other sectors of the economy. It has become especially important in the recent years because of enormous growth of information and communication technologies and their significant potential for the impact on the rest of the economy.

2. Building suitable telecommunication infrastructure has the same effect on growth of telecommunication as telecommunication services have on growth of the economy. Infrastructure investments can affect growth beyond adding to the capital stock. These effects can occur through a number of different channels, such as facilitating trade and the division of labour, competition in markets, a more efficient allocation of economic activity across regions of the country, the diffusion of technology and the adoption of new organisational practices. Results from a recent World Bank study on growth in 120 countries between 1980 and 2006 shows that for every ten-percentage-point increase in penetrations of telecom services like fixed, mobile, broadband etc, there is an increase in growth by 0.73 percent to 1.38 percent (Qiang, 2010)[1]. As can be seen these growth effects are significant and stronger in developing countries than in developed ones (Figure 1). The impact is expected to be even more robust once the penetration reaches a critical mass. As several countries including India are at a relatively early stage of

[1] Christine Zhen-Wei Qiang (2010) - Broadband infrastructure investment in stimulus packages: relevance for developing countries

infrastructure development especially for broadband, they are likely to gain the most from investing in telecom networks to reach the critical mass for higher impact and before the diminishing returns take effect. Therefore, development of an adequate telecommunication infrastructure has become one of the major goals of policymakers.

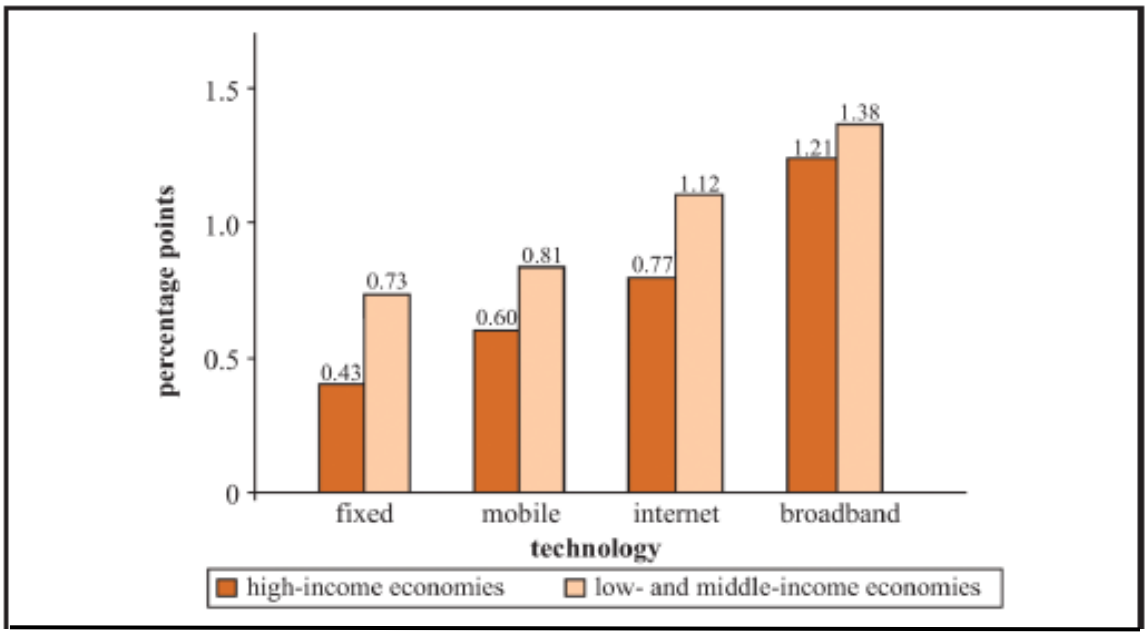


Figure1: Impact of telecom penetration on growth

Y axis represents the percentage point increase in economic growth per ten percentage point increase in telecommunication penetration.
Source: Qiang (2010)

3. NTP-99 had recognised the need for creation of world class telecommunication infrastructure as the key to rapid economic and social development of the country. Stressing the need for creation of necessary infrastructure for country's growth, India's Eleventh Five Year Plan (2007-12) includes strategies and plans for infrastructure development and inclusive growth, through both the public and

private sectors. Provision of telecommunications and broadband connectivity, to provide the benefits of the Internet to people all over the country, has been included as an important infrastructure priority under this Plan. With substantial investment in telecom infrastructure expected over the coming years, it is important to have an effective policy framework in place.

4. The growth in telecom sector, particularly of wireless subscribers has been impressive. India has over 825 million subscribers at the end of February 2011, of which 791 million are mobile subscribers. The country is expected to reach a figure of 1 billion customers by the year 2014. However, on provision of broadband access a lot needs to be done. 3G and BWA (Broadband Wireless Access) services are in the process of getting launched to take mobile and broadband to next level. Mobile communication in future is not going to be limited between Person to Person (P2P) but will extend to Person to Machine (P2M) and Machine to Machine (M2M). Examples of applications for mass M2M services include smart power grid, smart metering, consumer products, health care and so forth. Number of devices to be connected on wireless platform is expected to be 50 billion globally by the year 2020. Expecting current growth rates to continue approximately 1.5 billion and 5 billion connections, including for devices, can be expected in India by the year 2015 and 2020 respectively. Maintaining such exponential growth in mobile both for personal and machine communication; and meeting the latent demand for broadband access calls for creation of huge infrastructure requiring significant investment.

5. This infrastructure policy covers various elements of the infrastructure like optical fibre network, towers, cable landing stations, IP networks, evolving technologies like IBS, DAS etc.

Recommendations on National Broadband Plan, which is one of the components under this policy, have already been released in December 2010. This broadband plan envisages creation of an open access optical fibre network across the country connecting all habitation upto population of 500 and above by the year 2013.

6. For the deployment of the infrastructure active role of both the Central and State Governments is required to enable the growth of telecom infrastructure necessary for meeting the telecommunication demand of the people. However, in recent times it is found that local authorities are not providing the permission for erecting the infrastructure in a reasonable time limit. To enable continued investment in the sector and allow timely creation of modern telecommunication infrastructure, issues related to Right of Way need early resolution.

7. Apart from advancement towards converged networks, newer technologies are developing where certain elements of the network infrastructure can be shared to bring down the cost and decrease the roll out time. Sharing could be possible for both active and passive network elements. With the huge requirement of infrastructure creation there is an active involvement of Infrastructure Providers (IP-I) in meeting the infrastructure requirement of the service providers. IP-I and Telecom Service Providers should be able to share infrastructure with all licenced telecom service providers. Sharing of infrastructure will lead to reduced transaction costs and quicker roll out.

8. In order to address the issues related to infrastructure, a consultation process was initiated through a consultation paper on "Telecommunications Infrastructure Policy". The open house

discussions on this subject were held at New Delhi on 25th February 2011. Based on the written submissions of the stakeholders, the discussions in open house and prevailing international practices relevant to our country, the issues have been examined in depth and appropriate recommendations given.

9. The issues have been addressed in four chapters – Chapter I deals with the issues related to RoW, design of towers, camouflaging of towers, In Building Solutions and Cable Landing Station. Chapter II deals with issues related to Internet Protocol (IP) infrastructure covering Broadband, Internet Exchange Points, Migration to IPv6 and IPTV. Chapter III deals with infrastructure management where issues related to infrastructure sharing, MVNO, USO and Rural Telephony have been discussed. Chapter IV gives summary of recommendations.

CHAPTER I: INFRASTRUCTURE ELEMENTS

1.1 In the consultation paper a working classification of telecommunications infrastructure was proposed for the sole purpose of focusing on regulatory and policy issues relevant for different classes or categories of infrastructure. The telecom infrastructure was classified as:

(i) Fixed Network
(ii) Mobile Network
(iii) Broadband Network
(iv) Long Distance Network
(v) IP Network

1.2 In response to the question regarding the aptness of the above classification, most of the stakeholders were broadly in agreement with the proposed classification. However, some of the stakeholders were of the view that instead of classifying them from the service point of view, they should be classified in terms of discrete elements like BSS/OSS, NMS, Service Delivery Platform for VAS, Carrier Network, Access Network, Data centres, DSLAM, Metro Ethernet etc.

1.3 While making the above classification, the Authority was conscious of the fact that the telecom is undergoing a metamorphosis whereby convergence is taking place at various levels. At the industry level, telecommunications, IT and entertainment are converging and assuming cross-industry roles. A mobile telephone today is also a computer and a mobile TV. Increasingly TVs are becoming capable of providing internet connectivity. Cable TV network is being digitalised to become broadband capable. Traditionally, infrastructure has been

developed according to type of service it provided. However, with rapid technological advancement leading to convergence, it has become possible to use the same network elements or technology to provide multiple services through single platform, thereby avoiding duplication of infrastructure.

1.4 Both fixed and mobile networks can be equipped with technologies to provide broadband services. In other words broadband networks could be fixed - with copper or fibre or wireless. The long distance networks could be based on TDM, ATM, FR or IP or other technologies in future. In the context of licence today, the carriers or the long distance operator, set up inter-service area network and also networks to other countries. The same network could be used by fixed, mobile and broadband networks.

1.5 In view of the above, it will be perhaps appropriate that rather than looking at it from the point of view of a particular category of service providers, the network is conceived as a combination of infrastructure elements capable of delivering various services. Accordingly, following infrastructure elements, which are of key importance in meeting the requirements of telecommunications infrastructure, have been discussed in the subsequent paragraphs;

- Towers
- In Building Solution (IBS)
- Distributed Antenna System (DAS)
- Cable Landing Station (CLS)

1.6 The tremendous growth of telecommunications in recent years coupled with its capabilities to deliver a host of other services like e-health, e-education, commerce, entertainment and a number of other

applications have made telecommunication a basic need like water, electricity or road. Infrastructure development plays a crucial role in building a robust telecom network. The high level of growth in the Indian wireless telecom sector and recent launch of 3G and BWA services will continue to drive huge investments in building the telecom infrastructure. Given the substantial capital investment required, it is imperative to seek private sector participation in this area. Since communication has now become the basic need of every one, necessary infrastructure to fulfil this requirement need to be created, even in rural areas. Therefore, the essentiality of telecom infrastructure cannot be overstated.

1.7 **The Authority recommends that telecom infrastructure should be treated as an essential infrastructure.**

1.8 Section 19B of the Indian Telegraph Act, 1885 authorises the Central Government to confer licencees, by way of a notification, the powers of the Telegraph Authority under part III of the Act. The Government issued a notification on 24th May, 1999 (**Annexure-I**), permitting the licencees under Section 4 of the Act to seek way-leave from any person including public authority, public corporation, autonomous body, State Government or Central Government in the respective licenced service areas for the purpose listed therein. The dictionary meaning of the term 'way-leave' is right of use over the property of another. Traditionally the permitted kinds of uses were limited, most important being right of way.

1.9 Currently, infrastructure provision is being made by infrastructure providers who are currently being registered by the Department of Telecommunications. The telecom service providers who are licencees under Section 4 of the Indian Telegraph Act, 1885 are divesting

themselves of the task of infrastructure provision. Therefore, advantage of the notification under Section 19B is much less today than before.

1.10 In the Recommendations on "Spectrum Management and Licensing Framework" issued in May, 2010, this Authority had recommended that Infrastructure Providers (IP-I) should be brought under Unified Licence. In the context of the need for facilitating the infrastructure providers, by empowerment under Section 19B, the need for IP-I being brought under this is all the more urgent.

1.11 **The Authority recommends that Department of Telecommunications should immediately bring the IP-I under Unified Licence.**

1.12 As mentioned earlier around 1 lakh additional towers will be required to cater to 1 billion mobile telephones by 2014. At an average investment of Rs. 25 lakh per tower, this will require an investment of Rs. 25,000 crore. Given the substantial capital investment required, it is imperative to seek private sector participation in this area. The Government provides tax holidays under section 80 IA of the Income Tax Act, 1961 to infrastructure companies in sectors like power, ports, natural gas etc. Since telecommunication is an essential infrastructure, companies building the telecom infrastructure should also be brought under such a provision under Income Tax Act, 1961. Such a provision can also promote investments in the rural areas and incentivise private sector participation in telecom infrastructure projects.

1.13 **The Authority recommends that telecom infrastructure provider companies should be extended tax benefits under Section 80 IA.**

A. Towers

1.14 Presently, there are 12-14 telecom service providers in each service area catering to around 791 million wireless subscribers at the end of February, 2011. Additionally, all those operators who were successful bidders in the auction of spectrum for 3G and BWA services are also in the process of roll out of their networks. As telecom towers are an integral part of the wireless telecom infrastructure, number of towers will also increase along with network expansion. Currently there are around 400,000 telecom towers and it is estimated that approximately 100,000 more towers will be required to cater to projected subscriber base of around 1 billion by 2014 and to support rollout of 3G and BWA services.

1.15 In last few years, large number of towers with close proximity, especially in Metro and urban areas, has raised several concerns about aesthetics, health issues concerning radiation hazards and safety of telecom towers. The use of power generators to address lack of un-interrupted power supply also adds to pollution. As a result, stringent conditions have been imposed by various civic authorities for erection of towers. These include requirements such as advance clearance from Resident Welfare Associations (RWAs) in case of residential areas, structural safety certificate, clearance from pollution control authorities and fire authorities. At times there are huge delays in granting the permission. Moreover, there has been multi fold enhancement in levies for grant of permission.

1.16 While it is necessary to meet the requirements related to safety and pollution in the larger interest of the society, delays in granting permissions is not only impacting the growth of the sector but is also

adversely affecting the quality of telecom services being provided to the customers. This has necessitated a relook regarding the issues related to infrastructure elements and the current legal framework along with suggestions to align the legal framework with changing technological landscape. This has been discussed in the following paragraphs.

1. Clearances for infrastructure deployment from local Authorities

1.17 Service providers are required to put together various infrastructure elements for providing telecommunication services to end consumers. Some of the elements may be installed in the premises owned or leased by the service provider and other elements may be required to be placed in other's property. Other's property may come under the purview of local authority or could be owned by societies or an individual. In case the infrastructure elements are required to be placed in other's property, necessary permission for use of the property for placing the infrastructure will be required. In addition in certain cases, other clearances like fire safety, pollution, aviation, and defence may also be applicable. Local civic authorities have formulated guidelines for this purpose prescribing conditions to be fulfilled by the service providers before deploying the infrastructure like cable, towers etc.

1.18 In absence of a uniform national policy for granting permission to place a telecom infrastructure element, local civic authorities/State Governments have come up with their own policies. These policy guidelines vary widely across the country from State to State, city to city having different terms and conditions, taxes, levies, safety aspects and involve lengthy procedure for grant of permission. To illustrate the variations in the policies adopted by various states, the policies of

various states for erection of towers was studied. **(Annexure-II)**. As can be observed, there is a wide variation between the policies and conditions prescribed by the states even though all telecom services are governed under the same Indian Telegraph Act, 1885. In many cases, the process is reported to be complicated and time consuming. The main issues are high charges for grant of permission, complicated approval procedure and clearances required from multiple agencies resulting in delays. These procedural issues have resulted in increased costs, delayed investments, higher roll out time and poor quality of service. Therefore, there is an urgent need to streamline the procedures within the legal framework and come up with a national policy to achieve faster growth of telecommunication services in the country. A uniform policy should have a single legal framework for the entire country and need to be applicable for deployment of all kinds of infrastructure elements. Since major growth is happening in mobile area which requires deployment of large number of towers, specific questions relating to erection of towers were put up for consultation.

1.19 In the consultation paper, stakeholders were asked to provide comments on the following questions:

i. Do you consider that the existing framework of different civic authorities to grant permission for telecom towers is adequate and supportive for growth of telecom infrastructure?

ii. Is there a need to set-up a single agency for approval and certification of towers? Is there an existing agency that can do this work? If a new agency is proposed, what should be its composition and framework?

iii. Is it feasible to have a uniform framework of guidelines including registration charges, time frame, single window clearance etc for granting permission for installation of telecom

towers and laying of optical fibre cables? If so, can it be prescribed by the Licensor or the Regulator?

iv. What can be an appropriate time frame for grant of permission for erection of towers?

v. How can a level playing field be ensured for telecom service providers vis-à-vis other utility service providers especially in reference to tower erection?

vi. Which agency is best suited to inspect the buildings and certify the structural strength of the buildings in case of roof based towers?

1.20 In response, some of the stakeholders suggested that there is a need to set up a single agency for approval and certification of towers. They were of the opinion that Government may create a new agency consisting of persons from relevant departments and service providers or the industry associations. Such agency should be empowered with adequate power (e.g. fixation of tariff and other guidelines) and could interface with local civic authorities in grant of very specific approvals for setting up telecom towers such as certification of buildings, structural strength, or permissions to set up towers in certain sensitive areas such as defense cantonments, heritage sites, border areas, etc. One of the stakeholders opined that there is a need for a new agency consisting of representatives from Municipality concerned, certified structural engineer from the same city and a representative from RWA (applicable only in case of multi-storied building). However, few stakeholders were of the opinion that there is no need for a single agency and suggested that it should be the responsibility of the Municipal Corporation to give approvals in the same way, as they approve the building plans.

1.21 Some of the stakeholders suggested that the Government should formulate a National Telecom Infrastructure Policy (NTIP), in exercise of powers under Section 7 of the Indian Telegraph Act, 1885, to lay down clear guidelines to be followed by various states and local authorities for grant of approvals and certification for telecom towers and laying of optical fibre cables. They also suggested that uniformity in the rules across country in providing RoW, levies and specifying other requirements of safety are an absolute must. There should be uniformity in policies for RoW, procedure for laying underground cable, rules and levies related to Telecom Infrastructure including Telecom Towers.

1.22 Some stakeholders mentioned that Mobile Towers fall under the definition of "telegraph" under the provisions of Indian Telegraph Act, 1885 which is absolutely different and distinct from the concept and meaning of the expression "Building" as used in the various State Acts. They also mentioned that as per Entry 31 of List I of 7th Schedule (Union List), the Central Government has the exclusive legislative competence to deal with any matter relating to the same. They said that Entry 31 covers the entire field in relation to "Telegraphs" including erection/installation, maintenance and operation thereof and read with Entry 96 of the same List covers all and any fee payable in respect thereof.

1.23 Despite various steps taken by Government, problems such as levy of high charges, lack of uniformity in decision making processes, non-availability of single window system for RoW clearance, long time in granting permissions etc. have remained unresolved and are impeding growth of telecom infrastructure in the country. There is a need to ensure uniform procedures for RoW permissions across the country for timely and faster rollout of telecom infrastructure.

1.24 Present constitutional and legal framework for Telecommunications is as follows:

Schedule 7 of the Constitution of India consists of three lists as follows:

- List I – Union List
- List II – State List
- List III – Concurrent List

Telecommunication falls under the Union List. Entry 31 & 96 of this list cover all the matters related to telecom and associated fees. As per Part XI described below the Parliament has exclusive powers to make laws with respect to any of the matters covered under Union list, which includes telecom. The State legislative has exclusive powers to make rights related to land, which falls under the State list (List II).

1.25 Part XI of the Constitution of India covers the Relations between the Union and the States. Chapter I of Part XI of the Constitution of India relates to Distribution of Legislative Powers between the Centre and the States. Article 246 of chapter I covers subject matter of laws made by Parliament and by the Legislatures of States and is reproduced below:

"246.(1) Notwithstanding anything in clause (2) and (3), Parliament has exclusive power to make laws with respect to any of the matters enumerated in List I in the Seventh Schedule (in this Constitution referred to as the "Union List").

(2) Notwithstanding anything in clause (3),Parliament, and, subject to clause (1), the Legislature of any State also, have power to make laws with respect to any of the matters enumerated in List III in the Seventh Schedule (in this Constitution referred to as the "Concurrent List").

(3) Subject to clauses (1) and (2), the Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters enumerated in List II in the Seventh Schedule (in this Constitution referred to as the "State List").

(4) Parliament has power to make laws with respect to any matter for any part of the territory of India not included in a State notwithstanding that such matter is a matter enumerated in the State List."

1.26 Entries 31 and 96 of the List I of the 7th Schedule cover telecommunications and related fees. These are reproduced below:

"31 – Posts and telegraphs; telephones, wireless, broadcasting and other like forms of communication.

"96 – Fees in respect of any of the matters in this List, but not including fees taken in any court."

1.27 Clause (3) of Article 246 which mentions that the Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters enumerated in List II in the Seventh Schedule. Entry 18 of List II (State List) relates to Land and is reproduced below:

"18. Land, that is to say, rights in or over land, land tenures including the relation of landlord and tenant, and the collection of rents; transfer and alienation of agricultural land; land improvement and agricultural loans; colonisation."

1.28 The laws governing the telecommunications in India are governed by the Indian Telegraph Act, 1885 amended from time to time. Section 7 of the Indian Telegraph Act, 1885 empowers the Central Government

to make rules consistent with this Act for the conduct of all or any telegraphs established, maintained or worked by the Government or by persons licenced under this Act. Section 7 is reproduced below:

"Power to make rules for the conduct of telegraphs—(1) The Central Government may, from time to time, by notification in the Official Gazette, make rules consistent with this Act for the conduct of all or any telegraphs established, maintained or worked by the Government or by persons licensed under this Act.

(2) Rules under this section may provide for all or any of the following among other matters, that is to say:

[(e) the conditions and restrictions subject to which any telegraph line, appliance of apparatus for telegraphic communication shall be established, maintained, worked, repaired, transferred, shifted, withdrawn or disconnected;]

[(ee) the charges in respect of any application for providing any telegraph line, appliance or apparatus;]

(f) the charges in respect of –

(i) the establishment, maintenance, working, repair, transfer or shifting of any telegraph line, appliance or apparatus;

(ii) the services of operators operating such line, appliance or apparatus;

1.29 Regarding permission from local authorities, Sections 10, 12, 13, 15 and 16 of the Indian Telegraph Act, 1885 are relevant. Section 10 provides power to telegraph authority to place a telegraph line subject to clause (c), which mentions that telegraph authority shall not exercise those powers in respect of any property vested in or under the control or management of any local authority, without the

permission of that authority. Section 12 empowers the local authority to impose reasonable conditions as it thinks fit for giving any permission under Section 10, clause (c). Sections 10,12 and 13 are reproduced below:

"10. Power for telegraph authority to place and maintain telegraph lines and posts – The telegraph authority may, from time to time, place and maintain a telegraph line under, over, along, or across, and posts in or upon any immovable property:

Provided that –

a. *the telegraph authority shall not exercise the powers conferred by this section except for the purposes of a telegraph established or maintained by the [Central Government], or to be so established or maintained;*
b. *the [Central Government] shall not acquire any right other than that of user only in the property under, over, along, across in or upon which the telegraph authority places any telegraph line or post; and*
c. *except as hereinafter provided, the telegraph authority shall not exercise those powers in respect of any property vested in or under the control or management of any local authority, without the permission of that authority; and*
d. *in the exercise of the powers conferred by this section, the telegraph authority shall do as little damage as possible, and, when it has exercised those powers in respect of any property other than that referred to in clause (c), shall pay full compensation to all persons interested for any damage sustained by them by reason of the exercise of those powers."*

"12. Power for local authority to give permission under section 10, clause (c), subject to conditions – Any permission given by a local authority under section 10, clause (c), may be given subject to such reasonable conditions as that authority thinks fit to impose, as to the payment of any expenses to which the authority will necessarily be put

in consequence of the exercise of the powers conferred by that section, or as to the time or mode of execution of any work, or as to any other thing connected with or relative to any work undertaken by the telegraph authority under those powers."

"13. Power for local authority to require removal or alteration of telegraph line or post.—When, under the foregoing provisions of this Act, a telegraph line or post has been placed by the telegraph authority under, over, along, across, in or upon any property vested in or under the control or management of a local authority, and the local authority, having regard to circumstances which have arisen since the telegraph line or post was so placed, considers it expedient that it should be removed or that its position should be altered, the local authority may require the telegraph authority to remove it or alter its position, as the case may be."

1.30 A perusal of the provisions of the Indian Telegraph Act, 1885 indicates that RoW permission is required from local Authority, in case the land or property under question is under the management or control of local Authority and is subject to conditions as decided by local authorities. Further, provision for handling disputes is available in the Section 15 of the said Act, which reads as below:

"15.Disputes between telegraph authority and local authority.— (1) If any dispute arises between the telegraph authority and a local authority in consequence of the local authority refusing the permission referred to in section 10, clause (c), or prescribing any condition under section 12, or in consequence of the telegraph authority omitting to comply with a requisition made under section 13, or otherwise in respect of the exercise of the powers conferred by this Act, it shall be

determined by such officer as the [Central Government] may appoint either generally or specially in this behalf.

(2) An appeal from the determination of the officer so appointed shall lie to the [Central Government]; and the order of the [Central Government] shall be final."

1.31 Section 16 covers the disputes in case of property other than that of a local authority and is reproduced below:

"16. Exercise of powers conferred by section 10, and disputes as to compensation, in case of property other than that of a local authority.—(1) If the exercise of the powers mentioned in section 10 in respect of property referred to in clause (d) of that section is resisted or obstructed, the District Magistrate may, in his discretion, order that the telegraph authority shall be permitted to exercise them."

1.32 From the reading of the above provisions, it can be observed that the Indian Telegraph Act, 1885 envisages two categories of properties for providing rights of way. One category being properties "vested in or under the control or management of local authorities" and the second category being other private property. This dichotomous approach is evident in the provisions under Sections 10 (c) & 10 (d) as well as between Section 15 & 16 of the Act whereby these two categories of properties are differently treated in so far as ingress, disputes & compensation are concerned. Accordingly, local authority's power and authority in terms of exercising the provisions of the Indian Telegraph Act, 1885 should apply only to those properties that are vested in or under the control or management of local authority and all other private properties would not be under the purview of the local authorities. Consequently in so far as private properties are concerned; all transactions in terms of the provisions of the Indian Telegraph Act, 1885 would lie directly between the telegraph authority

and the property owner without the intervention or mediation of any local authority. The matter relating to private property will continue to be between telegraph authority and the owner of the property. If the owner of the private property is not satisfied with the intention of the telegraph authority to place telegraph on his/her property or any dispute arises between the owner of the private property and telegraph authority, he/she is required to approach the District Magistrate for settlement of the dispute as provided in Section 16 of the Indian Telegraph Act,1885.

1.33 It has been noticed that in last few years a number of local authorities are levying charges from the service providers/ IP-I for the telecom towers installed even on private properties. The charges levied have no uniformity and these are reported to have increased periodically. As discussed above, the Indian Telegraph Act, 1885 permits the local authorities to levy charges only for permission to place a telegraph line/ post on the properties that are vested in or under the control or management of local authority and not for the private properties.

1.34 **The Authority recommends that DoT should clarify this position – that the local authority's power in terms of exercising the provisions of the Indian Telegraph Act, 1885 is limited only to those properties that are vested in or under the control or management of local authority - to all the State Governments for strict compliance by local authorities.**

1.35 The disputes between the telegraph authority and local authority in consequence of local authority refusing permission or prescribing any condition or in consequence of telegraph authority omitting to comply with requisition made by local authority to remove or alter telegraph

line can be settled through a dispute resolution authority provided under Section 15. The dispute resolution authority for such dispute can be decided by Central Government. Our understanding is that no such authority has been established by Central Government and generally in the absence of such authority cases are landing in the courts. It is necessary that such an authority should have a comprehensive view of the working of the local bodies and should also have sufficient administrative experience and stature for quick resolution of the dispute. Resolution of disputes by different authorities is likely to result in disparate treatment of the subject. A single authority will help in the development of uniform guidelines. The Authority is of the opinion that the Joint Secretary in DoT is best suited to carry out this task.

1.36 **The Authority recommends that Central Government should appoint Joint Secretary in DoT as the Dispute Resolution Authority for dealing with the cases of refusal of permission or imposition of conditions for granting permission by local authority.**

1.37 Local authorities are allowed to impose reasonable conditions regarding the payment of any expenses to which the authority will necessarily be put in consequence of the laying/erection of the telecom infrastructure. Since there are no guidelines available, these charges for restoration as a consequence of infrastructure deployment differ between different authorities and sometimes in two different areas under the same authority. Non uniformity may lead to non agreement and delay in execution of infrastructure work. It is felt that charges for similar type of work may be more or less similar across similar types of cities, towns or villages. Therefore, it will be better if

the restoration charges are prescribed in advance by type of city and made applicable across the country.

1.38 It has been pointed out by the service providers that local authorities often delay according permissions in terms of the power entrusted to them. In the absence of any fixed time limit to grant permission under the Indian Telegraph Act, 1885, the service providers face a considerable delay in getting the RoW permission. A reasonable time limit for according permission by the local authorities can be stipulated through the instrument of the rule making provision under Section 7 of the Indian Telegraph Act, 1885. The issue of 'Right of Way' has also been indicated in TRAI's recommendations of December, 2010 where the Authority had recommended that "the Government may fix and notify the charges for Right of Way in consultation with the State Governments on priority basis and ensure time bound availability of RoW to telecom service providers after due intimation to the agency concerned."

1.39 **The Authority recommends that, subject to para 1.41 below, in case of laying of telecommunication cables, the reinstatement charges per kilometer should be as follows.**

Size	**Reinstatement charges (Per Km in Rs. lakh)**		
Cities with population	Black top/ cement road	Metal road	earthen road
above 1 million	5	3	1
above 1 lakh to 1 million	3	2	0.5
above 10000 to 1 lakh	2	1	0.25
Villages with population			
10000 and below	1	0.75	0.25

For the purpose of population, latest census will be the reference.

1.40 **The Authority recommends that, subject to para 1.41 below a maximum of forty five (45) days should be prescribed for grant of**

permission by the local authority for establishing telegraph line/ post/ laying of cable.

1.41 In this regard, the opinion in respect of the authority of the DoT, to issue a rule under Section 7 of the Indian Telegraph Act, 1885 is divided. The DoT will be well advised to seek the legal opinion in this regard. If it is determined that such rule cannot be made under Section 7 of the Indian Telegraph Act, 1885, the Authority would like the Government to make necessary amendments in the Indian Telegraph Act, 1885.

1.42 In order to streamline the provisions of Right of Way (RoW) for telecom services, a committee of secretaries was set up by Group on Telecom and IT Convergence (GOT-IT) in the year 2000. The committee studied the RoW policies of various State Governments and submitted its report containing model guidelines for streamlining the RoW provisioning. This report was circulated to all State Governments on 24th August, 2000. DoT has again circulated this report vide their letter no. 820-01/2008-DS dated 9th April 2008 to all the states **(Annexure-III)**. However, implementation of these guidelines has met with limited success. Therefore, there is an urgent need to engage with State Governments for resolving the RoW issues or to modify the legal framework such that a uniform policy gets applicable and implemented across the entire country.

2. Standardisation of Tower design

1.43 With the rapid growth in the mobile subscriber base, service providers are required to create adequate tower infrastructure for expanding the network. As there are no mandatory design specifications for towers, every service provider and infrastructure provider has adopted tower designs that suit their requirement. Due

to non availability of any uniform design specifications and lack of a designated approving body, cities and towns are cluttered with towers of various designs which make the skyline aesthetically unattractive. The strength of such towers also becomes important in view of the towers erected in residential and busy commercial hubs. Local authorities share the concerns of the customers about various aspects of the towers in particular about the safety and radiation aspects consequent to deployment of tower. Standardisation and certification will be needed to reassure the local authorities and customers about the safety and other related issues.

1.44 In the consultation paper, stakeholders were asked to provide comments on the following questions:

i. Would you agree that the design of towers can and should be standardised?
ii. If yes, how many different types of towers need to be standardised?
iii. What are the important specifications that need to be included in these standards?
iv. Which is the best Agency to standardise the tower design?

1.45 In response, some of the stakeholders suggested that design of tower should not be standardised as these are already being approved from the authorised agencies. They were of the view that considering the diverse geographies, the existing framework of self regulation is adequate and should be allowed to be continued. One of the stakeholders mentioned that any design that is aesthetically good, improves infrastructure sharing and reduces capital expenditure (CAPEX) for the operators, should be encouraged. Innovation in designs helps in increasing efficiency and enhancing safety, and

should be encouraged. Towers having lesser carbon footprint that are camouflaged and use aesthetic materials should be encouraged by giving subsidies. Some of the stakeholders mentioned that any efforts for standardisation must ensure that the standards only define optimal functional specifications. They suggested that specifications related to safety should only be standardised. One of the stakeholders opposing the standardisation of towers mentioned that no telecom infrastructure is deployed without ensuring the structural safety and it is done only after taking due clearances such as No Objection Certificate (NOC). Some of the stakeholders mentioned that in case standardisation is a must then Bureau of Indian Standards (BIS), Telecom Engineering Centre (TEC), SERC, CPRI and IIT are competent agencies to standardise the tower design. They also mentioned that BIS and TEC also have requisite statutory Authority to specify standards.

1.46 Towers are designed by taking into consideration several factors like size, weight, height & orientation of antenna and wind velocity at the site. Site survey and soil investigation are also carried out while designing and installing a tower. Technological evolution further facilitates better tower design to suit present requirements. The following paragraphs focus on various factors related to tower structure, design, standardisation and other important issues.

(a) Types of Towers

1.47 Several types of towers are used in mobile networks depending on the applicability, antenna load and terrain of the installation site. Some of the popular types of telecom tower structures are given below:

(i) **Steel Lattice structure:** Steel lattice structures are modular in construction and are made up of latticed steel elements. Such structures are usually triangular or square in cross-section. Steel lattice constructions are very widely used since they offer the advantage of minimum wind resistance and easy maintenance. These towers have good strength, low cost and can be erected very quickly. Most of the power transmission, telecommunication and broadcasting towers are of this type.

(ii) **Tubular Steel structure (Monopole):** Tubular steel structures offer high load bearing capacity. These towers are made up of elements with tubular section joined together to get great strength. The sections of tubular towers have their own advantages, but offer low durability especially at places with high corrosive environment, like a coastal area or an industrial zone.

(iii) **Reinforced concrete towers:** These towers are among the most expensive to construct. However, reinforced concrete towers provide maximum rigidity against high wind-loads. These towers can house within it, a control centre to monitor and control operations of the tower and associated equipment.

(iv) **Fibre glass towers:** These towers are used for very niche and limited applications in routine telecommunication.

1.48 Based on the installation type, mobile towers are further classified as Ground Based Towers (GBT) or Roof Top Towers (RTT).

(i) Ground based towers

1.49 These towers are erected on natural ground with suitable foundation. Height of these towers can vary from 30–200 meters; however most of the telecom towers are of 40 meters in height. The approximate cost of setting up a ground based tower is Rs. 25 lakh to Rs. 30 lakh depending upon the height of the tower. These towers

have high load bearing capacity and are suitable for sharing. As per Telecommunication Engineering Centre (TEC) generic requirement GR/TWR-11/01.Dec 2004, a four legged 30/40 meter tower can support upto 12 number of panel antennas and 3 number of 0.6m diameter microwave solid dish antennas.

(ii) Roof Top Towers

1.50 These types of towers are erected on top of the roofs of existing buildings with raised columns and tie beams. Height of these towers can vary from 9-30 meters. The capital expenditure for setting up a roof top tower is Rs. 15 to 20 lakh. Load bearing capacity of the building on which such towers is erected becomes important. Service Providers have to carefully evaluate the strength of roof top before taking a decision to erect roof top towers. As per TEC generic requirement GR/TWR-09/01.feb 2004, a 20/25/30 meter roof top tower with square base can support upto 12 number of panel antennas and 3 number of 0.6m dia microwave solid dish antennas. Whereas a 15/10 meter roof top tower with square base can support upto 6 number of panel antennas and 3 number of 0.6m diameter microwave solid dish antennas.

(b) Factors affecting the Tower Design

1.51 Some of the factors that are taken into consideration for designing towers are:

- Population and geographical conditions within the area served
- Aerial height requirement for each system
- Directions for the directional antennas
- Wind drag on each element of the array
- Size, weight and disposition of all feeders and cables

- Permitted angular rotations in azimuth and elevation of each aerial
- Need for all-weather access
- Possible future extension
- Atmospheric ice formation on the structure and aerials and its likelihood to occur with high wind
- Wind drag with ice
- Degree of security required
- Available ground area and access to the site
- Overall cost of land, foundations and structure
- Cost of future maintenance
- Any special planning considerations imposed by statutory bodies
- Aesthetic appearance of the structure

The above mentioned list is, however, not exhaustive. Any of the factors mentioned can singly but often in combination, influence the choice of the optimum structure.

1.52 A tower is designed and erected after taking into account all the important factors. Broadly, any new tower is expected to accomplish one or more of following three objectives:

(i) Coverage: A new tower provides coverage over areas that do not currently have coverage.

(ii) Capacity: A new tower provides additional capacity for handling more calls in areas where existing towers are overloaded.

(iii) Quality: A new tower can provide better coverage over an area where call drops are high or quality of calls is poor.

1.53 Coverage area (cell) of a tower depends on various factors. The cells are smaller in high-density population areas and larger in case of low density population areas. (Figure 1.1)

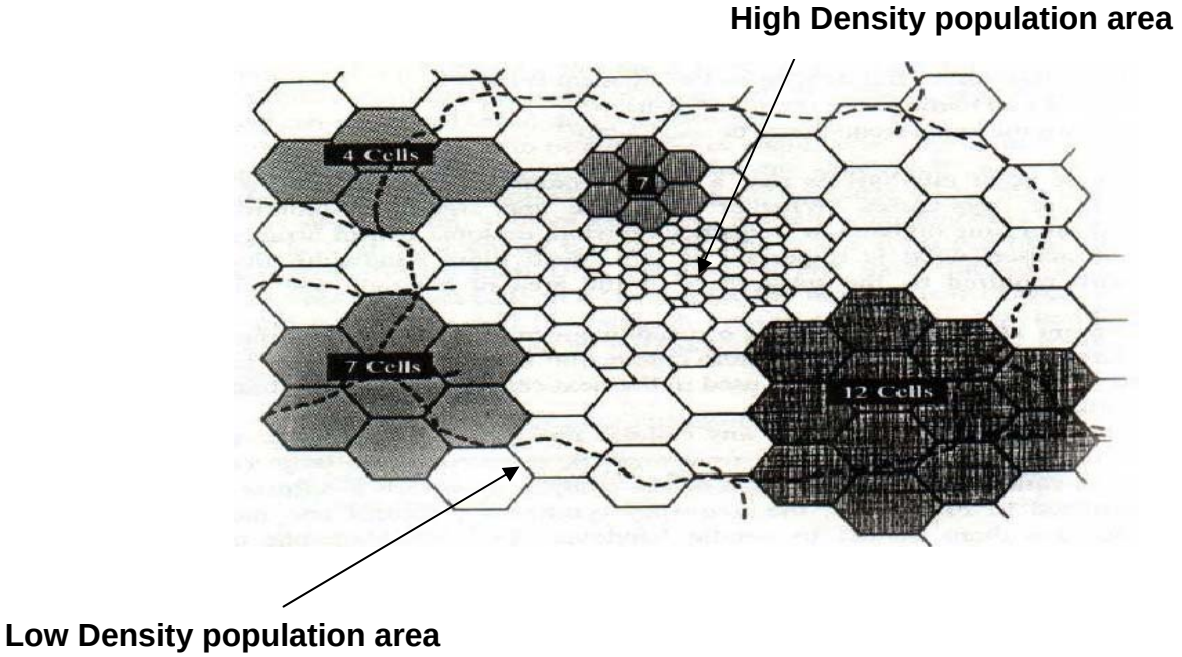


Figure 1.1: Cell Area Vs Population Density

1.54 Location and density of telecom towers in a service area are important factors bearing direct relation to the capacity and quality of service. Service providers split bigger cells into smaller cells by installing more BTSs, and consequently more towers, to increase the capacity for catering to the increased voice traffic.

1.55 The strength and rigidity of a tower is important to ensure safety of people and property near the towers. TEC has issued Generic Requirements (GR) for both ground-based as well as roof-top mobile towers including technical specifications and safety requirements.

However, UAS licence neither provides for any condition related to tower specification or standards, nor it has suggested any single body for tower design certification making adherence to TEC specifications optional for the service providers. Service providers and Infrastructure providers are of the view that TEC's GR are not suitable to meet their requirement particularly in the fast evolving industry. As there are no mandatory design specifications for towers, every service provider and infrastructure provider has adopted tower designs that suit their requirement. Service providers and infrastructure providers have taken approval for design of these towers from organisations such as Structural Engineering Research Centre (SERC), Central Power Research Institute (CPRI), educational institutes like IITs, State Electricity Regulatory Commissions and the like. Due to non availability of any uniform design specifications and lack of a designated approving body, cities and towns are cluttered with towers of various designs which make the skyline aesthetically unattractive. Safety of such towers is also questioned by different agencies including Resident Welfare Associations (RWA) of residential colonies. There appears to be a need to explore uniform designs and specifications for towers and a single approval or certification body. This will be helpful for standardisation of tower design and reducing the cost of manufacturing.

1.56 The current design practices draw reference primarily from Indian code of practice for transmission line towers and from multiple codes of practices for steel structures, wind load, seismic load, snow load, manufacturing codes etc. From the information on their website www.bis.org.in it appears that Bureau of Indian Standards is working on the development of Indian Codes of practice for telecom towers. Telecom Engineering Centre has prescribed certain specifications but they are not being followed in many of the cases. There is a need for a

comprehensive set of standards to be in place early so that the large number of towers that are expected to be built in future adhere to these standards. In the next few paragraphs we shall see what other countries have done in this regard.

1.57 The US and a few European Countries have developed dedicated and comprehensive codes for telecom towers which cover all the essential aspects of telecom towers from planning, design, manufacturing, soil investigation parameters, assembly & construction in field, safety requirements including grounding protection system and aviation obstruction requirements, periodic maintenance, condition assessment and reverse engineering for existing towers to ascertain the load carrying capacity of towers for enhanced antenna loading. The US also mandates all the operators and Infrastructure companies to comply with American Code of Practices for telecom towers as per ANSI - TIA - 222G[2].

1.58 Malaysian Communications and Multimedia Commission (MCMC) has prescribed technical standards[3] giving general requirements for rooftop tower sites, tower sites, mobile/portable BTS sites, operations & maintenance, design requirements for construction, structural, mechanical & electrical (C&S and M&E) of equipment cabins, antenna mounting structures, towers and power supply. Towers having aesthetic look are encouraged. Some of the suggested aesthetic structures are Monopole / Monopole Tree, Multipurpose Structures, Bill board, Minaret and Lamp Poles.

[2] http://www.tiaonline.org/standards/catalog/search.cfm?standards_criteria=TIA-222-G

[3] http://www.mtsfb.org.my/docs/technicalcodes/2009/MTSFB001-2009 TechStandardsInfraReqRadiocommunicationsNetworkInfraExt_(Part%203)_21052010.pdf

1.59 In Canada, design and construction of antenna sites[4] are subject to the National Building Code. To ensure the safety of air navigation, antenna proponents must comply with Transport Canada's antenna structure clearance rules and procedures.

1.60 Telecom Engineering Centre has prescribed certain specifications but these may not be followed as there is no mandate to adhere to these standards. Moreover, present standards cover towers with steel lattice structure only. With the technological evolution and innovation, several tower designs like Tubular Steel structure (Monopole), Reinforced concrete towers, Fibre glass towers, Carbon Fibre towers are coming up as discussed earlier. Ensuring safety of such towers will be of prime importance. There is a need for a comprehensive set of standards for different types of towers in a time bound manner so that deployment of towers with aesthetic designs can get a boost.

1.61 At present, telecom service providers and infrastructure providers take approval for design of these towers from organisations such as Structural Engineering Research Centre (SERC), Central Power Research Institute (CPRI), and educational institutes like IITs. These approvals are based on the Indian code of practice for transmission line towers and multiple codes of practices for steel structures, wind load, seismic load, snow load, manufacturing codes etc. Since these agencies work independent of each other, there could be variations among these agencies related to standards and other parameters required to be met. There is a need to create an institutional arrangement in which these agencies or any other agency prescribed later could work in a uniform manner across the country.

[4] http://www.cwta.ca/CWTASite/english/towers.html#regulations

1.62 **The Authority recommends that TEC in consultation with the standardisation body should develop standards for all types of towers used in telecommunications in a time bound manner. These standards should be made mandatory for all the service providers. Licence conditions should be amended to include that all the towers will conform to the standards developed by TEC.**

3. Reducing Visual impacts

1.63 Concerns have been raised regarding deterioration of skyline in metro and major districts due to erection of large number of telecom towers. Most current towers in India are lattice type and aesthetically unattractive. Alternative tower designs like monopole towers are available which are arguably more attractive. In some countries, innovative methods like camouflaging, landscaping and stealth structures are used to minimise the adverse visual impacts of telecom towers as depicted in figure 1.2 and 1.3. Such techniques are rarely being used in India.




Figure 1.2: Camouflaging of towers with structures

Left: Antenna hidden behind clock face. Centre: Concealed in GRP Chimney pots. Right; Antenna emulating a flagpole.

Figure 1.3: Towers Integrated with surrounding Structure

1.64 In the consultation paper, stakeholders were asked to provide comments on the following questions:

i. What is the likely cost of camouflaging the towers?
ii. Can camouflaging be made mandatory? If so, can this be made part of the design standards of the towers?

1.65 In response, some of the stakeholders were of the view that camouflaging should not be made mandatory as it involves very high cost and adversely affects the ability of the service providers in offering affordable tariff to the consumers. There are significant costs associated with camouflaging of towers, which will have to be passed on to the operators by the telecom infrastructure providers, and it would lead to additional burden on the end-consumer. Some of the stakeholders are of the view that it is difficult to assess the cost of camouflage towers, as it would depend on the camouflaging needs and required designs to enable it. They mentioned that from some similar experiences of camouflaging towers in other countries, the cost of such towers could be as high as two to three times that of a regular telecom towers. Camouflaging may be prescribed only if it is considered necessary for certain aesthetic purposes in areas of heritage, environmental or architectural importance**.** Some of the stakeholders are in favour of making camouflaging mandatory. However, they also mentioned that camouflaging will depend upon each site, hence cannot be made part of tower design. Therefore design of the tower and related issues like camouflaging should be left to the operators.

1.66 Currently service providers erect towers as per their requirement of expanding coverage, capacity or quality. Most of the current towers in India are lattice type and aesthetically unattractive. Use of

Camouflaging and similar techniques involves certain cost, which may be passed to the end consumers if it is mandated. On the other hand it is also important to ensure the aesthetics of certain geographical areas of heritage, environmental or architectural importance. There is a need to encourage the operators to adopt such techniques.

1.67 Every city has its own characteristics and looks; therefore, different cities have different aesthetic requirements depending upon their location, historical values and local sentimental factors. These requirements can suitably be assessed by local bodies. While the Authority would have liked that most of the towers in cities are camouflaged to give the aesthetic look to towers, it is conscious of the cost implications. The National Broadband Plan issued by TRAI in December 2010 envisages establishing of optical fibre network in 63 Jawaharlal Nehru National Urban Renewal Mission (JNNURM) cities by 2012. With the availability of fibre, solutions like active Distributed Antennae System (DAS) can be deployed. Solutions like DAS and emerging "Light Radios" will lead to reduction in number of towers. Therefore, mandatory camouflaging for all towers is not being suggested. Nevertheless, some towers will remain. Therefore cost effective camouflage designs will have to be developed in the meantime. Besides, in certain areas, camouflage of towers will be required despite possible additional costs. TRAI will work on development of cost effective camouflage designs involving institutions having expertise in design.

1.68 **The Authority recommends that camouflaging should be made mandatory in areas of heritage, environmental or architectural importance.**

4. Electricity connection for tower sites

1.69 Availability of electricity is one of the most important requirements to energise the telecom equipments. Lack of timely supply of electricity can affect the roll out of services and sustained functioning of telecom services. It is reported by service providers that it is often difficult to get electric supply from State Electricity Boards especially in rural areas. Unavailability or delay in power supply affects the timely powering up of Base Transceiver Stations (BTS) thereby affecting roll out of services to customers and QoS. Moreover, the electric supply is not regular in rural areas. This results in high dependence on diesel, which increases the cost and leads to pollution. The increased cost can make the services economically unviable and expensive.

1.70 **The Authority recommends that DoT should address all State Governments to direct the Power Distribution companies in the States to provide grid power connectivity on priority for telecom tower sites.**

B In Building solutions

1.71 With the rapid growth in the wireless subscriber base, the wireless platform is being increasingly used to provide a host of new applications like M-banking, data transfer, accessing social networking sites, gaming, mobile TV etc. According to CISCO[5], global mobile data traffic reached 237 petabytes[6] per month in 2010 with 2.6 fold growth over the last year. Overall, mobile data traffic is expected to grow to 6.3 exabytes[7] per month by 2015, a 26-fold increase over 2010. India is also poised to see rapid growth in data services on

[5] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015
[6] Petabyte = 10^{15} bytes
[7] Exabyte = 10^{18} bytes

account of 3G and BWA service launches. This has resulted in, on the one hand, an increased demand on the already scarce spectrum and, on the other hand, an enhanced requirement of provision of seamless services anytime & anywhere, specially inside the buildings. The service providers are required to augment their network coverage inside the buildings to provide low latency, high speed network services.

1.72 Till a few years ago, most of the service providers were providing the mobile services mainly by installing macro cells mounted on mobile towers. However, with the increase in the usage for both voice and data services, the macro cells are not adequate to provide seamless and good quality of service inside the building. Additionally, because of signal loss inside the buildings, these macro cells need to radiate at higher power from outside the building, which results in smaller cell size and inter cell interference. In building solutions like IBS and DAS are the solutions to overcome the problem and also to ensure that the spectrum is utilised efficiently.

1.73 In the consultation paper, stakeholders were asked to provide comments on the following questions:

i. What methods would you propose for reduction of the number of towers?

ii. In what ways do you think that IBS can be encouraged for better in-building coverage, better QoS and reduction in level of radiated power from Macro cell sites?

iii. How can sharing of IBS among service providers be encouraged? Does TRAI need to issue any guidelines in this regard?

1.74 In response, most of the stakeholders suggested that the local administration should make it mandatory while approving/clearing the construction of new facilities, such as multiplexes, malls, hotels, and recreational facilities etc. to facilitate IBS inside the buildings and take an undertaking from identified service provider to ensure execution of IBS in such facilities. In order to maximise bandwidths without increasing dependence on spectrum, it is important to encourage the use of IBS in all large structures with high usage of communications. Some of the stakeholders suggested that there should be neutral host provider and IP-I should be allowed to import, setup and operate specialised active IBS such as Fibre Optic based Active DAS and Grid Femtocells independent of the operators. Some of the stakeholder stated that it should be mandatory for Service Providers to use indigenously developed Indian products in their IBS infrastructure. In contrast, the views of some other stakeholders were that service providers should be free to choose the best system available based on specifications, real world performance and purchasing an indigenous product should not be made mandatory. Some of the stakeholder suggested that Government should consider incentives (e.g. reduction in licence fees) linked with number of operators sharing the IBS in a particular facility. Some of the stakeholders were of the view that in order to ensure high quality of service inside the building, to deliver better performance in terms of capacity and consistency and not just the availability of service, IBS is the best option for commercial complexes, high rise building, in metro and big cities.

1.75 It is important for all the service providers to provide coverage inside big buildings and complexes as their subscribers may be present at these places. However it will not be possible to install individual in-building infrastructure as this will result in not only duplication of

network but will also entail huge avoidable cost. It will be beneficial if one service provider or infrastructure provider installs the IBS and others share this infrastructure.

1.76 Although there are technical challenges and impediments in rolling out of IBS, the IBS system is widely deployed in some of the countries. There are various mode of deployment of In Building solutions such as built and managed by building owners(in such cases the building owner managing other services through same network), deployment by a neutral host infrastructure provider and built and managed by mobile operator and sharing as tenant with other service providers etc. Examples of some of the deployment of IBS[8] are given in table 1.1.

Case	Description	Remarks
Suvarnabhu Airport (Bangkok Thailand)	The country's top five mobile operators have gained the right to roll out an IBS inside the airport. The five operators have achieved an agreement to roll out a shared Distributed Antenna System that let them to provide mobile services based on second and third generation technologies (Ericsson, 2006).	Operational (Example of Built & Share DAS by multi-operators)
Hartsfield-Jackson Atlanta international Airport (HJAIA)	The airport's operator (The City of Atlanta's Department of Aviation) has built, owns and manages its own IBwS designed to accommodate all major wireless standards and protocols (both mobile services and Wi-Fi access to the Internet) in the Atlanta International Airport. The system has also enhance airport operations with a completely separate layer to support Public Safety and other operations groups that rely on dependable wireless coverage and service to communicate under regular and emergency circumstances. The main objectives pursued by Department of Aviation with this neutral host system are the following: improve wireless radio coverage for mobile and Wi-Fi throughout the airport, ensure equal opportunities among all the operators, encourage the roll-out of new services and applications in the airport	Operational (Built & Managed by Airport Authority for multiple services like Mobile service,Wi-Fi & public Safety)

[8] Report on Next generation mobile networks development: technical, regulatory and strategic issues of the roll-out of in-building solutions in high traffic places: Universidad Politecnica de Madrid, May 20th, 2008 & inputs from Delhi Metro Rail Corporation.

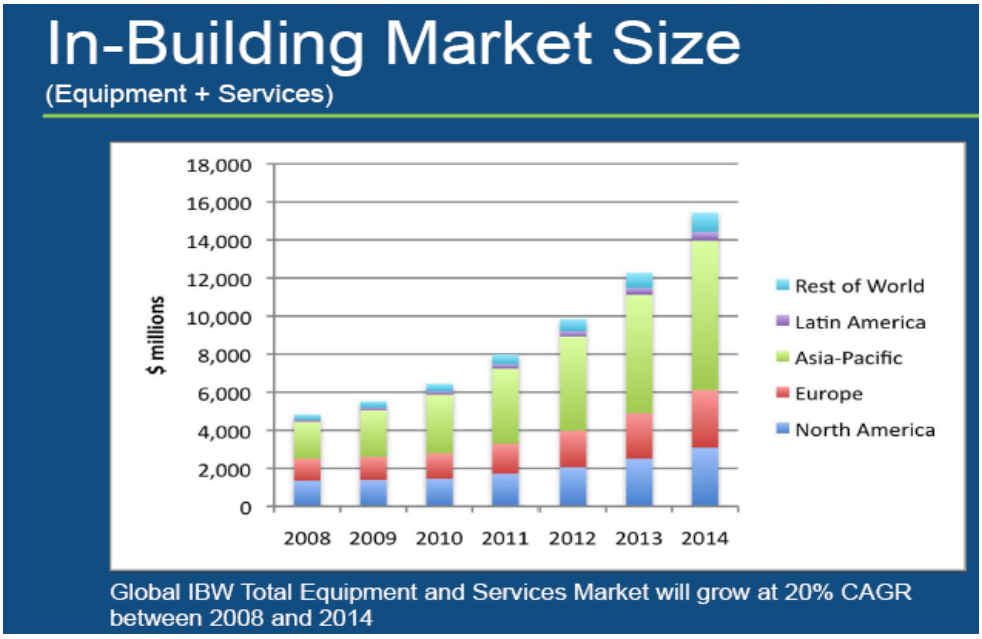
	and have an integrated infrastructure that can support all new cellular devices and handheld technology that will be introduced in the market place during the next 10-15 years (HJAIA, 2006; HJAIA, 2008).	
Madrid Subway System	The project to provide mobile services in the Madrid's subway system was launched in the year 2000 with the set up of Metrocall, a neutral host provider partly participated by the subway's owner Comunidad de Madrid. The plan of Comunidad de Madrid was that Metrocall was responsible of the infrastructure roll-out inside the subway. However, the different proposals of Comunidad de Madrid (first trying to get a spectrum licence for the use of GSM inside the subway system and then making an exclusive agreement with one mobile operator that would provide roaming services to the rest of operators) was rejected by mobile operators and some of them by the Spanish National Regulatory Authority. Finally, the agreement was achieved in 2005. Mobile operators accepted that Metrocall was responsible of the DAS inside the subway in exchange for an annual fee that let Metrocall to finance the infrastructure in addition to the operation and maintenance costs (CincoDías, 2006). Despite the agreement, mobile services are only available in a few lines nowadays what shows that mobile operators do not completely agree with the actual exploitation model.	Operational/ Roll-out (A case of Neutral Host Model)
New York Subway System	Metropolitan Transportation Authority invited tenders to send proposals for wiring the 277 underground stations in the New York subway system to provide cellular and Wi-Fi services. The company that finally have won the right to wire the stations is Transit Wireless, a joint venture involving Nab Construction, Q-Wireless, Dianet Communications and Transit Technologies, will pay New York City Transit a minimum of $46.8 million over 10 years. The company will also pay the full cost of building the wireless network in the underground stations, estimated at $150 million to $200 million. Under the agreement, mobile operators would pay the company a fee to carry their signals on the network (New York Times, 2007).	Roll-out (Example of deployment of IBS by neutral host)
Paris Airport	Airports de Paris has taken advantage of its experience in the airport sector and in the telecommunication services provision to its own employees to set up Hub Telecom . Hub Telecom is a new telecommunications operator that provide services as a specialized operator in certain sites characterized by a high concentration of business traffic, a need for (and a habit of) mobility, which is a real added value especially for large sites and a community dimension, providing the possibility to share resources in the general interest of all concerned. Hub Telecom is expanding its business providing services to tenants of Airports de Paris' airports first and then moving to other places such as business centre, convention and exhibition centre, business hotels, etc	Operational (Example of IBS deployment by a specialised operator and shared resource with tenants)

	(Hubmag, 2005a, 2005b). Moreover, a consortium that include this company has been awarded with 12 regional WiMAX licenses including the region of Paris (Hub Telecom , 2007) and Hub Telecom has reached an agreement with Orange to provide a mobile voice service together for Hub Telecom 's customers (Hub Telecom , 2006).	
Delhi Metro	In India Delhi Metro Rail Corporation has registered itself as Infrastructure provider and created infrastructure in underground tunnels. Telecom operators share this infrastructure to provide services to commuters.	Operational (Example of IBS deployment by a an independent operator and shared resource)

Table 1.1: Example of different model of IBS rollout

1.77 As can be seen from above table, IBS solutions are provided by telecom operators, neutral service providers, building owners and specialised operators. In all cases sharing has been ensured. Further, deployment of In Building wireless system is increasing globally. Global IBS equipment and services market growth trend[9] are depicted in Figure 1.4. Therefore, IBS is the required solution and sharing is definitely required to avoid duplicate infrastructure and reduce cost.

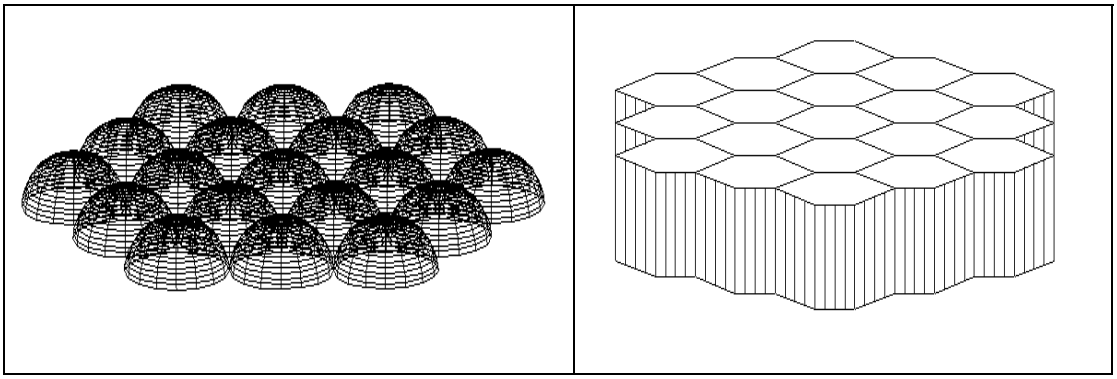
[9] Challenges of Designing & Implementing Distributed Antenna Systems: Bob Butchko



(Source: ABI Research)

Figure1.4: Global IBS total Equipment and Services Market trends

1.78 There is another technology used for cellular coverage inside the high rise building called 3D cellular network[10]. It converts existing macro cells into 3D cells. The 3D cells have three dimensional space coverage; covering ground, lower and upper space above ground in its cells. Its coverage has columnar shape and is much higher in elevation than conventional macro cell's coverage. Similarly, multiple technologies are evolving which can be deployed in the network and shared for efficient resource utilisation.



[10]http://www.3dcell.net/introduce.htm

3D view of coverage of incumbent cellular network	3D view of coverage of 3D cellular network

Figure 1.5: 3D Cellular network

1.79 It is clear from the preceding analysis that there is a need to install IBS or any other indoor infrastructure for providing ubiquitous coverage, improve spectrum utilisation, provide quality of service and achieve cost efficiency. Accordingly, the Authority is of the view that proliferation of IBS and other low power devices for indoor coverage needs to be mandated for the future.

1.80 There are various technologies for providing in building solutions. One of the technologies is DAS which can also be used for services in indoor as well as outdoor locations and is discussed in section C below. Accordingly, recommendations related to in building solutions have been clubbed with the recommendations on DAS.

1.81 Most of the infrastructure, especially installation of towers is being done by IP-I. The In building solutions or DAS can also be deployed by IP-I and shared with telecom service providers. For deploying indoor solutions these companies will be requiring permissions from the building owners. Moreover, these IP-I companies will also have to install active infrastructure like optical fibre for connecting IBS/DAS nodes for which again RoW permissions will be required. Government vide its notification issued on 24th May 1999 (**Annexure-I**), has in exercise of provision under Section 19B of the Indian Telegraph Act, 1885 has permitted the private licencees who are issued licence under Section 4 of the Act to seek RoW from any person including local authorities. Since IP-Is have not been issued licence under Section 4, these companies cannot seek RoW as provided in the Indian Telegraph Act, 1885. Therefore, these IP-Is are required to be brought

under licencing regime so that these companies could also be able to seek RoW for deployment of infrastructure. TRAI in its recommendations of May 2010 has already recommended that the IP-Is should be brought under the Unified Licence regime.

1.82 Regarding the issue of sharing of IBS and allowing the IP-I operators to install both passive and active infrastructure, the same has been discussed in Paras 3.1 to 3.22 of Chapter III of these recommendations.

C Distributed Antenna Systems:

1.83 In most of the developed countries, cellular telecom service providers are deploying Distributed Antenna System to overcome the coverage and capacity problems. Macro antenna systems tend to be bigger and higher, while the DAS systems have many smaller antennas located very close to the mobile users. Since DAS is a low power application, it also reduces the impact of the radiation.

1.84 DAS systems can be broken down into two main categories; Active or Passive. Active systems use power to transport RF between the service provider's equipment and all parts of the DAS. These systems are generally used within large enclosures having complex wall systems. Passive systems do not use power to amplify or convert the RF signal and require only cabling, connectors and antennas to operate. Many of the smaller less complex locations can be served with passive systems. The size of the venue, complexity, and other factors will determine the type of system required during the design phase of the process.

1.85 The cellular network with DAS enhanced in-building coverage may provide effective coverage, but may be challenged to provide adequate bandwidth for emerging mobile multimedia services. A private wireless LAN can also be installed to support the premises network mobile multimedia applications. A typical deployment of DAS providing both cellular and Internet service using common infrastructure is shown in figure 1.6.

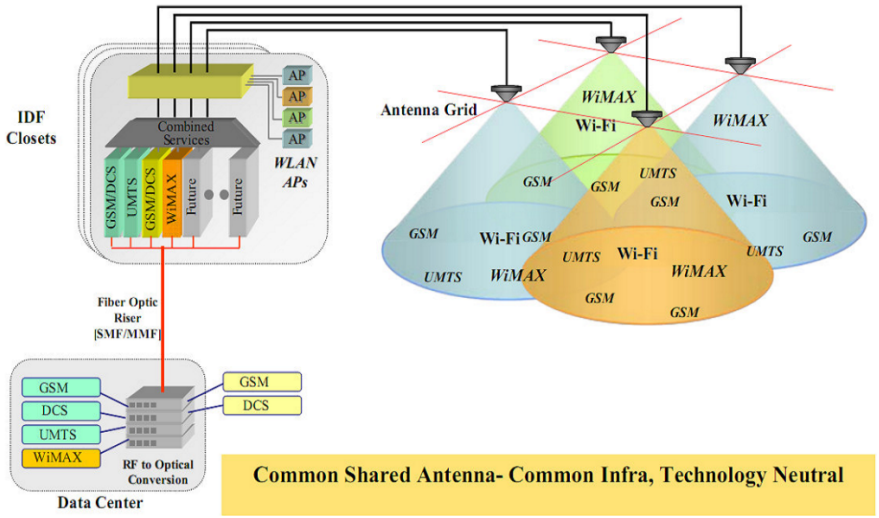


Figure 1.6: A Typical deployment of DAS providing both cellular and Internet service[11]

1.86 Both the cellular network and the wireless LAN may need to coexist and to provide complete building-wide coverage. The two networks may provide complementary services, and both can be designed to provide multimedia capabilities. Both the DAS for cellular coverage and the wireless LAN for multimedia applications can be deployed using common infrastructure. Coordination in design, installation and deployment can result in a cellular DAS overlay on wireless LAN with consequential reduction in deployment cost.

[11] http://www.canavents.com/its2008/abstracts/258.pdf

1.87 In the consultation paper, stakeholders were asked to provide comments on the following questions:

i. Do you agree that innovative technologies such as 'Distributed Antenna System' (DAS) can be effectively utilised to reduce number of towers and migrate towards tower-less cities?

ii. What are the impediments in adoption of new technologies such as DAS and how can these be removed?

1.88 In response, some of the stakeholders stated that 'Distributed Antenna system' is at the nascent stage and may be encouraged to reduce the number of towers. However, there are constraints/impediments in terms of dedicated power supply, slow RoW clearance and back haul connectivity to adopt these new technologies. It is also stated that licence does not stipulate use of any specific network and is technology neutral. Hence, the operator should not be mandated to deploy these technologies and the same should be left to the operator choice. Most of the stakeholders stated that DAS or use of street furniture for providing cellular services can be effective way for reducing number of towers, but may not eliminate the use of towers. DAS design with Multi Operator and Multi Technology support for both indoor and outdoor site will lead to a better utilisation of the overall infrastructure as well as from the point of aesthetics. They suggested that Incentives should be provided by way of reduction / removal of custom duties, exercise duties, tax benefits etc. Government may subsidise taxes, duties, levies etc for sharing the infrastructure for IBS and DAS. Increasing the use of DAS solutions requires incentives to deploy new fibre and to access fibre that is already deployed. Some of the stakeholders suggested that DAS should be used in scenarios where alternate technologies are infeasible due to terrain, zoning challenges for cell towers, infeasible

cell tower placements, etc. Some of the stakeholders suggested that a provision in the JNNURM must be made for including data connectivity i.e. OFC and suitable ducting in the construction of all new infrastructure viz roads, ports, airports and residential constructions.

1.89 The deployment of DAS will necessitate laying of optical fibre for connecting the DAS nodes. Local civic authority should encourage the deployment of fibre connectivity to every nook & corner in cities/urban areas for back-haul. This requires a disciplined coordination among different public departments while digging, repairing, laying pipes, cables and widening roads for laying of FTTB (Fibre-to-the-building) for backhaul.

1.90 In Europe, the Framework Directive 2009/140/ec[12] of the European Parliament and of the council of 25 November 2009 addresses the topic of rights of way. The Directive states that Member States shall ensure that procedures exist for the granting of rights to install facilities on, over or under public or private property that are timely, non-discriminatory and transparent, in order to guarantee the conditions for fair and effective competition. The Directive also sets that these provisions are without prejudice to national provisions governing the expropriation or use of property, the normal exercise of property rights or the normal use of the public domain.

1.91 There are several licenced service providers and if each lay a separate cable and install separate active & passive DAS infrastructure on the street furniture, it will result in duplication of network and may create a condition much worse than the towers.

[12] http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF

This situation can be handled by mandating sharing of such infrastructure. DAS implementation can also provide aesthetic look and reduction in radiation in addition to reduction of towers. A typical outdoor implementation[13] is shown in figure 1.7.

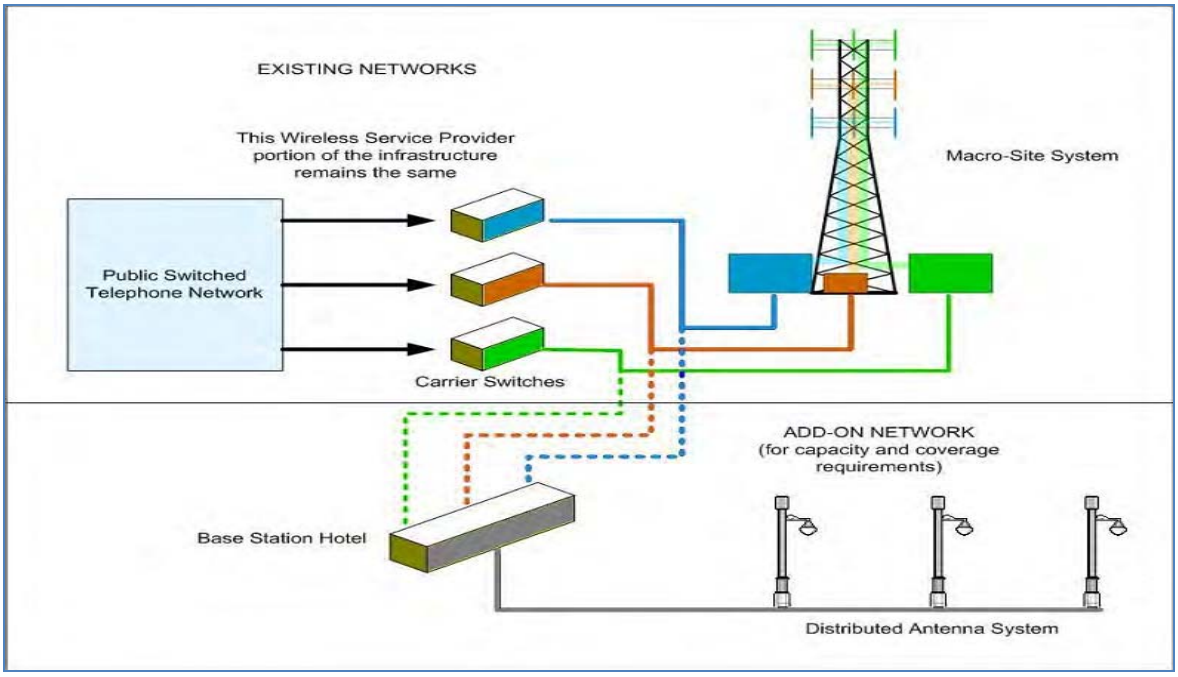


Figure 1.7: Typical outdoor DAS implementation

1.92 It is clear that DAS solutions can provide a cost effective, time efficient, environment sensitive solution which can be shared by multiple operators. The same infrastructure can be used for wireless broadband services. There is a need for a framework such that multiple service providers share such cost effective, time efficient and environment friendly solutions in indiscriminate manner.

1.93 There are two important reasons for ensuring robust indoor coverage. Firstly, around 70% of traffic on mobile networks is generated indoor and hence calls for efficient coverage with better

[13] http://www.thedasforum.org : Distributed Antenna System (Das) 101

spectrum utilisation. Secondly, at present indoor coverage is generally quite limited and mostly consists of voice services under 2G technologies. There is a trend worldwide towards increase in use of data services. With 3G and BWA getting launched, which are capable of providing high data rate services, there will be an increase in data traffic. The impact of indoor traffic on the capacity of UMTS networks has been analyzed in many papers (for example Perez-Romero et al. 2004)[14] and it is a consequence of the intrinsic characteristic of the W-CDMA system where multiple users share the same base station transmitter and thus the same power source in the downlink. Moreover, users inside building have greater path loss due to building penetration loss that is estimated as 20 dB on average (Chevalier et al. 2006)[15]. Therefore indoor users consume a proportionately larger share of the downlink resource of the base station. Moreover, for high bit rate services the capacity degradation will be even greater. The effect of indoor traffic can be eliminated by the roll out of a dedicated in building solution (Anderson et al. 2002)[16] . Roll out of distributed antenna system also provides better HSDPA quality of service and capacity (Hiltunen et al. 2005)[17]. Therefore, DAS solutions can increase the capacity of 3G and BWA networks and also offload macro cells releasing additional system capacity. In addition, DAS solutions can be used to provide other services like wireless LAN and BWA

[14] J. Pérez-Romero, O. Sallent, R. Agustí (2004). On the Capacity Degradation in W-CDMA Uplink-Downlink Due to Indoor Traffic

[15] WCDMA (UMTS) deployment handbook- Planning and Optimization Aspects: Christophe Chevallier et al (John Wiley & Sons, Ltd)

[16] H. Andersson, R.S.Karlsson, P. Larsson, P. Wikström (2002). Improving System: Performance in a WCDMA FDD Network Using Indoor Pico Base Stations.

[17] K. Hiltunen, B. Olin, M. Lundevall (2005). Using dedicated in-building systems to improve HSDPA indoor coverage and capacity

services using same infrastructure thereby reducing CAPEX and OPEX costs drastically.

1.94 **The Authority recommends that IP-I and telecom service providers should be mandated to share IBS/DAS system deployed in the buildings, complexes or streets.**

1.95 **DoT should advise all ministries to provide, within next one year IBS/DAS solutions in all Central Government buildings including central PSU buildings, Airports and buildings falling under their jurisdiction & control.**

1.96 **All State Governments should be similarly advised to provide/ mandate, within next one year, IBS/DAS solutions in all buildings including hospitals having more than 100 beds and shopping malls of more than 25000 square feet super built area.**

1.97 For provisioning of DAS in outdoor scenario, availability of optical fibre network is must for connecting the DAS nodes. Sixty three cities under JNNURM are planned to be brought under optical fibre network by the year 2012 as per the National Broadband Plan recommended by the Authority in December 2010. The Authority noted that Government is likely to undertake the National Broadband Plan shortly. Therefore, leveraging from the optical fibre network, deployment of DAS can be planned in these cities. In view of the planned optical fibre network in JNNURM and other cities, it is necessary to have a time bound program for deployment of DAS or similar other technologies. These solutions will not only reduce towers but also lead to better spectrum efficiency and reduced radiation. The Authority is of the opinion that DAS must be mandated to be

implemented within 18 months of the laying of optical fibre network in a city, at least to the extent of 63 cities covered under JNNURM.

1.98 **As far as outdoor coverage is concerned, DAS should be mandated for deployment in 63 JNNURM cities within 18 months after completion of optical fibre network in these cities under the National Broadband Plan.**

D Cable Landing Station

1.99 International bandwidth is lifeline of country's economy. Availability of timely and cheaper bandwidth is important for growth of many sectors in general and particularly important for the growth of IT and ITES sectors. Moreover international traffic is also increasing on account of rapidly increasing subscriber base in telecom sector. These sectors in turn have multiplier effect on overall growth of the economy. Launch of 3G and BWA services will increase broadband penetration at much faster rate, requiring more international bandwidth. Therefore, international capacity needs to grow in tune with the growing demand for international bandwidth from various sectors of the economy.

1.100 In the consultation paper, stakeholders were asked to provide comments on the following question:

i. What measures can be taken to encourage more ILDOs and ISPs to set up cable landing stations?

1.101 In response, some of the stakeholders have indicated that at present multi department regulatory clearances, from Ministry of Home Affairs (MHA), Defence, Environment etc., are needed which takes upto two years' time. They have suggested simplification of the procedure for

setting up of cable landing stations through a single window clearance instead of highly complex clearance procedure at present. Some stakeholders have commented that the initial cost in setting up of a landing station is high and gestation periods are longer. It is also mentioned that setting up of cable landing station involves considerable risk in making a large investment as the recovery of the cost is very slow and there is no certainty of the business. They have argued for cheaper electricity & land, lower licence fee, reduction in duties, subsidy/soft loans and other tax benefits for cable landing stations. One of the stakeholders suggested the need for Neutral Cable Landing Stations on consortium based International Cable Systems, which can be operated by an independent licenced entity that can be provided cost plus based compensation to operate the Landing Station. All the International Cable Landing Systems in India should mandatorily terminate into this Carrier Neutral Landing Station. Another stakeholder suggested that ILDO/ISP themselves should participate in cable projects and invest to generate competition in this market. It also suggested for making it mandatory for ILDO/ISP operators to significantly invest and participate in at least two cable systems in a period of seven years. One of the stakeholders has asked for review of custom rules for submarine cables. He also informed that cable spares are currently kept at Singapore due to levy of custom duty on storage of cable spares in India which is not the case in countries like Singapore, Philippines etc. Some stakeholders have suggested that in view of the constantly changing International Bandwidth prices, there is a need for regularising the practice of periodic review of RIO pricing by TRAI on Quarterly or Half-yearly basis. It is also mentioned that internationally, access charges are within the range of 5% of international bandwidth cost but in India it is more than 50%. Hence the same may be revised and reviewed by TRAI every year.

1.102 Infrastructure for providing international bandwidth consists of three parts. Submarine optical fibre cable network which reaches through sea in the country, cable landing station where these optical fibre cables lands and back haul long distance network which distributes the landed bandwidth across the country and finally access network which transports the bandwidth to end customers. Typical diagram of submarine cable system is given in figure 1.8.

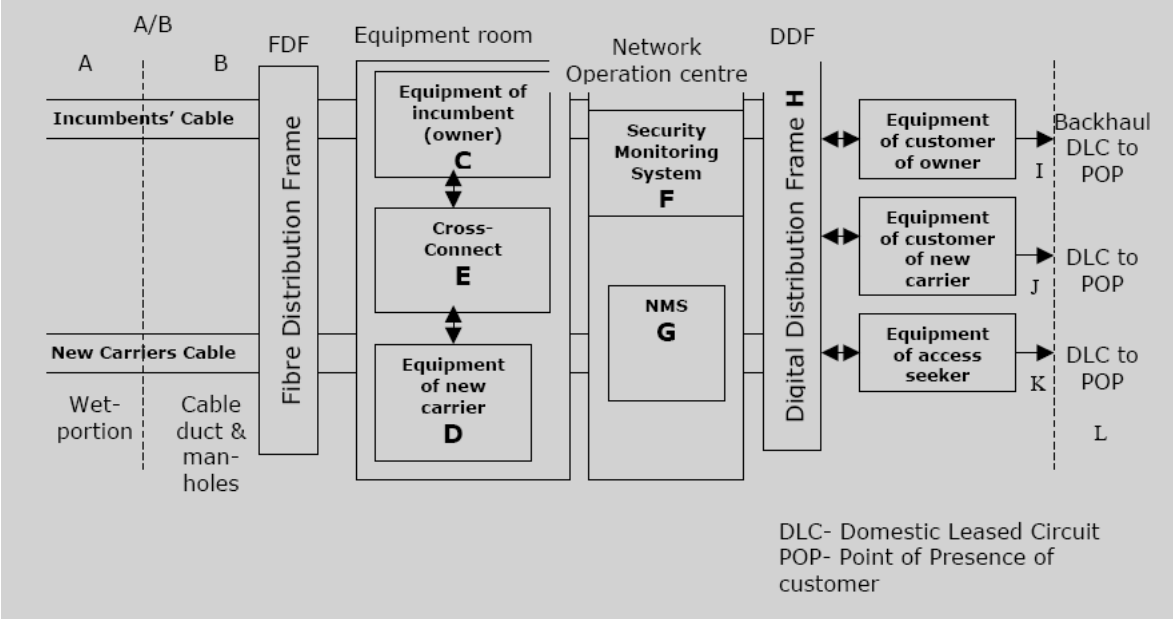


Figure 1.8: Submarine Cable System

1.103 The first two parts, the Optical fibre cable network and cable landing station, fall under ILDO licence and ISP licencees having permission to establish submarine cable landing stations for International Gateway for Internet. Developing the optical fibre network through sea is the most capital intensive component. In comparison, cable landing stations where multiple submarine cables are terminated is far less capital intensive. An ILDO can develop its own optical cable network, become one of the members of consortium developing the optical fibre cable network or can buy bulk bandwidth on this cable network.

Similarly ILDOs can have their own cable landing station or access other's cable landing station by paying access facilitation charges as per the RIO approved by TRAI.

1.104 Submarine cables are getting added according to country's bandwidth requirement at regular interval. Three to four new cables like GBI and WACS are also planned for landing in India. Moreover advancements in technology like DWDM have enabled multifold bandwidth to be derived from the same fibre. A single fibre itself can provide a capacity of 1 Terabit. Therefore, there is no constraint on cable side. The new cables are either landed on existing cable landing station or on a new landing station depending upon the space available in the CLS and requirement of diversity for routing of traffic. Currently there are 24 ILDOs providing ILD services in the country. However, Cable landing stations are owned and managed by only four major ILDOs. Other ILDOs use the CLS facilities of these major ILDOs and pay according to RIO approved by TRAI on 26.10.2007 and on 25.05.2009.

1.105 New landing stations will come up based on new cables planned for landing. The decision of setting up of the cable landing station gets taken at the investment stage. In case of ILD operator owning the cable, the cable landing decision is taken by itself. For consortium cable, number of cable landing stations in a country are generally get decided at the investment planning stage and finalisation of construction and maintenance agreement. In both the cases once decision of setting up of CLS and its location is finalised, the uncertainty in terms of various approvals will have to be removed at the earliest in view of huge investments on submarine cable system and early decision on approval or otherwise is required.

1.106 **The Authority recommends that a single window system for providing clearance to the operators intending to establish cable landing station should be established at DoT. The operator desiring to establish cable landing station should submit all the forms required by all concerned ministries to this single window agency and final approval of clearance should be intimated by the single window agency within six months.**

1.107 One of the stakeholders suggested setting up of neutral cable landing station. As per the current licensing regime this function falls under ILD licence & ISP licence with permission to establish submarine cable landing stations for International Gateway for Internet and there are enough ILDOs/ISPs who could potentially invest in CLS facility, if required, based on their business case. Another stakeholder suggested that ILDO/ISP themselves should participate in cable projects and invest to generate competition in this market. It was also suggested for making it mandatory for ILDOs/ISPs to significantly invest and participate in at least two cable systems in a period of seven years. Since cable landing stations are treated as essential facilities, TRAI had issued "International telecommunication access to essential facilities at cable landing stations" regulations on 7th June 2007. As per these regulations owners of the cable landing station are required to provide access to cable landing station and submarine cable system on fair and discriminatory terms to all ILDOs and ISPs. Therefore non discriminatory access is ensured.

1.108 Some of the stakeholders have suggested that in view of the constantly changing International bandwidth prices there is a need for review of RIO pricing by TRAI. It is also mentioned that internationally, access charges are within the range of 5% of

international bandwidth cost but in India it is more than 50%. Hence the same be revised and reviewed by TRAI every year.

1.109 TRAI had issued regulations on "Access to essential facilities at cable landing station" and based on the regulations CLS-RIO including co-location charges were also approved by the Authority on 26th October 2007 and 25th May 2009. As per the regulations, the owner of the cable landing station is also required to publish the RIO rates on its website. While the TRAI mandated RIO publication has ensured fair practices, the Authority understands the need for a periodic review of RIO pricing especially in view of the constantly changing International bandwidth prices.

CHAPTER II: IP INFRASTRUCTURE

A- Broadband

2.1 The power of Internet has brought greater awareness, skills and resources, helping markets to reach to a diverse global audience. Broadband provides the opportunity to do things differently, to achieve better outcome for people, countries and to ensure continuous growth of economy and social development. The proliferation of the broadband enables growth of Information and Communication Technologies (ICT), content, applications and services which may help India to become a truly competitive knowledge based economy and leverage citizens to become healthier, better educated and more engaged in their community & society.

2.2 Internet and Broadband access are widely recognised as catalysts for economic and social development of a country. Availability of broadband services at affordable price can contribute to higher GDP for growth rates, provide for a larger & more qualified labour force and increased working efficiency. As per the report of World Bank[18], a 10 percentage increase in broadband penetration accounted for 1.38 percentage increase in per capita GDP growth in developing economies. It is of great concern that the broadband penetration per 100 inhabitants in country is lagging behind compared to other countries. The net broadband addition per month is just 0.1 to 0.2 million in contrast to 18 million mobile connections per month. The broadband penetration is just 0.94% when compared with teledensity of 67.67%.

2.3 The primary reason for low broadband penetration in villages is lack of support infrastructure, backhaul capable of providing high

[18]Christine Zhen-Wei Qiang (2010) - Broadband infrastructure investment in stimulus packages: relevance for developing countries

bandwidth, low penetration of fixed line services, high cost of service roll out and unviable business model. In addition to key infrastructural issues availability of relevant content and high cost of CPE will also be crucial for broadband growth.

2.4 Presently, Optical fibre connectivity is largely available upto the district headquarters. In the rural areas, OFC is available upto block headquarters. In India, about 750,000 route kilometer optical fibre is available which includes 500,000 Km optical fibre network of state owned operator BSNL. In rural domain optical fibre is primarily provided by BSNL. There is hardly any coverage at the level of Panchayat and other villages. If broadband is to be extended to the villages then arrangements need to be made to aggregate village traffic and backhaul it to the backbone.

2.5 The problem of availability of high bandwidth fibre optic network is not limited to rural areas. Growth of broadband in urban areas too is limited by non-availability of fibre in the aggregation and the access networks. In the urban areas, there is a need to deploy various configurations of FTTX taking the fibre into households where bandwidth requirement is high or upto the building for serving multi-dwelling units or to the kerb where a number of discreet houses are to be served.

2.6 Considering the importance of creating a nationwide robust infrastructure to support broadband growth, the Authority made its recommendations on "National Broadband Plan" to DoT on 8th December 2010. A summary of main recommendations is given below:

(i) The National Broadband Plan envisages establishment of a National Broadband Network, which will be an open access optical fibre network connecting all habitation with population of 500 and above. This Network will be established in two phases. The first phase covering all cities, urban areas and Gram Panchayats will be completed by the year 2012. Phase II will see the extension of the network to all the habitations having a population more than 500, to be completed by the year 2013.

(ii) The optical fibre network would support backhaul bandwidth requirement for provision of broadband and facilitate broadband growth.

(iii) To establish this broadband network National Optical Fibre Agency (NOFA) and State Optical Fibre Agency (SOFA) will be set up. This network will be established at a cost of about Rs. 60000 crore. It will be financed by USO fund and the loan given/ guaranteed by Central Government.

(iv) The National Broadband Plan envisages provision of 75 million broadband connections (17 million DSL, 30 Million cable and 28 million wireless broadband) by the year 2012 and 160 million broadband connections (22 million DSL, 78 million cable and 60 million wireless broadband) by the year 2014.

(v) The objective of national broadband Network is to provide fibre to home in 63 cities covered under JNNURM, and Fibre to kerb in all other cities (0.5 Km from any residence) by 2012.

(vi) The program is expected to bring immense benefit when fully operational. The Network will provide easy access to high speed data and information to citizens, promoting thereby the efforts in the field of education, health etc.

2.7 Thus, recommendations on "National Broadband Plan" covers all major issues for creating a nationwide optical fibre network which will facilitate the provision of broadband up to villages. This network will not only provide the broadband connectivity but will also be capable to cater the high bandwidth demand for various services of that area. However, there is an urgent need to create the required infrastructure in a time bound manner. It is noted that Government is taking necessary steps to implement these recommendations on priority basis.

B- Internet Exchange Points (IXP)

2.8 An Internet Exchange Point (IXP) is a framework for Internet Service Providers (ISPs) to peer and exchange IP traffic with each other. The main purpose of IXP is to facilitate exchange of Internet traffic originated and destined within the country among Internet Service Provider (ISP) without using International bandwidth. The key objectives of an IXP are:

i) Enable domestic bandwidth utilisation for routing of the domestic traffic resulting in reduction in cost for bandwidth utilisation.

ii) Improvement in Quality of Services in terms of lower latency and number of hops. This will also help to effectively utilise International Internet bandwidth for routing International Internet traffic only.

2.9 At present, National Internet Exchange of India (NIXI) is working as IXP through its various nodes. In addition to NIXI, various Internet service providers and International Internet bandwidth providers are also facilitating exchange of Internet traffic within country. In the absence of well defined IXP hierarchy and lack of proper peering

arrangements among ISPs, routing of the domestic traffic at domestic bandwidth cost is a challenge.

2.10 NIXI was established by Department of Information Technology (DIT) in 2003 with 4 nodes at Delhi, Mumbai, Chennai and Kolkata on the basis of TRAI recommendations. It was observed that till October 2006, only 27 ISPs out of 135 operational ISPs had joined NIXI nodes at four locations indicating suboptimal utilisation of NIXI. In order to enhance the utilisation of NIXI, TRAI made its recommendations on "Improvement in the Effectiveness of National Internet Exchange of India (NIXI)" to DIT and DoT, *suo-motu*, in April 2007. Major recommendations were as follows:

- All the ISPs or their upstream providers (ISP who is carrying the traffic to International Internet Bandwidth providers or NIXI) either connect to NIXI or with International Internet bandwidth providers through direct peering link.
- Compulsory announcement and acceptance of all the routes at NIXI nodes to facilitate effective exchange of domestic Internet traffic at NIXI without requiring direct connectivity of ISPs.
- Quality of Service parameters of NIXI nodes were prescribed to ensure effective functioning of the NIXI.

2.11 These recommendations were accepted by DoT in June 2009. Some of the recommendations regarding announcement of routes by ISPs, connection by regional ISPs to NIXI through upstream ISP over a single link and up-gradation of ISP link to NIXI were also implemented by NIXI.

2.12 Presently, NIXI has 7 nodes[19] operating at Mumbai, Delhi, Chennai, Kolkata, Bengaluru, Hyderabad and Ahmedabad. According to

[19] http://nixi.in/index.php?option=com_noclocation&Itemid=28

information available at NIXI website, equipments have also been deployed at two more nodes at Lucknow & Mohali (Chandigarh) but ISPs are yet to start peering at these nodes.

2.13 At the end of December 2010, there were 164 operational ISPs, out of which 59 were category 'A', 58 were category 'B' and 47 were category 'C'. Presently only 34 ISPs are connected to 7 nodes of NIXI. Out of 34 ISPs connected to NIXI, 26 are category 'A', 7 are category 'B' and one is category 'C'. Category 'A' ISPs are connected to multiple nodes (refer Table 2.1).

Sl no.	**NIXI NODE**	**Number of ISPs Connected**			**Total Connections**
		A	**B**	**C**	
1	NOIDA(Delhi)	20	3	1	24
2	MUMBAI	20	6	-	26
3	CHENNAI	13	2	-	15
4	KOLKATA	8	-	-	8
5	BENGALURU	5	-	-	5
6	HYDERABAD	4	1	-	5
7	AHMEDABAD	1	-	-	1

Table 2.1: Number of ISPs connected at NIXI nodes

2.14 The above data indicates that by and large category 'A' ISPs are connected at 4 metro cities only. Very few ISPs are connected at the nodes at State capitals other than metros.

2.15 The urgency of effective IXP is evident from the fact that IP traffic has increased manifold since 2003 when NIXI came into existence. Increasing content digitisation, adoption of IP backbone to provide various applications and services, migration towards NGN and exponential increase in broadband customers in near future is all set to paradigm change in present scenario. Global IP traffic grew 45 %

during year 2009 to reach an annual run rate of 176 exabytes per year or 15 exabytes per month[20]. It is expected to quadruple from year 2009 to year 2014 with a CAGR of 34 %. In 2014, global IP traffic is expected to reach 767 exabytes per year or 64 exabytes per month. Mobile IP traffic is also increasing very rapidly. Global mobile data traffic nearly tripled (2.6-fold growth) in 2010[21], for the third year in a row. Global mobile data traffic is expected to increase 26-fold between 2010 and 2015, reaching 6.3 exabytes per month by 2015 with CAGR of 92 % during this period. Two-thirds of the world's mobile data traffic is expected to be video by 2015. Mobile video will more than double every year between 2010 and 2015. With a robust subscriber base and the ongoing launch of 3G and BWA services, the IP traffic is expected to increase many fold in our country.

2.16 Another area leading to increased domestic IP traffic is the large number of initiatives that have been undertaken by various State Governments and Central Ministries in the area of e-Governance. Under the National e-Governance Plan (NeGP), a massive countrywide infrastructure is evolving and large scale digitisation of records is taking place to enable easy, reliable access over the internet to the citizens. Governments are in the process of implementation of NeGP, comprising of 27 Mission Mode Projects (MMPs)[22] encompassing 10 Central MMPs, 10 State MMPs and 7 Integrated MMPs covering various services from State and Central departments (Table- 2.2). Data centres at various states have either been commissioned or are in various stages of commissioning. Citizens will be getting the services delivered from various departments through State Data Centre or the data centres of the respective departments. Therefore, a

[20] Cisco Visual Networking Index: Forecast and Methodology, 2009–2014
[21] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015
[22] http://www.mit.gov.in/content/mission-mode-projects

lot of data will need to be transacted between citizens and the data centres and will necessitate an efficient routing and delivery system.

Central MMPs	State MMPs	Integrated MMPs
• Banking • Central Excise & Customs • Income Tax (IT) • Insurance • MCA21 • National Citizen Database • Passport, Immigration, Visa and Foreigners Registration& Tracking • Pension • e-Office	• Agriculture • Commercial Taxes • e–District • Employment Exchange • Land Records • Municipalities • Gram Panchayats • Police • Road Transport • Treasuries	• CSC • e-Biz • e-Courts • e-Procurement • EDI For e-Trade • National e-governance Service Delivery Gateway • India Portal

Table 2.2: Mission Mode Projects

2.17 Further, several services will be either real-time or otherwise time sensitive and will require strict control on latency, packet loss and jitter.

2.18 In contrast to the projected growth, average daily traffic during last one year for all the nodes of NIXI was only 6976.6 Mb/s (incoming) and the 6981.9 Mb/s (outgoing). As per the quarterly Performance Monitoring Report for the period ending December 2010, the total domestic bandwidth being utilised by ISPs is 537 GB. This clearly indicates that a lot of domestic traffic is still not routed through NIXI. This required analysis of present framework to ensure availability of effective IXP.

2.19 TRAI issued a consultation paper on "Issues related to Telecommunications Infrastructure Policy" on 14th January 2011. Following questions relating to IXPs were asked from the stakeholders:

i. Do you perceive the need for effective Internet exchange point(s) in the country to efficiently route domestic IP traffic?

ii. If your answer to issue (i) is in affirmative, please comment on the licensing framework of the entities for setting up Internet Exchange Points in India.

iii. Will it be desirable to permit those Unified licencees to setup IP exchange points in the country who have no vested interest in routing of the IP traffic?

2.20 In response, some of the stakeholders are of the view that there is no need for additional internet exchange points as the low traffic at the existing seven nodes does not support viable investment for additional points and existing internet points are sufficient to meet the QoS, QoE and SLA requirements. One of the stakeholders suggested that private operators and neutral third party providers may be allowed to set up Internet Exchange Points (IXPs) but there should not be any mandatory requirement for ISPs to connect to IXP and same should be left to market forces. Some of the stakeholders are of the opinion that it should be mandatory to have internet exchanges in each State capital/ licenced service area for effective utilisation of resources and routing of domestic internet traffic as our country is having States like countries of Europe. They mentioned that this will help small data centres & ISPs, enable efficient use of available resources within the country and monitoring of the internet traffic by the security agencies. One of the stakeholders described a hierarchical model for NIXI. It was also suggested that another 17 locations where primary switching centres of PSTN are located should also be designated as level 1

national internet exchange locations. It was further mentioned that immediate steps should be taken to install internet exchanges with switches, routers etc. to provide facility similar to network access point in US. It was also suggested that Reference Interconnect Offer (RIO) must be published for enabling interconnection in non-discriminatory manner.

2.21 The analysis of present scenario indicates that only few ISPs are connected to NIXI, and in some cases, the bandwidth available at NIXI for some ISPs is inadequate to handle the traffic. Some ISPs are not declaring their full routes and are not accepting the traffic at NIXI though they are physically connected to NIXI. NIXI is a company registered under Section 25 of the Companies Act of India and is not a telecom licencee; therefore is not under the purview of either DoT or TRAI. TRAI cannot mandate ISPs to join NIXI as NIXI is not a service provider. NIXI being independent agency cannot be regulated in terms of QoS, tariff, interconnection port charges and infrastructure being provided by it. It is learnt that some of the service providers having stake in operation of NIXI, are on NIXI's board.

2.22 Domestic Internet traffic can be routed either through NIXI or through International Internet bandwidth providers usually called upstream providers. All ISPs require international Internet bandwidth for routing its international traffic. For this purpose, ISPs obtain a link generally from their upstream provider which carries entire traffic (both domestic as well as international). The upstream provider routes the international traffic to the international link and routes the domestic traffic either to other downstream ISPs connected to it or to other peering ISPs who in turn routes this traffic to their downstream ISPs. This indicates that upstream providers are also performing IXP functions. Quite a few ISPs also have direct peering among

themselves. Hence, traffic between ISPs having direct peering may not be routed through NIXI even if both are connected to same NIXI node; and may be routed through direct peering link.

2.23 Mandating all ISPs to connect to NIXI may not be desirable as in that case an ISP will require two links, one to connect NIXI and other for International Internet bandwidth. A combination of direct peering with upstream providers and direct connection of upstream providers to NIXI may provide effective solution. Encouragement of data centres to host Internet content within India is desirable. NIXI does not permit direct connectivity with data centres. In fact direct connectivity of data centres with IXPs need to be encouraged to facilitate viable business model and reduce latency for better Quality of Experience (QoE) to customers.

2.24 The licencing of IXPs is necessary to exercise effective control on QoS of IXP, ensure smooth interconnection, regulate tariff & port charges and ensure mandatory interconnection of ISPs at IXPs. TRAI in its recommendations on "Spectrum Management and licensing Framework" on 11th May 2010 has recommended introduction of a new licensing regime characterised essentially by the Unified licence. The Authority also recognised need for introduction of Class Licence for VSAT services and licence through authorisation for other services. While prescribing licensing framework for IXPs, the Authority has considered various options and is of the view that Class licence will be most appropriate for IXP services. DoT may therefore, bring IXPs under class licence. NIXI may be asked to obtain class licence within one month of notification by DoT. All National ISPs and International Internet Bandwidth (IIB) providers may be mandated to connect to all IXPs for peering of domestic Internet traffic. QoS of IXPs, interconnection provisions, port charges, and other applicable tariff

will be regulated by TRAI from time to time. A committee will be constituted by TRAI to workout national hierarchical topology for routing and managing Domestic Internet traffic through IXPs.

2.25 **The Authority recommends that**

(i) IXPs may be brought under Class licence. Once this recommendation is accepted, detailed terms and conditions of Class licence for IXP services will be provided by TRAI.

(ii) Data centres may be permitted to connect directly to the IXPs.

(iii) National level ISPs and International Internet bandwidth (IIB) providers may be mandated to connect to all IXPs.

C- Migration to IPv6

2.26 One of the major challenges for the future of the Internet is its ability to scale to connect billions of people and devices. Each device must have an IP address in order to communicate. However, IPv4 addresses are getting exhausted. Internet Assigned Numbers Authority (IANA) has reported that IPv4 addresses have finally exhausted on 3rd February 2011[23,24]. The last five blocks of 16 million IPv4 addresses each were officially handed over to the five Regional Internet Registries (RIRs). The projections indicate that even available blocks of IPv4 addresses would be exhausted by August-September 2011.

2.27 The migration to IPv6 addresses will become imminent, once IPv4 addresses are exhausted. IPv6 is 128-bit address defined by Internet Engineering Task Force (IETF) in year 2000, called IPv6. The new protocol could theoretically support 3.4×10^{15} unique addresses. For

[23] www.potaroo.net/tools/IPv4, IP Address report 1st March 2011

[24] http://www.apnic.net/community/ipv4-exhaustion/ipv4-exhaustion-details

this reason, the timely deployment of IPv6 by network operators and content/application providers is necessary.

2.28 TRAI issued a consultation paper on "Issues related to Telecommunications Infrastructure Policy" on 14th January 2011. Following questions relating to migration to IPv6 were asked from the stakeholders:

i. What measures are required to encourage the deployment and adoption of IPv6 in the country?

ii. In your opinion, what should be the timeframe for migration to IPv6 in the country?

2.29 In response, some of the stakeholders suggested that emphasis should be given to spread awareness of IPv6 amongst the stakeholders. They mentioned that the Task force created by the Govt. to increase the awareness of exhaustion of IPv4 and impact of IPv6 on internet/ broadband services needs to have regular programs to inculcate the migration process. Some of the stakeholders suggested that suitable policy framework to be formulated by Government for smooth transition. They also stressed for demonstrated Government commitment for adoption of IPv6. They also mentioned that TEC has prepared the "National IPv6 Deployment Roadmap", which examines the different issues related to the deployment of IPv6 in India. They believe that the industry and TRAI should support TEC in its endeavour for migration from IPv4 to IPv6 by mid 2012. Some of the stakeholders suggested that there should be a mandate for the transition from IPv4 to IPv6 in a time bound manner seeing the projected timelines for IPv4 address getting over. Some are of the opinion that licensor may like to make it mandatory for support of IPv6 as well. Some of the stakeholders suggested that Government departments should take IP-based services from only IPv6 ready

Internet Service Providers after a certain period of time. They mentioned that Government should also ensure that all the equipment/network used in e-governance, CSC (Common Service Centres) etc. should be IPv6 enabled. Some of the stakeholders suggested that Government should make IPv6 test bed available so that end-to-end IPv6 traffic can flow. They mentioned that this would reduce IPv6 rollout time as well as help all service providers, as they need not spend time/cost to learn about IPv6 connectivity. This would avoid duplication of costs. Some stakeholders were of the view that no time line should be fixed to migrate from IPv4 to IPv6. They were of the opinion that ISPs/Service Providers decide how and when this transition shall happen in India, keeping pace with similar development in other parts of the world.

2.30 TRAI has sent its recommendation on "Issues relating to Transition from IPv4 to IPv6 in India" on 9th January 2006. Based on TRAI's recommendations, the Government has modified the definition of the IP addresses in the ISP licence in October 2007 to include 128 bit addresses provided by IPv6. A National Internet Registry (NIR) to allocate IPv6 has to be setup by NIXI.

2.31 Migration to IPv6 in India is very slow at present. Only 92 entities[25] (ISPs, Educational institutes and other organisations) have obtained IPv6 addresses, out of which only 16 have deployed and announced their IPv6 routes. Figure 2.1 shows how countries have deployed the IPv6 in their internet networks[26]. It can be seen by the advertised routes that many countries have already started migrating to IPv6 in a big way.

[25] http://www.sixxs.net/tools/grh/dfp/all/?country=in
[26] http://resources.potaroo.net/iso3166/v6cc.html

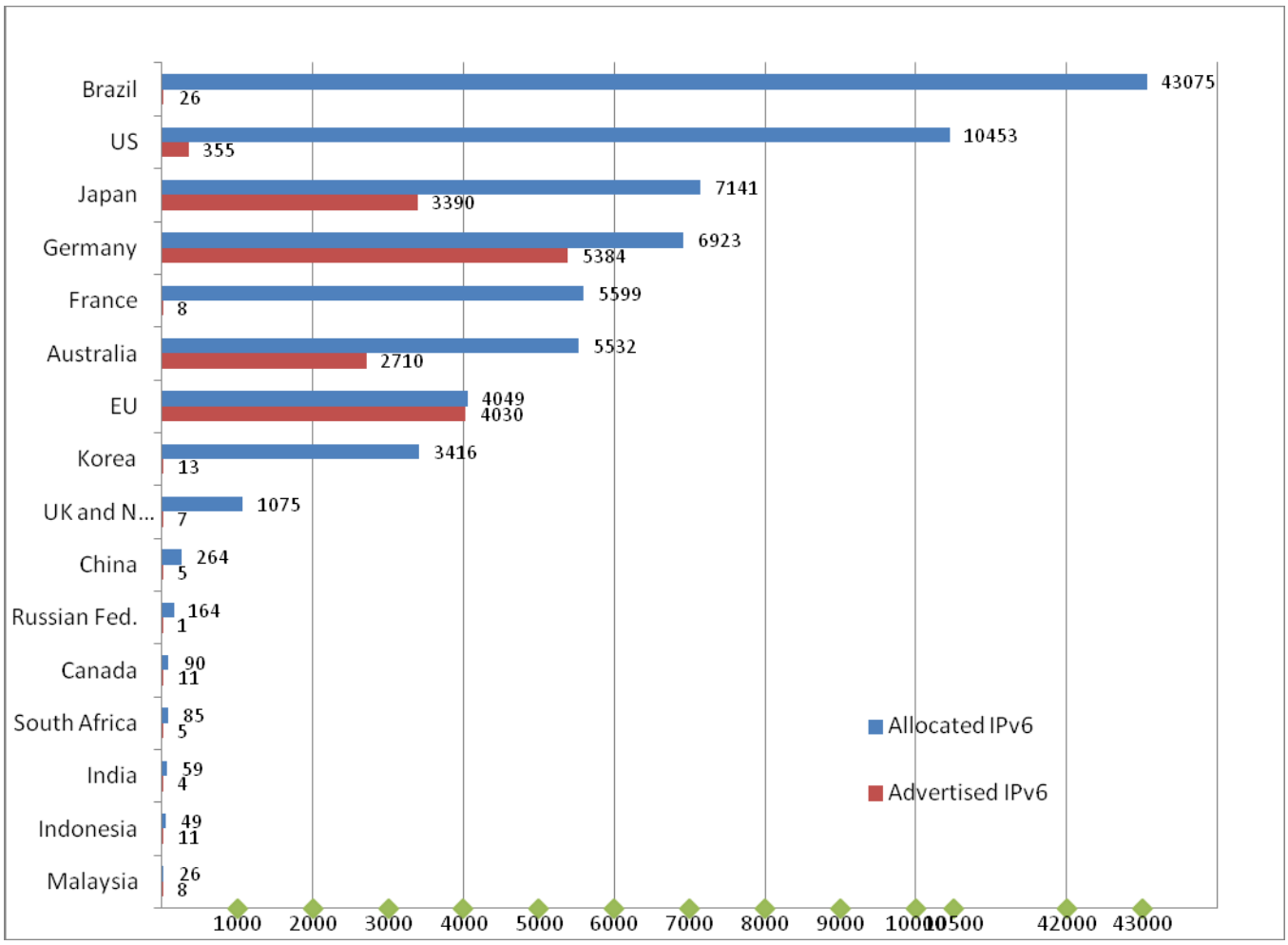


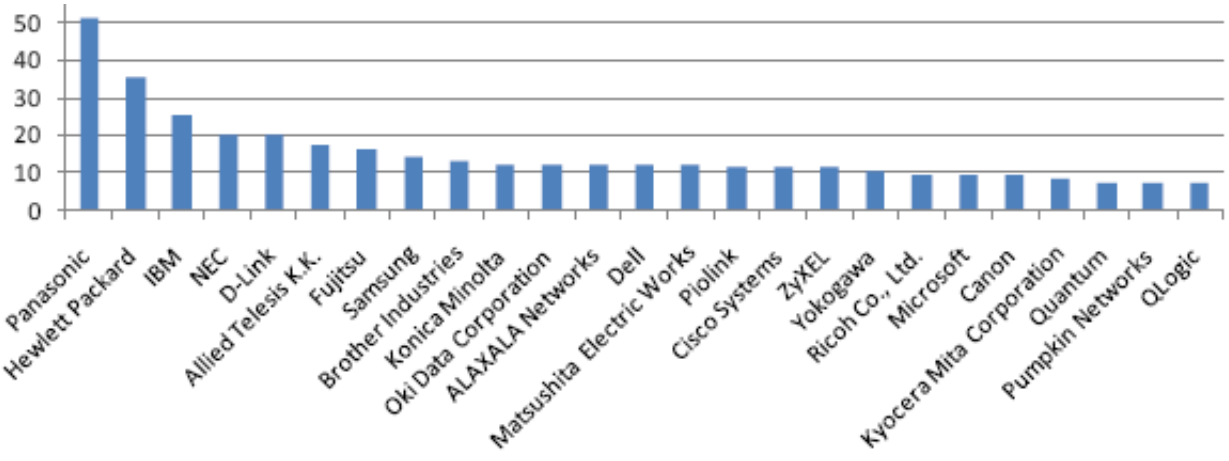
Figure- 2.1: **Allocated & Advertised IPv6 addresses (in lakhs)**

2.32 The major hurdle in IPv6 deployment seems to be unavailability of IPv6 content and applications leading to lack of interest from the consumers. In addition, migration from IPv4 to IPv6 may require hardware and software upgrades, in the operators' network as well as in the applications and programs used at the user's end. Needless to say that this would have financial repercussions which would be weighed against the benefits obtained from migration. It is worth mentioning that apart from additional address space, IPv6 offers better quality of service, better security features, auto configuration, mobility and support for multi-media services.

2.33 Mobility feature supported by IPv6 can open up immense possibilities for new applications with enhanced quality. 3G and BWA services launch will see an increasing number of mobile users accessing the Internet using devices, such as smartphones, Laptops or PDAs that connect to mobile operator or wireless broadband operator's network. In such a situation huge IP addresses requirement can only be met with migration to IPv6.

2.34 Content need to be created on IPv6 platform to attract and raise demand from users. The top Websites having high Internet traffic such as Google, Facebook, Yahoo and YouTube already support IPv6 to end users with IPv6 enabled CPEs. Once CPEs are IPv6 enabled, users can access the IPv6 content.

2.35 Telecom equipment Vendors are playing crucial role to facilitate migration to IPv6. Many companies are getting their IPv6 products approved through IPv6 ready logo program. Figure-2.2 shows number of IPv6 products got approved by top 25 companies[27] through IPv6 ready logo program.



[27] OECD Report -Internet Addressing : Measuring Deployment of IPv6 April 2010

Figure - 2.2: Top 25 companies for products accepted in the IPv6 Ready Logo Program

2.36 IPv6 ready logo program tests the products against IPv6 standards. Products approved by IPv6 ready logo program[28] till 2009 are indicated in Figure-2.3below:

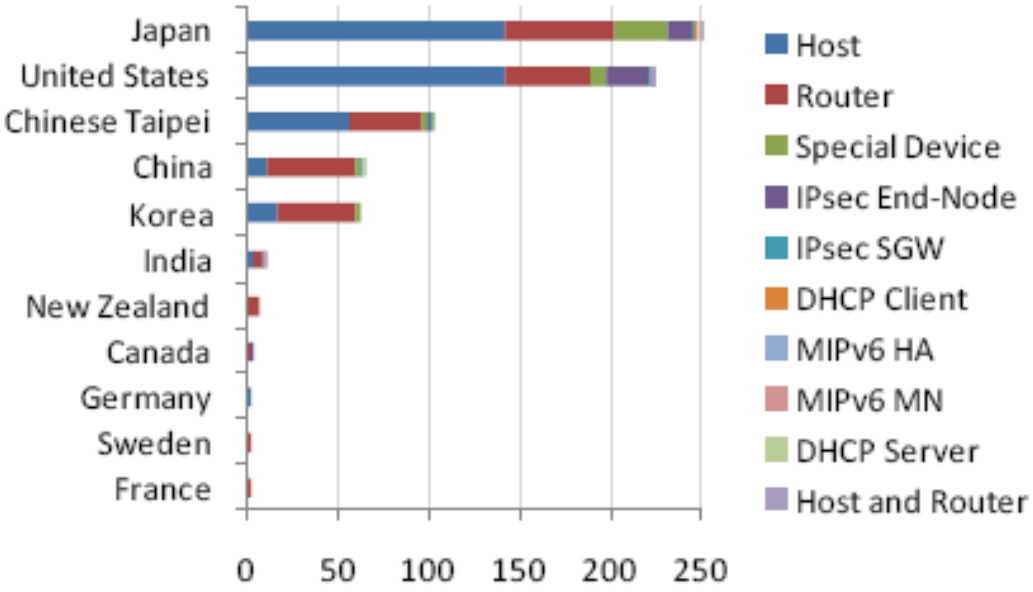


Figure-2.3: Products approved by the IPv6 Ready Logo Program, by country(2009)

2.37 Although some of the Indian vendors have also got their products approved but the figure is quite small compared to countries like China and Korea. To promote the production and use of IPv6 products in the country test bed for end to end testing is required. Further, before migration all applications running on IPv4 need to be tested in IPv6 environment. Therefore, for testing the products in end to end traffic environment , test beds also need to be created.

2.38 TRAI is aware that TEC has published a report on roadmap for migration to IPv6. DoT has constituted working groups to look into

[28] OECD Report -Internet Addressing : Measuring Deployment of IPv6 April 2010

various issues relating to migration to IPv6. TRAI is watching the development and not giving any specific recommendations on roadmap for the migration to IPv6 as of now.

2.39 **The Authority recommends that**

(i) TEC may develop IPv6 standards keeping in view country specific requirements based on global standards.

(ii) IPv6 test bed facilities should be created for simulating and testing products in end to end IPv6 traffic environment. The IPv6 test bed facilities, already available with academic institutions like IITs, IISc should be extended to National Institutes of Technology (NITs) for easy access to stakeholders.

(iii) All Government websites should be made IPv6 compliant by 2012.

D- IPTV

2.40 Rapid developments in telecom technologies, enormous capabilities of IP platform and increasing digitalisation in broadcasting sector is driving services like Internet Protocol TV (IPTV).

2.41 As per existing regulatory framework, telecom access service providers (Unified Access Service Licencees, Cellular Mobile Telephone Service Licencees and Basic Service Licencees) having licence to provide triple play services and Internet Service Providers (ISPs) with net worth of

more than Rs. 100 crores and having permission from the licensor to provide IPTV are permitted to provide IPTV services.

2.42 Cable TV operators can provide this service under the provisions of the Cable Television Network (Regulation) Act, 1995 which is under purview of Ministry of Information & Broadcasting (MIB).

2.43 For providing IPTV services all these service providers have to adhere to the guidelines issued by the Ministry of Information & Broadcasting in September 2008. Services providers are also subjected to various levies (licence fee & other taxes etc.) as prescribed in their respective licences/permissions. Presently telecom access providers are subjected to a licence fee of 6%, 8%, and 10% of Adjusted Gross Revenue (AGR) for category "C", Category "B" and category "A" circles and ISPs are subjected to a licence fee of 6% of AGR. As per present structure, cable TV operators are not subjected to any levy.

2.44 TRAI issued a consultation paper on "Issues related to Telecommunications Infrastructure Policy" on 14th January 2011. Following questions were asked relating to provision of IPTV from the stakeholders:

i. What measures do you suggest to enhance provision of IPTV services by various service providers?

ii. Should there be any restriction on ISPs for providing IPTV services?

2.45 In response, some of the stakeholders felt that there should be no restriction on ISPs providing IPTV services and advocated the reduction in net worth of IPTV services providers. They mentioned that ISPs will spur innovation in the broadband sector ecosystem as they will be able to use IPTV infrastructure not only for entertainment

but also for communication (VoIP), secure sharing of local content (e.g. digital photos and films), Tele-education, online games, ecommerce, remote supervision and home control. One of the stakeholders mentioned that ISPs are geared to offer IPTV; however, the condition of minimum net worth of Rs. 100 crore for ISPs who wish to start IPTV services has put most of the ISPs out of the IPTV bandwagon. They raised the concern that a cable operator can offer IPTV without any extra fee or obligation whereas ISPs are required to pay entry fee as well as licence fee. It was also mentioned that IPTV is a value added service on the IP platform which can make Internet/broadband more attractive especially in the small towns, remote and rural areas. Some of the stakeholders are of the opinion that in order to ensure only serious players providing IPTV, the current requirement of minimum net worth of Rs. 100 Crores for ISPs is correct. They mentioned that IPTV service entails large bandwidth and technical requirement; hence, capacity building could be one of the many challenges faced by Service Providers.

2.46 According ITU,[29] four main network segments that constitute an IPTV service network are the content acquisition, encoding and play out. ITU has also defined minimum level of transport layer performance required to provide satisfactory QoE for IPTV services. These parameters include transport stream bit rate, jitter, maximum duration of a single error event, corresponding loss period in IP packets, Loss distance and average IP video stream packet loss rate.

2.47 The challenges for rolling out IPTV services are building a new service delivery network that can handle the increased bandwidth needs of IPTV, re-engineering the core network to support video services, and adding new technologies for video content management, distribution

[29] ITU-T recommendations G.1080: Quality of experience requirements for IPTV services

and billing. This will require a significant investment. In addition, IPTV providers will require access network capable to support a bandwidth of at least 3-4 Mbps for good quality of service.

2.48 ISPs are subjected to the condition of net worth of Rs. 100 crore for providing IPTV. On the other hand for cable TV operaters are not subjected to any such condition for providing IPTV services. Stakeholders have contested the issue of level playing field and wanted equal treatment under different verticals. In order to maintain level playing field between ISPs and cable TV operators providing IPTV services, the condition of net worth of Rs. 100 crore for ISPs may be removed. All other conditions will remain unchanged.

2.49 **The Authority recommends that the present condition of minimum net worth of Rs. 100 crore for an ISP to provide IPTV services should be done away with.**

CHAPTER III: INFRASTRUCTURE MANAGEMENT

A- Infrastructure Sharing

3.1 In the consultation paper, stakeholders were asked to provide comments on the following questions:

i. How can sharing of IBS among service providers be encouraged? Does TRAI need to issue any guidelines in this regard?
ii. Should sharing of mobile towers be mandated?
iii. Should sharing of active infrastructure, created by themselves or infrastructure providers, be allowed?

3.2 In response, some of the stakeholders were not in favour of mandating the sharing of towers and suggested that it should be encouraged but should be left to the discretion of the operators as each operator would have their own requirement/strategy. They were of the view that tower sharing can be encouraged by providing certain incentives like availability of utility power connections on priority and concessional basis. One of the stakeholders was of the view that Infrastructure sharing may only be mandated in Critical locations like Lutyens Bunglow Zone (LBZ), Cantonment areas, Central Government and State Government office buildings, Designated Forest/ Green Belt areas and Government Residential colonies, etc., where installation of cell sites by individual operators is either difficult or is not permitted due to policy/ security / aesthetic concerns. Those stakeholders who favoured mandating submitted that sharing will result in more efficient use of resources and lower overall cost to the industry, society & environment while at the same time enabling a faster rollout of coverage. Some of the stakeholders suggested that sharing of active infrastructure created by the telecom infrastructure companies should be allowed, as this is expected to reduce costs, encourage standardisation, and ultimately result in further decline of tariffs. They also mentioned that sharing of the active infrastructure should be extended to the core network also. Some of the stakeholders mentioned that approval for new towers could be given subject to that there is no sharable capacity available in existing towers.

3.3 Some of the stakeholders suggested that there should be neutral host provider and allowing IP-I to import, setup and operate specialised active In Building Coverage Solutions such as optical fibre based Active DAS and Grid Femtocells independent of the operators. It will be important for all the service providers to provide coverage inside

big buildings and complexes as their subscribers may be present at these places. However, it will not be possible to install their individual in-building infrastructure as it will not only result in duplication but also require huge cost. It will be beneficial if one service providers installs the IBS and others share this infrastructure.

3.4 Some stakeholders argued that infrastructure companies (IP-I) may be permitted to install in building solutions as neutral host and should make this infrastructure available to all the service providers non-discriminately on similar terms and conditions.

3.5 As per the terms and conditions of the CMTS/UAS licence, the access service providers were initially permitted sharing of "passive" infrastructure viz., building, tower, dark fibre etc. only, among themselves. In order to reduce input capital cost of telecom access service providers towards fixed infrastructure, thereby facilitating further reduction in tariff and to enhance the teledensity in the rural areas, DoT in April 2008 had issued 'Guidelines on Infrastructure sharing". Through these guidelines sharing of <u>active</u> infrastructure was also permitted amongst the Service Providers. Some of the main points were:

i. *Sharing of active infrastructure amongst Service Providers based on the mutual agreements entered amongst them is permitted. Active infrastructure sharing, limited to <u>antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only, was permitted</u>. Sharing of the allocated spectrum will not be permitted;*

ii. *Infrastructure Providers (IP) Category-I were allowed to seek SACFA siting clearance for erecting towers with or without agreement with licensed Service Providers;*

iii. *To provide incentives on the infrastructure sharing in the urban areas, State Governments were requested to charge same amounts for setting up of the shared tower, irrespective of the number of Service Providers sharing the same tower at par with unshared tower;*

3.6 The DoT, vide its letter dated 9th March 2009 has clarified that the scope of IP-I, which was limited to sharing of passive infrastructure only, has been enhanced to cover the active infrastructure if this active infrastructure is provided on behalf of the licencees, i.e. they can create active infrastructure limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system only for/on behalf of UASL/CMSP licencees.

3.7 Most of the infrastructure works especially erection of towers is being done by IP-I. For erecting towers these companies will be requiring permissions from local authorities or the private owners as the case may be. Moreover, these IP-I companies will also establish active infrastructure for which again RoW permissions will be required wherever necessary. Government vide its notification issued on 24th May 1999, in exercise of provision under Section 19B of the Indian Telegraph Act, 1885 had permitted the private licencees who are issued licence under Section 4 of the Act to seek RoW from any person including local authorities. Since IP-Is have not been issued licence under Section 4, these companies cannot seek RoW as provided in the Indian Telegraph Act, 1885. Therefore, these IP-Is are required to be brought under licencing regime so that these companies could also be able to seek RoW for deployment of infrastructure.

3.8 As noted in the consultation paper, the Authority in its recommendations on "Spectrum Management and Licensing Framework" of May 2010 observed that in view of increasing role of IP-I in the sector, there are enough reasons to bring them under the ambit of licensing regime and permitting them to provide both passive and active infrastructure, independent of the service providers. This will facilitate faster roll out and reduction in the capital expenditure on the part of the service providers. Therefore recommended *"...that IP-I category be also brought under the licensing regime with immediate effect."*

3.9 As per the Indian Wireless Telegraphy Act, 1933 Government authorisation/licence is required even to deal and/or possess any wireless telegraphy/telecommunication equipment/apparatus etc.

3.10 Presently, a IP-I, is not permitted to setup/ install Radio Access Network of its own, as it has not been assigned access spectrum and accordingly not granted the Wireless Telegraphy (WT) licence. This constraint will continue to be applicable in the proposed licensing regime, in case the Unified Licencee is not assigned the access spectrum. Therefore, in order to facilitate the installation and maintenance of complete Radio Access Network by the third party for use of the access providers, it is proposed that such Unified Licencee may be permitted to possess and maintain the WT equipment. They may also be allowed to be assigned spectrum for providing backhaul through microwave systems which can be offered to service providers on sharing basis. They will be permitted to offer the complete Tower site (active & passive components along with wireless equipment) to the prospective telecom operator on lease. The Telecom operators having the UAS/CMTS licence along with the WT licence can approach such Licencees to just connect its MSC to the respective

tower site, complete in all respect, on mutually agreed terms. The scenario of the wireless network implementation would be like in the following figure:

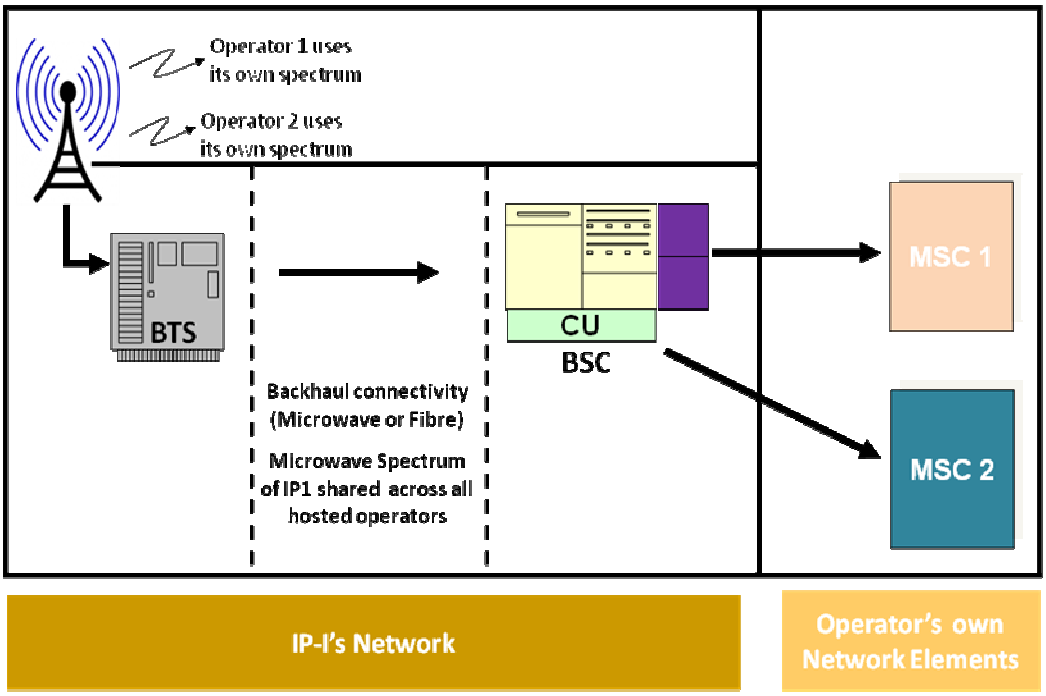


Figure 3.1: Scenario of the wireless network implementation

3.11 **The Authority recommends that**

(i) Infrastructure providers should be permitted to install and share active network limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system, subject to the condition that they are brought under the Unified Licensing regime as recommended by this Authority in May 2010.

(ii) Such Unified licencee should also be permitted to possess and maintain wireless telegraphy equipment.

(iii) Such Unified licencee may also be assigned spectrum for providing backhaul through microwave system

3.12 With the rapid increase in the number of telecom subscribers and also the roll out of 3G and BWA networks, the telecom operators have to incur a higher amount of expenditure in expansion of their networks. Moreover, in view of the enhanced competition and decreasing tariffs, operators are also exploring various measures to drive down cost of infrastructure deployed for telecom services, as deployment of infrastructure amounts to approximately 60% of total cost for service provisioning. Roll out of separate infrastructure by all of them will not only result in duplication but will also require high cost. In this context, concept of infrastructure sharing between mobile operators assumes crucial importance, as it allows operators to leverage and ride on existing infrastructure. At present approximately 60% of the total towers are shared, even though infrastructure sharing is not mandated as per the existing licensing conditions. The issue for deliberation is how the infrastructure sharing can be further encouraged.

3.13 One of the major issues is the availability of infrastructure at critical sites in areas of heritage, security & environmental importance, which may prove to be a bottleneck as the municipal and local bodies are restricting the new infrastructure creation at such locations. Identification and sharing of critical sites, harmonisation of tower sharing in such areas will be required for provisioning of seamless telecom services.

3.14 Several countries worldwide recognised the importance of infrastructure sharing and initiated several measures to encourage this. As per the guidelines issued by Telecommunications Regulatory

Commission of Sri Lanka[30] in July 2009, Antenna Structures should be designed and constructed with provisions for more than one service provider. Such constructions are encouraged through incentive schemes.

3.15 In Brazil, National Telecommunications Agency (ANATEL) has laid down rules on infrastructure sharing among telecommunications service providers. The rules set out the conditions and standards for sharing of ducts, conduits, poles, towers and utility easements in the telecommunications sector.

3.16 In Hong Kong the network operators are encouraged to share facilities on a fair commercial and technical terms & conditions in order to avoid uneconomic duplication of network resources. The Telecom Authority is empowered under the Telecommunication Ordinance in Hong Kong to direct the cooperation and coordination among the licencees in public interest to share the use of network facility after considering the factors such as bottleneck facility and duplication of network resources. The Telecom Authority can also make any determination in terms and conditions of the shared use of facility should the operators have failed to reach an agreement.

3.17 The Commerce Commission of New Zealand, in the year 2008 had issued Standard Terms Determination (STD)[31] for the specified service co-location on Cellular Mobile transmission sites. As per this, access providers must make co-location on cellular mobile transmission sites (the Mobile Co-location Service) available to other mobile network operators.

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[30] Guidelines on Antenna Structures **:** http://www.trc.gov.lk/images/pdf/guide_l.pdf

[31] http://www.comcom.govt.nz/mobile-co-location-service/

3.18 In 2008, China's Ministry of Industry and Information Technology (MIIT) had published new rules which encouraged the mobile operators to share their network infrastructure wherever possible. The main beneficiaries of this policy were two smaller operators, China Telecom and China Unicom who were able to rollout coverage quicker by sharing towers belonging to China Mobile.

3.19 The Turkish Regulator has issued a Communication on Principles and procedures regarding Co-location and Facility sharing[32] in telecommunication market. This communication set out the principles and procedures for facilitating the entries of new operators into telecommunications market, maintaining the efficient use of resources, minimising the cost of investment & services, fostering the competitive market conditions etc. All the operators having significant market power (SMP) including the incumbent Turk Telecom are obliged to provide Co-location to smaller, new operators. The telecom infrastructures including erection, sharing of towers and masts are included in this proposal.

3.20 Pakistan Telecommunications Authority (PTA) grants 'Telecommunication Infrastructure (Tower) Provider Licence[33] to firm/person to establish, maintain, lease, rent and sale of telecommunications tower facilities in Pakistan as per the prescribed terms and conditions. The terms and conditions of the licence authorises sharing of towers also by the licencee and the licencee can provide access to its towers and related facilities for the use by the licenced/registered telecommunication service providers.

[32] http://www.tk.gov.tr/pdf/en-2003.pdf
[33] www.pta.gov.pk

3.21 The Authority is of the opinion that while sharing of infrastructure should be encouraged, mandating it will pose a major challenge in implementation and monitoring and will be seen as undesired regulatory intervention. Instead, there is a need to ensure that process of sharing the infrastructure by service providers should be transparent and non-discriminatory. Further, there is a need to identify sites of heritage, security and environmental importance where restrictions are put by local authorities for erecting new towers and mandate the sharing of infrastructure in such locations.

3.22 **The Authority recommends that infrastructure sharing should be mandated in locations of heritage, security and environmental importance.**

B- Mobile Virtual Network Operator (MVNO)

3.23 Mobile Virtual Network Operators (MVNOs) are the service providers who offer mobile services to end users without an allotted spectrum by using the radio spectrum of a licenced mobile network operator (MNO) who has the radio spectrum and hosting services through commercial agreements with an MNO. MVNO may have little or no network infrastructure of their own. They may build, buy or lease network capacity from a MNO to obtain essentially the same possibilities to offer mobile services to end-users as an MNO. Usually their services are augmented by brand appeal and product differentiation with focused customer segments. Depending on the technical approach chosen and commercial agreements made between the MVNO and the existing MNOs, the MVNO may be able to offer different packages of services and tariffs from those available today from service providers. Because of low OPEX and investments, MVNOs may be able to go into areas which MNOs did not consider

viable. Also the introduction of MVNO is seen as a contributor to efficient use of existing telecommunication infrastructure and also to development of new infrastructure.

3.24 Based on the reference from DoT, TRAI sent its recommendations on the need and timing for introduction of MVNO as well as terms and conditions of the licence to be granted to such operators to DoT on 6th August 2008. Further, DoT vide its D.O. letter no. 800-18/2009-VAS-III/5 dated 24th February 2009 sought reconsideration on some of the recommendations on MVNO. Most of the observations/suggested modifications by DoT were related to procedural matters, which were acceptable to the Authority. On one of the issues DoT suggested that one MVNO should be able to get attached to a maximum of two MNOs to avoid monopolistic situation. In the reconsidered view, it was reiterated by the Authority that for the time being, one MVNO may be restricted to get parented to one MNO in view of the large number of access providers in each service area and parenting to multiple MNOs could create problems in implementation of mobile number portability. The Government is yet to notify the guidelines for MVNO in the country.

3.25 In the meantime, there have been various developments in the sector that warranted reconsideration of a number of recommendations that were given earlier by the Authority. One of the major developments has been the release of recommendations on 'Spectrum Management and Licensing Framework' by the Authority in May 2010 which covered in a comprehensive manner, all the aspects of licensing for provision of access services. A framework for issue of future licences is also a part of the recommendations. The recommendations relevant for MVNO guidelines are mentioned in the following paragraphs:

(i) Considering the spectrum demand and supply position, development of technologies in different spectrum bands and the possibilities of offering applications on wireline and fibre networks, the Authority recommended that no more UAS licence linked with spectrum should be awarded. At the same time, keeping in view the possibility of some service providers wanting to launch access services without spectrum, the Authority recommended that future licences must be unified licences, not linked to spectrum. A Unified licencee shall be permitted to offer any/all services covered under 'Class licence' and 'Licensing through Authorisation' but not vice-versa. Such a licensing regime will be service and technology neutral and shall permit a unified licence holder to offer any or all telecom services. Spectrum, if required, is to be obtained separately. The Authority had also recommended two types of unified licences – national and service area specific. The national unified licencees would be allowed NLD/ILD services.

(ii) The Authority also expressed the opinion that the existing roll out obligations, of covering at least 10% of the District Headquarters (DHQs) in the first year and 50% of the District Headquarters within three years of effective date of licence are very lenient and are urban centric. As a result even 15 years after the introduction of mobile service in the country, the rural teledensity is still below 25. The Authority stressed upon the importance of telecommunications in the development of rural areas in the context of the objective of the Government to bridge urban-rural divide. The Authority therefore recommended imposing an obligation of coverage of habitations having a population of more than 2000 in a

phased manner. It shall be incumbent on every service provider to provide connectivity through its own network in all habitations with a population of more than 5000 persons. A licencee would however be allowed to cover the habitations having a population between 2000-5000 through intra service area roaming, subject to the condition that at least one-third of the habitations shall be covered by its own network. The Authority has also proposed a system for discouraging non-fulfillment of roll-out objectives in terms of higher spectrum usage charges. For habitations with a population of 500 to 2000 persons, the Authority proposed incentives for roll out of services in terms of reduction in annual licence fee.

(iii) It was mentioned that encouraging Mobile Virtual Network Operators (MVNOs) would be a way of sharing spectrum. Permitting use of MNO's spectrum by MVNO is one of the mechanisms for increasing efficiency in spectrum utilisation and temporarily fulfilling the demand for spectrum. The Authority, inter-alia, recommended sharing of spectrum among licencees each of whom does not have more than 4.4 MHz/2.5 MHz (GSM/CDMA) spectrum for a maximum period of 5 years.

3.26 In the consultations paper on Telecommunications Infrastructure Policy also it was proposed that in view of the fact that various developments have taken place in the sector, the framework recommended for MVNOs through TRAI's recommendations of 6th August 2008 needed reconsideration. In view of the fact that MVNOs can assist MNOs in extending coverage to rural and remote areas, the MNOs should be allowed to cover habitations having populations between 2000-5000 through MVNOs in addition to the intra service

area roaming option recommended in the May 2010 "Spectrum Management and Licencing Framework" recommendations. In the light of the same recommendations it was mentioned that, there may not be any need for a separate MVNO licence but a Unified licencee could be allowed to work as an MVNO, share the spectrum of the MNO and setup or lease the required infrastructure for providing service in the contracted areas. It is clarified that sharing of spectrum here means use of MNO's spectrum by MVNO also. In the process the spectrum already held by the MNO gets utilised more effectively. In view of the above stated facts stakeholders were asked to give their opinion on the proposed modifications to the recommendations of TRAI on MVNO dated 6th August 2008.

3.27 The following modifications to the TRAI's recommendations dated 6th August 2008 were put up for consultation:

a. A Unified licencee who does not possess spectrum should be allowed to work as an MVNO in any service area. The Unified Licence ceases to be an MVNO if he gets his own spectrum.
b. An MVNO should fulfill all the obligations of the Unified Licence.
c. An MVNO should be allowed to use the spectrum of an MNO and also to set up infrastructure including Radio Access Network (RAN)/Base Station Subsystem, if required.
d. There should not be any limit to the number of MVNOs attached to an MNO. However, an MVNO cannot get attached to more than one MNO in the same service area. Additionally, the MNO should ensure that there is only one MVNO in one revenue district.
e. MVNO should pay spectrum charges as per the slab applicable to the parent MNO.

f. For counting the roll out obligations, the MNO can take into account the roll out done by the MVNOs attached to it.

3.28 In response, some of the stakeholders suggested that existing unified access service licencees may be permitted to become MVNO for 3G services in case they do not have spectrum. They mentioned that operators waiting for allocation of initial 2G spectrum may also become MVNO linked to other MNO. They are of the opinion that these licencees should be permitted to operate as MVNO only in the circles in which they do not have spectrum. Once a licencee owns spectrum he ceases to act as MVNO. However, this modification may cease to exist once spectrum sharing is permitted by regulator.

3.29 On the contrary, some of the stakeholders mentioned that concept of MVNO seems to be irrelevant considering the scarcity of spectrum, competition among the telecom operators, and prevailing very low tariffs. They also mentioned that if it is felt that the Indian telecom market has a place for MVNO in current scenario, the same can be introduced under a distinct regulatory regime and MVNO should not be allowed to share spectrum. They are of the opinion that market forces should decide the relationship between MNO and MVNO and there should not be any compulsion on MNO to enter into any commercial arrangement with any MVNO. MNO and MVNO should be free to decide the terms of its agreement.

3.30 One of the stakeholders suggested that operators like EPABX & DID (Direct Inward Dialling) franchisees are miniature version of an MVNO and they may be allowed to share the service providers' spectrum or a small spectrum band may be de-licenced for low power applications within large complexes using this spectrum.

3.31 One of the stakeholders suggested that it is better to introduce "Physical Operators" & "Service Operators", work with each other on revenue basis in place of MNO or MVNO. It is also mentioned that physical operators should manage all physical infrastructures (active & passive) & service operators will deliver services & manage customers. This method will eliminate the multiple infrastructures and thus minimises the future environmental hazards

3.32 The spectrum for mobile services is finite and a scarce resource. Today there are around seven to twelve licencees in each operational service area effectively offering services in the country. The finite resource of spectrum can become a serious constraint in meeting the capacity and QoS requirements. Therefore, there is a need for efficient and optimal use of spectrum. Some licencees have not been allocated startup spectrum. These licencees can work as MVNO and provide access service including various types of value added services in some remote areas or specific towns where MNO may not have its presence. Availability of 2G spectrum for further allotment is either very difficult or very much limited. For 3G spectrum service providers have paid a large sum to obtain the spectrum. There is no certainty regarding allotment of further block of 3G and BWA spectrum in short term. Therefore, unified access service licencees without spectrum could provide mobile services through MVNO route. Permitting spectrum use by MVNO will also lead to increased efficiency in spectrum utilisation. Stakeholders also agreed that Unified licencees could become the MVNOs. However, one stakeholder has argued for a separate and distinct regulatory regime for MVNOs. In Indian context where enough competition exists, creation of further licence for MVNOs may not be desirable.

3.33 **The Authority recommends that a Unified licencee who does not possess spectrum should be allowed to work as an MVNO in any licenced service area. The Unified licencee ceases to be an MVNO if it is allocated spectrum for accessing the subscribers.**

3.34 One of the stakeholders mentioned that operators like EPABX & DID franchisees are miniature version of an MVNO and could be allowed to share the service providers' spectrum or a small spectrum band may be de-licenced for low power applications within large complexes using this spectrum. Since operators can use solutions like IBS/DAS/3D cell, which are low power applications with efficient reuse of the spectrum, releasing separate spectrum to cover large complexes out of the allotted spectrum may not be needed. However, releasing spectrum on a separate band for indoor applications band is being reviewed separately.

3.35 The Authority in its recommendations on 'Spectrum Management and Licensing Framework' in May 2010 recognised that encouraging Mobile Virtual Network Operators (MVNOs) would be a way of sharing spectrum. In addition, MVNO could provide access service including various types of value added services in some remote areas or specific towns where MNO may not have its presence. In such a scenario MNO may not be interested in incurring expenditure on deploying infrastructure like Radio Access Network/ Base station Subsystem in such areas.

3.36 The International Telecommunications Union (ITU), which references each country's MVNO development, provides the following two-part definition of MVNOs:

1. MVNOs offer mobile communications services to end users without having their own radio spectrum that is MVNOs do not own licences and must lease network capacity or equipment from licenced operators.
2. An MVNO can be a provider of a mobile communication service or a value-added service and possess its own mobile network code (MNC) and SIM cards.

3.37 The MVNO business model deployed in different countries vary depending on the local conditions and the regulatory regime. While some MVNOs operate their own core network infrastructure including switching, Home Location Register (HLR), billing, customer care, value added services platforms and intelligent network systems, other MVNOs simply repackage network operators' services and issue their own SIM cards by relying almost completely on the host network's facilities with a little product differentiation. Accordingly the three types of MVNO models have been differentiated as:

(i) **Full MVNOs**, which provide their own network core including a Mobile Switching Centre (MSC);
(ii) **Intermediate MVNOs**, which acquire a switched service, but either provide their own home location register (HLR) or share a jointly owned HLR with an MNO; and
(iii) **Thin MVNOs**, which only provide additional applications and content and which are not much different from pure resellers or service providers. These thin MVNOs are also called Enhanced Service Providers.

3.38 With the launch of 3G and BWA services there will be more emphasis on wireless data services and customised service offerings with innovative services. Under these conditions MVNOs who focus on

service innovation can provide various innovative services to the customers. The business model or the type of MVNO, however, may depend on the local context, level of competition and maturity in the market. Therefore the Authority does not feel to impose any restrictions to be placed on type of MVNO model to be followed and leaves the agreement between MNO and MVNO on market forces. There may be a clause of exit from such agreements. Under the situation of exit due to any reason, it needs to be ensured that consumer interests are protected and the service is not interrupted. In case of exit, customers need to be informed in advance about such exit and should be given the option of migrating to the parent MNO.

3.39 **The Authority recommends that**

i) MVNO may be allowed to set up its own infrastructure including MSC, Radio Access Network (RAN)/Base Station Subsystem etc., if required.

ii) Commercial model between MVNO and MNO should be left to mutual agreement between the MVNO and MNO subject, however, to the licence conditions of both MVNO and MNO.

3.40 MVNO is a provider of services to the customers similar to the services provided by the MNO. Once the customer belongs to MVNO, all service obligations related to customer like billing, customer care, national security requirements, quality of service, access to emergency services, subscriber verification and directory services should also become the responsibility of the MVNO. Since MVNO will be working on behalf of the MNO and will be using the numbers out of the allotment of MNO, number portability will be the responsibility of the MNO. However, customers can approach the MVNO and MVNO in coordination with MNO will get the process completed.

3.41 **The Authority recommends that an MVNO should fulfill all the service obligations of the Unified Licence. Allocation of numbers, number portability, interconnection with other service providers and roaming should be provided to MVNO by the parent MNO.**

3.42 Presently circle wise licences are given to MNOs and spectrum is also allocated circle wise. Therefore a MVNO may be a reseller of the MNO services in a particular service area or a MVNO may also offer service in multiple service areas of the same MNO. It is also possible that a particular MVNO may tie up with different MNO in different service area. In order to create a healthy & competitive environment, and the possibility of serving different segments through different business models, MNO should be allowed to have multiple MVNOs. However, more than one MVNO per revenue district will make it difficult in ensuring a viable business model of a MVNO. Since most important resource for MVNO is the spectrum, attachment of MVNO to more than one MNO will lead to sharing of spectrum of multiple MNOs simultaneously. Moreover, annual spectrum charges depend on the amount of spectrum held; it will be difficult to separate out the AGR of MVNO for each spectrum shared. Therefore it will be better if the MVNO does not get attached to another MNO. Also as mentioned earlier, parenting to multiple MNOs could create problems in implementation of mobile number portability.

3.43 **The Authority recommends that**

(i) There should be no restriction on the number of MVNOs attached to a MNO subject, however, to their being only one MVNO in a revenue district.

(ii) An MVNO cannot get attached to more than one MNO in the same service area.

3.44 In a situation where MVNO does not exist, the subscribers would have belonged to the MNO and MNO would have paid spectrum charges on the revenue from these subscribers. In order to ensure that the revenue that is accrued to the Government does not decline on account of introduction of MVNO, AGR of MVNO should be counted for the calculation of spectrum charges. Since MVNO can share the spectrum held by MNO, the spectrum charges levied on MVNO should also depend upon the spectrum held by MNO.

3.45 **The Authority recommends that MVNO should pay spectrum charges on its revenue. The slab applicable to MNO will equally be applicable to the MVNO.**

3.46 In the licence issued to MNO certain roll out obligations are specified. The rolls out obligations are in the nature of coverage of the service area. Any delay in fulfilling the obligations attract liquidated damages. One of the objectives of MVNOs is to extend service to areas where MNO is not interested in providing service. If roll out by MVNO is considered as the roll out on account of parent MNO, this will further facilitate growth of MVNOs and will also benefit MNOs.

3.47 **The Authority recommends that for complying with its roll out obligations, the MNO can take into account the roll out achieved by its MVNOs.**

3.48 The recommendations on "Mobile Virtual Network Operator (MVNO)" made in August 2008 had 27 recommendations. Out of these recommendations 9 have been replaced with new recommendations, 10 are not relevant now and 8 are still relevant.

3.49 The details of 9 recommendations which have been replaced are as follows:

S.No.	August 2008 recommendations	Replaced with recommendations at
1	Definition (Para 2.1)	Para 3.33
2	Need and timing for introduction of MVNO (Para 2.2)	Para 3.33
3	Types of MVNO(Para 2.3)	Para 3.39 (i)
4	Regulatory Models (Para 2.4)	Para 3.39 (ii)
5	Number of MVNOs (Para 3.4)	Para 3.43
6	Commercial Model (Para 3.5)	Para 3.39 (ii) & 3.45
7	Service obligations of MVNO (Para 3.6)	Para 3.41
8	Allocation of numbers, number portability, interconnection with other service providers and roaming (Para 3.9)	Para 3.41
9	Roll out obligations (Para 3.11)	Para 3.47

3.50 As per the earlier recommendations, a separate licence was to be issued to MVNO whereas as per the current recommendations any Unified Licencee without spectrum can work as an MVNO. So, the following 10 earlier recommendations are not relevant now. Instead, the conditions of the Unified licence will applicable to the MVNOs.

i. Issue of licence
ii. Duration of licence
iii. Eligibility conditions
iv. Entry fees
v. Annual licence fee and AGR
vi. Mergers
vii. Substantial Equity
viii. Foreign Direct Investment
ix. Bank Guarantees

x. Customer acquisition

3.51 The remaining 8 following earlier recommendations are still relevant:

i. Licenced Service area
ii. Scope of Service of MVNO
iii. Failure of agreement between MVNO and MNO
iv. Quality of Service
v. Tariff
vi. Technical standards
vii. National security
viii. Reporting requirements.

3.52 In order to avoid any ambiguity, the Authority recommends the following set of recommendations on "Mobile Virtual Network Operator (MVNO)". This supersedes the earlier recommendations on MVNO issued in August 2008.

3.53 **A Unified licencee who does not possess spectrum should be allowed to work as an MVNO in any licenced service area. The Unified licencee ceases to be an MVNO if it is allocated spectrum for accessing the subscribers.**

3.54 **MVNO may be allowed to set up its own infrastructure including MSC, Radio Access Network (RAN)/Base Station Subsystem etc., if required.**

3.55 **Commercial model between MVNO and MNO should be left to mutual agreement between the MVNO and MNO subject, however, to the licence conditions of both MVNO and MNO.**

3.56 **The Authority recommends that an MVNO should fulfill all the service obligations of the Unified Licence. Allocation of numbers, number portability, interconnection with other service providers and roaming to be provided to MVNO by the parent MNO.**

3.57 **There should be no restriction on the number of MVNOs attached to a MNO subject, however, to their being only one MVNO in a revenue district.**

3.58 **An MVNO cannot get attached to more than one MNO in the same service area.**

3.59 **MVNO should pay spectrum charges on its revenue. The applicable slab to MNO will equally be applicable to the MVNO.**

3.60 **For counting the roll out obligations, the MNO can take into account the roll out done by the MVNOs attached to it.**

3.61 **The Licenced Service Area (circle) of MVNO should be same as that of parent MNO. However, the MVNO could offer service anywhere within the licenced service area (circle) of the parent MNO as specified in the mutual agreement between MNO and MVNO.**

3.62 **In case a MVNO attached to a MNO has licence in more than one service area then it will have to have separate agreement for each service area.**

3.63 **The scope of service of MVNO would be within the scope of service of MNO, i.e. the MVNO can offer any or all of the services that the MNO can offer subject to the agreement between MNO and MVNO.**

3.64 **In case of a dispute between MVNO & MNO, the procedure for resolution of dispute would be same as that being followed for disputes between MNOs.**

3.65 **In case MVNO desires to exit the business:**

i. **It shall give six months' notice to subscribers, MNO, Licensor and the TRAI before stopping its services.**
ii. **Consequent upon (i) above, the MNO should offer its services to the subscribers of MVNO to migrate to any of the tariff plan of MNO without any extra charges such as upfront/ activation charges. In the case of lifetime subscribers, they should be offered life time plan of MNO. The subscriber should be allowed to retain the same number.**

3.66 **Responsibility of the Quality of Service to its subscribers would remain with the MVNO. The Regulations/ Direction/ Orders of TRAI in this regard would be binding on MVNO.**

3.67 **MVNO being directly responsible for the tariff related matters, MVNOs should independently comply with the applicable Telecom Tariff Orders (TTOs) and tariff related requirements as prescribed by TRAI.**

3.68 **Facility based MVNOs who set up their own infrastructure have to ensure that the equipment that they use conforms to the prescribed standards.**

3.69 **MVNO should comply with all the requirement of National Security.**

3.70 **MVNO should comply with all the reporting requirements of the licensor and the Authority.**

C- USO and Rural Telephony

3.71 Universal service refers to the idea that basic infrastructure such as electricity, roads, transportation, water, or telecommunication should be available to everyone. In the past, TRAI has made various recommendations to promote universal service in telecommunications in the country. The ubiquitous service was aimed to be achieved through roll out obligations and through use of the Universal Services Obligation Fund (USOF). However, till date, USO schemes have met with limited success. To provide impetus to rural telephony, TRAI issued its recommendations on 'An Approach to Rural Telephony – Suggested Measures for an Accelerated Growth' on 19th March 2009. These recommendations had covered, inter alia, the issue of reorganisation of USOF, management of fund without the need of budgetary process, following bidding process only when necessary, setting up of towers by IP-I/CMTS/UASL for sharing, reduction of USOF levy based on coverage of number of development blocks, provision of subsidy from USOF for laying optical fibre from tower to nearest block headquarter and sorting out delays in Right of Way permissions. These recommendations are yet to be accepted by the Government.

3.72 Taking into account the developments that had taken place since March 2009, the Authority, in its recommendations on "Spectrum management and licensing framework" of May 2010 and 'National Broadband Plan' of December 2010, revisited the issue of penetration of mobile services and broadband in the rural areas. One of the major

shifts stemming out of these recommendations is that the areas in which USO fund need to be utilised will undergo a change.

3.73 In its recommendations of May 2010, the Authority has made the following observations and recommendations:

- The Authority has observed that the present roll out obligations are very lenient and are urban centric. The service providers are mandated to provide coverage only in the district headquarters or major towns. As a result even 15 years after the introduction of mobile service in the country, the rural teledensity is still below 25%.
- Providing telecommunications to the rural areas and bridging the urban-rural divide has been the objective of the Government for long. The Authority would ideally like to see all the villages/habitations with a population of 500 and above to be covered within the next three years. Since earlier efforts in this direction have met with limited success, the Authority would like to adopt a two-fold approach to this challenge. One segment of this approach is to impose a full service obligation on the service providers. The Authority is in favour of imposing an obligation of coverage of Habitations having a population of more than 2000 in a phased manner, as follows:

Time	**Habitation>10000**	**Habitation 5000-10000**	**Habitation 2000-5000**
2 years from effective date	100%	50%	-
3 years from effective date	100%	100%	50%
4 years from effective date	100%	100%	100%

In the above roll out obligations, coverage of 90% or above habitations will be taken as compliance of the obligation.

Table 3.1: Roll out obligations

- In order to ensure that the smaller habitations are also covered, the Authority also recommended that those licencees who have covered 50% of the habitations with a population of 500-2000 be given a reduction of 0.5% in the annual licence fee and those licencees who have covered 100% (90% & above to be treated as 100%) of the habitations with a population of 500-2000 should be given a 2% discount in the annual licence fee.

- On the use of USO fund, the Authority recommended that the Universal Service Obligation Fund be utilised by the Government for provision of telecommunications facilities in habitations having a population of less than 500 and to provide broadband to all the villages having a population of more than 1000 to start with and later extend the same to all habitations having a population of 500 and above.

3.74 In the recommendations on "National Broadband Plan" issued in December 2010, the following were the main points relating to rural coverage:

- The Authority has emphasised that the primary objective of the USO fund should be to lay optical fibre cable from Block Head Quarters (BHQ) to villages so as to fulfill the backhaul bandwidth requirement for provision of broadband and facilitate broadband growth in the rural areas. Accordingly, the Authority recommended for formation of National Optical Fibre Agency (NOFA) and State Optical Fibre Agency (SOFA) and stated that this network would require a fund of Rs.

60,000 Crore, which may be financed by USO Fund and the loan given/ guaranteed by Central Government.

- The issue of 'Right of Way' has been a major constraint in proliferation of optical fibre network in the country, therefore in its recommendations of December, 2010, the Authority has again discussed this issue and has recommended that "the Government may fix and notify the charges for Right of Way in consultation with the State Governments on priority basis and ensure time bound availability of RoW to telecom service providers after due intimation to the agency concern."

- On the issue of local content for the rural areas, the Authority has discussed various applications like e-Health, e-Banking, e-Commerce, e-Education, e-Governance, e-Entertainment etc. which are required to develop and customised for the local needs. On the issue of developing content in local languages the Authority in the same recommendations observed that websites that currently exist in local languages are insufficient to cater to the needs of the users. The content that is available today on the Internet is largely in English and is not customised to local needs. The task is to make this content available in Indian languages. Further, there is also a need for a higher proliferation of vernacular user interface (keyboards, software etc) to facilitate usage of local language content.

3.75 In view of the above two recommendations, the Authority had proposed in the consultation paper that since as per the recent recommendations made through National Broadband Plan 2010, most of the USO fund will be utilised for creation of optical fibre open

access network through NOFA/SOFA, the earlier recommendations related to utilisation of USO funds need to be revisited. Stakeholders' comments were invited on this proposal.

3.76 In response, some of the stakeholders suggested that no action should be taken by the Government on the recommendations on Rural Telephony made on 19th March 2009. They mentioned that service providers should be provided subsidy for providing accessibility and affordable service to the rural areas. Support from USO fund should not be restricted to particular service providers. It should be available to all service providers with compensation to be fixed by predefined norms, which should be suggested by an independent agency. Some of the stakeholders suggested that USO fund should be made mandatory for mobile service providers for creating broadband infrastructure and to ensure connectivity at rural panchayat level. They also opined that USO subsidy support should be open for all participants as against bidding model with limited participations. One of the stakeholders suggested that the OFC connectivity is available up to DHQs and most of SDCAs and therefore, the USOF should be used to give subsidy for linking Block Head Quarters and Gram Panchayats to any service provider who wants to lay OFC beyond SDCAs. Some of the stakeholders suggested that keeping in view the targets set out for National Broadband /rural telephony in remote and far flung areas, the thrust on rural coverage using USO fund should be on last mile access where laying of fibre to Home is not feasible. Adoption of wireless technologies could be a suggested approach which could be implemented in a short span of time and with lesser capital cost in comparison to lying of fibre to home (FTTH). USO scheme should be technology neutral and should include all technology platforms like GSM/ CDMA/ 3G/ BWA/ Wireline/ Satellite/ VSAT/ OFC etc. Some of the stakeholders suggested that to

encourage speedy penetration of mobile services in rural areas, DoT should accept the roll out obligations proposal as recommended by TRAI in May, 2010. DoT should consider 2% reduction in USOF contribution in case a TSP covers 75% of the Block Head Quarters. One of the stakeholder mentioned that DoT had constituted a Committee to examine recommendations of TRAI on "An Approach to Rural telephony –Suggested Measures for an Accelerated Growth" in detail and submitted an action plan. DoT Committee's recommendations should be considered in the formulation of the policy related to telecom infrastructure and be accepted in order to have a optimal utilisation of the USO fund for the rural areas. Some of the stakeholders suggested that TRAI's recommendations of May 2010 on rural rollout obligations are not the most efficient way to meet the objectives of rural coverage as these recommendations place an onerous burden on the economy, consumers and the telecom industry as a whole due to creation of duplicate and redundant telecom infrastructure in the rural areas. Some of the stakeholders supported the recommendations for setting up towers by any IP-I, CMTS, UASL operator, coordination of USOF activities with State Governments & granting permission for RoW within 90 days, on Rural Telephony made by TRAI.

3.77 As indicated above, some of the stakeholders have suggested that no action should be taken by Government on the recommendations on Rural Telephony made on 19th March 2009. Further stakeholders have argued the support of USO for all participants. Some stakeholders have emphasised on provision of OFC connectivity till gram panchayat level. The open access network proposed through TRAI's recommendations on National Broadband Plan of December 2010, meets all these requirements as the optical fibre open access

network will be available till gram panchayat level for all service providers using any kind of access technology or application.

3.78 On the suggestion that USO fund should be used for last mile access using wireless technology instead of costly FTTH, the Authority is of the view that the open access network can not only provide access for wireless technology but open up many possibilities of multiple service creations. In the National Broadband Plan issued in December 2010, the Authority has emphasised that the primary objective of the USO fund should be to lay optical fibre cable from Block Head Quarters (BHQ) to villages so as to fulfill the backhaul bandwidth requirement for provision of broadband and facilitate broadband growth in the rural areas. Since this optical fibre network will be an open access network all operators will be able to use this network for various services. This backhaul can be used for establishing broadband network, connecting mobile towers, provision of media services, e-education, telemedicine and host of other services. On the contrary funding only last mile access without creation of necessary backhaul will limit the multiplier effect of the investment. The optical fibre network can also be utilised for establishing more than 2 lakh Citizen Service Centres (CSC) under NeGP, support or complement State Wide Area Network (SWAN) for delivery of efficient Government services.

3.79 **The Authority recommends that in future, application of USO fund should be restricted to**

i. **Provision of telecommunication facility in habitations having a population of less than 500;**

ii. **To lay optical fibre cable from District to Block head quarters and Block headquarters to villages so as to fulfil the backhaul bandwidth requirement for the provision of**

broadband and facilitate broadband growth in the rural areas;

iii. Any other use, if a commitment has already been agreed upon.

3.80 As discussed earlier, the Authority in its recommendations of March 2009, has recommended the need for restructuring the USOF, its use for giving subsidy for setting up of towers in rural areas, reorganisation of USOF, reduction of USOF levy based on coverage of number of development blocks, provision of subsidy from USOF for laying optical fibre from tower to nearest block headquarter and sorting out delays in Right of way permissions. However, in view of its recent recommendations, restricting the use of USOF for only providing coverage in habitations with a population of less than 500 and laying of optical fibre, the Authority is of the view that some of the recommendations given in March, 2009 need to be revisited by the Government.

3.81 In its recommendations of 19th March, 2009, the Authority had made sixteen (16) recommendations. Out of these, one recommendation relates to the issue of RoW. In this paper, the Authority has revisited the issue of RoW and after analyzing the various legal aspects regarding RoW, it has made its recommendations which are discussed in detail in chapter I under para 1.34, 1.36, 1.39 and 1.40. Ten (10) of the recommendations given earlier in March, 2009 are no longer relevant in view of the recent recommendations on 'National Broadband Plan' of December 2010. The remaining five (5) recommendations which are still relevant are being reiterated.

3.82 TRAI has given its recommendations on "National Broadband Plan" on 8th December 2010. The plan envisages laying of optical fibre from district head quarter to panchayat and villages. A framework has been

prescribed for the participation of the State Governments to facilitate RoW and to provide optical fibre network. In view of this, the following 10 recommendations on rural Telephony made in March 2009 are no longer relevant now:

i. Restructuring of USO fund
ii. Simplification of project identification, determination of financial assistance, project monitoring and implementation
iii. Sharing of USO towers
iv. Incentives through concession in licence fee
v. Provision for Backhaul
vi. Broadband in rural establishments
vii. Coordination with State Governments
viii. Setting up of mobile chargers
ix. Development of Technical skills for rural youth
x. Tie up with Department of Post

3.83 The remaining 5 following earlier recommendations are still relevant:

i. Monitoring of Projects and Disbursements of subsidies
ii. Role of USOF in facilitating Local Contents
iii. Land conversion for setting up tower in rural areas
iv. Power supply to rural BTSs
v. Facilitating VSATs for mobile infrastructure in rural areas

3.84 In order to avoid any ambiguity, the Authority recommends the following set of recommendations on USOF and rural telephony. This supersedes the earlier recommendations on Rural telephony issued in March 2009.

3.85 **In future, application of USO fund should be restricted to**

i. **Provision of telecommunication facility in habitations having a population of less than 500; and**

ii. **To lay optical fibre cable from District to Block head quarters and Block headquarters to villages so as to fulfil the backhaul bandwidth requirement for the provision of broadband and facilitate broadband growth in the rural areas.**

iii. **Any other use, if a commitment has already been agreed upon.**

3.86 **Applications like e-Health, e-Banking, e-Commerce, e-Education, e-Governance, e-Entertainment etc. are required to be developed and customised for the local needs. Websites that currently exist in local languages are insufficient to cater to the needs of the users. The content that is available today on the Internet is largely in English and is not customised to local needs. The task is to make this content available in Indian languages. Further, there is also a need for a higher proliferation of vernacular user interface (keyboards, software etc) to facilitate usage of local language content.**

3.87 **In order to curtail the delay, the Authority recommends that the payments for subsidy claims shall be made in a certain time frame based on the self certifications of the service providers. In case any discrepancy is found after verification, the recovery, if any, shall be made from the service provider.**

3.88 **Development of local content needs to be area specific and should address the local and immediate needs of the people.**

3.89 **The installation of towers and related equipment in rural areas serves the purpose of local population and to some extent business organisations. Hence the requirement for land conversion (around 400 Square metre of land) for setting up tower in rural areas by the telecom service providers should be dispensed with.**

3.90 **State electricity boards should provide power supply to rural BTSs on priority basis.**

3.91 **DoT should review the existing procedure for various approvals regarding VSAT and prescribe strict timelines so as to reduce the delay. It is also recommended that DoT should also simplify the procedures with emphasis on automatic clearances in case of non critical approvals. It is further recommended that the charges for VSATs (except transponder charges) may be borne by USOF initially for a period of three years for all the VSATs installed in rural areas. The TERM cell may be entrusted to certify the eligibility for the exemption.**

CHAPTER IV: SUMMARY OF RECOMMENDATIONS

4.1 Telecom infrastructure should be treated as an essential infrastructure. (Para 1.7)

4.2 Department of Telecommunications should immediately bring the IP-I under Unified Licence. (Para 1.11)

4.3 Telecom infrastructure provider companies should be extended tax benefits under Section 80 IA. (Para 1.13)

4.4 DoT should clarify this position – that the local authority's power in terms of exercising the provisions of the Indian

Telegraph Act, 1885 is limited only to those properties that are vested in or under the control or management of local authority - to all the State Governments for strict compliance by local authorities. (Para 1.34)

4.5 Central Government should appoint Joint Secretary in DoT as the Dispute Resolution Authority for dealing with the cases of refusal of permission or imposition of conditions for granting permission by local authority. (Para 1.36)

4.6 In case of laying of telecommunication cables, the reinstatement charges per kilometer should be as follows. (Para 1.39)

Size	**Reinstatement charges (Per Km in Rs. lakh)**		
Cities with population	Black top/ cement road	Metal road	earthen road
above 1 million	5	3	1
above 1 lakh to 1 million	3	2	0.5
above 10000 to 1 lakh	2	1	0.25
Villages with population			
10000 and below	1	0.75	0.25

For the purpose of population, latest census will be the reference.

4.7 A maximum of forty five (45) days should be prescribed for grant of permission by the local authority for establishing telegraph line/ post/ laying of cable. (Para 1.40)

4.8 TEC in consultation with the standardisation body should develop standards for all types of towers used in telecommunications in a time bound manner. These standards should be made mandatory for all the service providers. Licence conditions should be amended to include that all the towers will conform to the standards developed by TEC. (Para 1.62)

4.9 Camouflaging should be made mandatory in areas of heritage, environmental or architectural importance. (Para 1.68)

4.10 DoT should address all State Governments to direct the Power Distribution companies in the States to provide grid power connectivity on priority for telecom tower sites. (Para 1.70)

4.11 IP-I and telecom service providers may be mandated to share IBS/DAS system deployed in the buildings, complexes or streets. (Para 1.94)

4.12 DoT should advise all ministries to provide, within next one year, IBS/DAS solutions in all Central Government buildings including central PSU buildings, Airports and buildings falling under their jurisdiction & control. (Para 1.95)

4.13 All State Governments should be similarly advised to provide/ mandate, within next one year, IBS/DAS solutions in all buildings including hospitals having more than 100 beds and shopping malls of more than 25000 square feet super built area. (Para 1.96)

4.14 As far as outdoor coverage is concerned, DAS should be mandated for deployment in 63 JNNURM cities within 18 months after completion of optical fibre network in these cities under the National Broadband Plan. (Para 1.98)

4.15 A single window system for providing clearance to the operators intending to establish cable landing station should be established in DoT. The operator desiring to establish cable landing station should submit all the forms required by all concerned ministries to this single window agency and final approval of clearance

should be intimated by the single window agency within six months. (Para 1.106)

4.16 IXPs may be brought under Class licence. Once this recommendation is accepted, detailed terms and conditions of Class licence for IXP services will be provided by TRAI. (Para 2.25)

4.17 Data centres may be permitted to connect directly to the IXPs. (Para 2.25)

4.18 National level ISPs and International Internet bandwidth (IIB) providers may be mandated to connect to all IXPs. (Para 2.25)

4.19 TEC may develop IPv6 standards keeping in view country specific requirements based on global standards. (Para 2.39)

4.20 IPv6 test bed facilities need to be created for simulating and testing products in end to end IPv6 traffic environment. The IPv6 test bed facilities, already available with academic institutions like IITs, IISc should be extended to National Institutes of Technology (NITs) for easy access to stakeholders. (Para 2.39)

4.21 All Government websites should be made IPv6 compliant by 2012. (Para 2.39)

4.22 The present condition of minimum net worth of Rs. 100 crore for an ISP to provide IPTV services should be done away with. (Para 2.49)

4.23 Infrastructure providers should be permitted to install and share active network limited to antenna, feeder cable, Node B, Radio Access Network (RAN) and transmission system, subject to the condition that they are brought under the Unified Licensing regime as recommended by this Authority in May 2010. (Para 3.11)

4.24 Such Unified licencee should also be permitted to possess and maintain wireless telegraphy equipment. (Para 3.11)

4.25 Such Unified licencee should also be assigned spectrum for providing backhaul through microwave system. (Para 3.11)

4.26 Infrastructure sharing should be mandated in locations of heritage, security and environmental importance. (Para 3.22)

4.27 A Unified licencee who does not possess spectrum should be allowed to work as an MVNO in any licenced service area. The Unified licencee ceases to be an MVNO if it is allocated spectrum for accessing the subscribers. (Para 3.33)

4.28 MVNO may be allowed to set up its own infrastructure including MSC, Radio Access Network (RAN)/Base Station Subsystem etc., if required. (Para 3.39)

4.29 Commercial model between MVNO and MNO should be left to mutual agreement between the MVNO and MNO subject, however, to the licence conditions of both MVNO and MNO. (Para 3.39)

4.30 An MVNO should fulfill all the service obligations of the Unified Licence. Allocation of numbers, number portability,

interconnection with other service providers and roaming should be provided to MVNO by the parent MNO. (Para 3.41)

4.31 There should be no restriction on the number of MVNOs attached to a MNO subject, however, to their being only one MVNO in a revenue district. (Para 3.43)

4.32 An MVNO cannot get attached to more than one MNO in the same service area. (Para 3.43)

4.33 MVNO should pay spectrum charges on its revenue. The slab applicable to MNO will equally be applicable to the MVNO. (Para 3.45)

4.34 For complying with its roll out obligations, the MNO can take into account the roll out achieved by its MVNOs. (Para 3.47)

4.35 The Licenced Service Area (circle) of MVNO should be same as that of parent MNO. However, the MVNO could offer service anywhere within the licenced service area (circle) of the parent MNO as specified in the mutual agreement between MNO and MVNO. (Para 3.61)

4.36 In case a MVNO attached to a MNO has licence in more than one service area then it will have to have separate agreement for each service area. (Para 3.62)

4.37 The scope of service of MVNO would be within the scope of service of MNO, i.e. the MVNO can offer any or all of the services that the MNO can offer subject to the agreement between MNO and MVNO. (Para 3.63)

4.38 In case of a dispute between MVNO & MNO, the procedure for resolution of dispute would be same as that being followed for disputes between MNOs. (Para 3.64)

4.39 In case MVNO desires to exit the business:

i. **It shall give six months' notice to subscribers, MNO, Licensor and the TRAI before stopping its services.**
ii. **Consequent upon (i) above, the MNO should offer its services to the subscribers of MVNO to migrate to any of the tariff plan of MNO without any extra charges such as upfront/ activation charges. In the case of lifetime subscribers, they should be offered life time plan of MNO. The subscriber should be allowed to retain the same number.**

(Para 3.65)

4.40 Responsibility of the Quality of Service to its subscribers would remain with the MVNO. The Regulations/ Direction/ Orders of TRAI in this regard would be binding on MVNO. (Para 3.66)

4.41 MVNO being directly responsible for the tariff related matters, MVNOs should independently comply with the applicable Telecom Tariff Orders (TTOs) and tariff related requirements as prescribed by TRAI. (Para 3.67)

4.42 Facility based MVNOs who set up their own infrastructure have to ensure that the equipment that they use conforms to the prescribed standards. (Para 3.68)

4.43 MVNO should comply with all the requirement of National Security. (Para 3.69)

4.44 MVNO should comply with all the reporting requirements of the licensor and the Authority. (Para 3.70)

4.45 In future, application of USO fund should be restricted to

i. **Provision of telecommunication facility in habitations having a population of less than 500;**
ii. **To lay optical fibre cable from District to Block head quarters and Block headquarters to villages so as to fulfill the backhaul bandwidth requirement for the provision of broadband and facilitate broadband growth in the rural areas;**
iii. **Any other use if a commitment has already been agreed upon**

(Para 3.79)

4.46 Applications like e-Health, e-Banking, e-Commerce, e-Education, e-Governance, e-Entertainment etc. are required to be developed and customised for the local needs. Websites that currently exist in local languages are insufficient to cater to the needs of the users. The content that is available today on the Internet is largely in English and is not customised to local needs. The task is to make this content available in Indian languages. Further, there is also a need for a higher proliferation of vernacular user interface (keyboards, software etc) to facilitate usage of local language content. (Para 3.86)

4.47 In order to curtail the delay, the Authority recommends that the payments for subsidy claims shall be made in a certain time

frame based on the self certifications of the service providers. In case any discrepancy is found after verification, the recovery, if any, shall be made from the service provider. (Para 3.87)

4.48 Development of local content needs to be area specific and should address the local and immediate needs of the people. (Para 3.88)

4.49 The installation of towers and related equipment in rural areas serves the purpose of local population and to some extent business organisations. Hence the requirement for land conversion (around 400 Square metre of land) for setting up tower in rural areas by the telecom service providers should be dispensed with. (Para 3.89)

4.50 State electricity boards should provide power supply to rural BTSs on priority basis. (Para 3.90)

4.51 DoT should review the existing procedure for various approvals regarding VSAT and prescribe strict timelines so as to reduce the delay. It is also recommended that DoT should also simplify the procedures with emphasis on automatic clearances in case of non critical approvals. It is further recommended that the charges for VSATs (except transponder charges) may be borne by USOF initially for a period of three years for all the VSATs installed in rural areas. The TERM cell may be entrusted to certify the eligibility for the exemption. (Para 3.91)

Annexure-I

इस अधिसूचना के अधीन प्रदत्त शक्तियां उस सम्पत्ति पर लागू उक्त अधिनियम के उपबंधों द्वारा शासित होंगी जिसके संबंध में संबंधित स्वामी उक्त स्वामी की अनुज्ञा ऐसे लागू हुए ऐसी पूर्वापेक्षाओं के अधीन होंगी जो संबंधित स्वामी अधिरोपित करना ठीक समझे जैसे कि इस प्रकार प्रदत्त शक्तियों के प्रयोग करने के परिणामस्वरूप स्वामी को किसी प्रकार के व्यय का भुगतान करना आवश्यक हो जाए अथवा उक्त शक्तियों के अधीन कृत अनुज्ञप्तिधारी द्वारा किए गए किसी कार्य के लोप के संबंध में अथवा किसी अन्य बात के संबंध में किसी कार्य के निष्पादन के समय के संबंध में लागू की जा पालन किया जाए।

परन्तु यह भी कि जब उक्त उपबंधों के अधीन उक्त अनुज्ञप्तिधारी द्वारा किसी स्वामी की सम्पत्ति के नीचे-ऊपर, उसके साथ-साथ उसके आर-पार, उसमें या उस पर उसके नियंत्रणाधीन या प्रबंधाधीन कोई टेलीफोन लाइन या उसका सम्बन्ध किया गया हो और ऐसा स्वामी उन परिस्थितियों को ध्यान में रखते हुए जिनके अधीन टेलीफोन लाइन अथवा सम्बन्ध इस प्रकार लगाया था इसे हटाने अथवा इसका स्थान-परिवर्तन समीचीन समझता हो तो स्वामी, उक्त अनुज्ञप्तिधारी से इसे हटाने या इसका स्थान बदलने की अपेक्षा कर सकेगा।

4. उक्त अनुज्ञप्तिधारी द्वारा इस अधिसूचना के अधीन प्रदत्त की गई शक्तियां अनुज्ञप्त क्षेत्र के संबंध में सम्यक्तः सुसंगत प्रतिबन्ध का संपूर्ण करने के पश्चात और अन्य आवश्यक औपचारिकताओं को पूरा करने के पश्चात उक्त अनुज्ञप्तिधारी द्वारा भारत के राष्ट्रपति के साथ उक्त अनुज्ञप्ति करार, तथा उक्त संबंधित करार पर हस्ताक्षर करने की तारीख से केवल उसी प्रचालन क्षेत्र विशेष/सेवा क्षेत्र जिसके लिए उसे अनुज्ञप्ति प्रदान किया गया है, पर ही प्रयुक्त होंगी।

5. उक्त अनुज्ञप्तिधारी द्वारा इस अधिसूचना के अधीन प्रदत्त शक्तियों की प्रवर्तनीयता उस सीमा तक निर्बन्धित होगी जिस तक प्रयोजन के लिए उसे अनुज्ञप्ति प्रदान किया गया है और वह ऐसी अन्य शर्तों तथा निर्बन्धनों के अधीन रहते हुए होगा जो केन्द्र सरकार द्वारा समय-समय पर अधिरोपित की जाएं।

6. यह अधिसूचना राजपत्र में प्रकाशन की तारीख से लागू होगी।

स्पष्टीकरण

इस अधिसूचना के प्रयोजनों के लिए "सेवा" से केवल वास्तविक समय में, उक्त अनुज्ञप्तिधारी के पॉइन्टटॉएन (फिक्स्ड स्विच्ड टेलीफोन नेटवर्क) पर आईएनऑएन (एकीकृत सेवा डिजिटल नेटवर्क) की सुविधाओं सहित वॉयस अथवा नॉन-वॉयस संदेशों के प्रेषण और इसमें इनका रास्ता बदला जाने भेजना/रुका जाना तथा पुनः प्रारंभ करने वाले किस्म के संदेशों का प्रेषण तो अथवा केवल वॉयस अथवा नान-वॉयस संदेशों के प्रसारण के लिए स्विच्ड डोटा टेलीफैक्स अथवा मात्र सेवा जैसे वॉयस और नॉन-वॉयस सेवाएं वायस मेल आडियोटेक्स्ट और ई-मेल जैसी मूल्यवर्धित सेवाएं सम्मिलित नहीं हैं।

[सं. 10-2/95-पीएस-II/खंड-IV]

एन. परमेस्वरन्, उप महानिदेशक (सीएस) (संयुक्त सचिव भारत

MINISTRY OF COMMUNICATIONS

(Department of Telecommunications)

Licensing Group (Basic Service Cell)

NOTIFICATION

New Delhi, the 24th May, 1999

S. O. 382(E).—In exercise of the provisions of section 19B, of Part-III of the Indian Telegraph Act, 1885 (13 of 1885) (hereinafter referred to as the said Act), the Central Government, hereby, confers the powers upon duly authorised licensee(s)/private basic telephone service operator(s) under section 4 of the said Act, (hereinafter referred to as the said licensee) to seek way-leave from any person including public authority, public corporation, autonomous body, State Government or Central Government (hereinafter referred to as the "owner" of immovable property) in the respective licensed service area for the following in respect of a property vested in or under the control or management of the owner, in connection with providing the telephone service by the said licensee(s) to its subscribers in the said licensed service area during the currency of its licence, namely :—

(a) to place and maintain telephone lines under, over, along or across and posts in or upon property vested in or under the control or management of concerned owner;

(b) to enter on that property under, over, along, across, in or upon which the line or post has been placed, in order to examine, repair, alter or remove telephone lines or posts established or being maintained by the said licensee(s).

Provided that the said licensee shall :

(i) always comply with the provisions of the said Act or any other law for the time being in force; and

(ii) not exercise the powers conferred under this notification in respect of the said property vested in or under the control or management of the concerned owner, without the express permission of that owner;

(iii) pay full compensation to the aggrieved owners for any damage sustained by them by reason of the exercise of the powers conferred on the said licensee under this notification.

2. The powers conferred under this notification shall be subject to absolute protection or safety of all the underground services including telecom installations of Department of Telecommunication's telephone network from any kind of damage, interference, interruption, disruption or failure of any services thereof.

3. The powers conferred under this notification, shall be governed by the provisions of the said Act, as applicable to that property regarding which the concerned owner may give permission to the said licensee and subject to such reasonable conditions as such owner thinks fit to impose, as to the payment of any expenses to which such owner will necessarily be put in consequence of the exercise of the powers so conferred, or as to the time or mode of execution of any work, or as to any other thing connected with or relating to any work undertaken by the said licensee under the said powers.

Provided that when, under the said provisions, a telephone line or post has been placed by the said licensee under, over, along, across, in or upon the property vested in or under the control or management of an owner not being a local authority, and such owner, having regard to circumstances under which the telephone line or post was so placed, considers it expedient that it should be removed or that its position should be altered, the owner may require the said licensee to remove it or alter its position, as the case may be.

4. The powers conferred under this notification shall be enforceable by the said licensee, only in the particular operational area/service area licensed to him, from the date on which the said licensee signs a licence agreement and interconnect agreement with the President of India after payment of relevant consideration duly fixed and completion of other necessary formalities in respect of the licensed service area.

5. The enforceability of the powers conferred under this notification, by the said licensee, shall be restricted to the extent of his licence for the purpose for which it is granted and subject to any other conditions and restrictions as the Central Government may determine from time to time.

6. This notification shall come into force on the date of its publication in the Official Gazette.

Explanation :— For the purpose of this notification, "service" means transmission of voice or non-voice message inclusive of ISDN (Integrated Service Digital Network) facilities over the said licensee's PSTN (Public Switched Telephon Network) in real time only and does not include, the store and forward/store and retrieve type of message transmissio broadcasting or voice of non-voice message over wire or wireless media, packet switched data, telex or telegraph servic mobile voice and non-voice services, value added services such as voice mail, audio text and E-Mail.

[No. 10-2/95-BS-II/Vol-I

N. PARAMESWARAN, Dy. Director General (B

(In the rank of Jt. Secy

—TRUE COPY—

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Annexure II

Comparison of Guidelines issued by different States and UTs for erecting mobile towers

		Permissions					Applicable Fee			
S. No.	**State/ UT**	**Building permission / Land Use conversion**	**General Conditions ***	**Initial permission for**	**Time frame for erection of tower**	**Time frame for Granting Permission**	**Installation fee**	**Annual fee**	**Monthly fee**	**Other fee**
1.	**Himachal 22.8.2006**	Restricted	1,5,7,8,10, 11,12	5 years	Not mentioned	30days	`20,000 (Maximum) different for urban & Rural areas	`10000	Nil	Extra @60% additional for sharing with each additional operator
2.	**Delhi (MCD) 9.2.2010**	Restricted	1,2,3,4,5, 6,7,8,9,10,1 1,12	Initially for 5 Years	3 months	Not mentioned	`5Lakh	Nil	`25/- per sq. ft minimum of ` 25000/- for municipal building	Additional `1 Lakh per sharing

3.	**Delhi** **(NDMC) 26.7.2002**	Restricted	1,2,3,4,5,6, 7,8,9,10,11, 12,13	10 years	3 months	Not mentioned	`2Lakh		` 25/- per sq. ft minimum of ` 25000/- for municipal building	Additional `1 Lakh per sharing
4.	**Rajasthan**	Restricted	1,7,8,9,13	Not mentioned	Not mentioned	Not mentioned	`1Lakh	Nil	`25/- per sq. ft minimum of `10000/-	Additional `50000 for each sharing
5.	**Haryana** **11-11-2009**	Restricted	1,2,3,4,5,6, 7,8,9,10,11, 12,13	Not mentioned	Not mentioned	Not mentioned	`2Lakh (Maximum) Vary from high potential zone to Low potential zone	10% of the licence fee	nil	Additional ` 1 Lakh for each sharing
6.	**Chandigarh** **4-1-2008**	Restricted	1,2,3,4,5,6, 7,8,9,10,11, 12,13	11 years	Not mentioned	2 months from date of receipt of application	Location and Zone wise, details not mentioned, Penalty `2 Lakh per tower for installing without permission.			
7.	**Greater Noida**	Restricted	1,5,6,7,8,9, 13	3 Years	Not mentioned	Not mentioned	`1Lakh	---	`25000	` 50,000 per sharing

8.	**Andhra Pradesh** **27.2.2008**	Exempted	2,4,5,10	Not mentioned	Not mentioned
9.	**Tamil Nadu** **12.2.2001**	Exempted	--	Initially for 10 Years	Not mentioned

*General conditions:

1. Affidavit from building owner
2. NOC from neighbour,
3. 3rd party Insurance
4. Fire Safety Clearance
5. Indemnity Bond for building damage/ public safety,
6. Affidavit for radiation level,
7. Copy of building sanctioned plan
8. **C**ertificate for structural safety
9. Noise standards for DG sets
10. Clearance from Civil aviation
11. Clearance from Defence
12. Clearance from Pras**a**arBharti
13. Restriction for Heritage building

Annexure- III

Government of India
Ministry of Communications & IT
Department of Telecommunications
Sanchar Bhawan. 20. Ashoka Road. New Delhi - 110 001
(DS-Cell)

No.820-01/2008-DS Dated: 09/04/2008

Subject :- **Report of the Committee set up Group on Telecom & Information Technology Convergence (GOT-IT) for Streamlining the Provision of Right of Way to Telecom Service Licensees.**

Uniform Right of Way(RoW) procedures and streamlined / rationalized RoW cost are crucial for growth of Telecom Services as well as speedy role out of Broadband. It has been decided to circulate the report of the **Committee set up Group on Telecom & Information Technology Convergence (GOT-IT) for Streamlining the Provision of Right of Way to Telecom Service Licensees** to all States and Union Territories. A copy of the report is being enclosed with this letter.

2. It is requested to confirm the compliance of the report within one month of receipt of this letter which will help not only in faster proliferation of Broadband services through out the country but also in achieving Broadband targets defined as per Broadband Policy 2004.

09.04.08

(Subodh Saxena)
Dir.(DS-II)
Tel: 011-23372601
Fax: 011-23359454

To,

The Chief Secretary/Administrator of Sate/Union Territory

STATE GOVERNMENTS

1. Chief Secretary , Andhra Pradesh
   Government of Andhra Pradesh .
   Hyderabad , Andhra Pradesh

MODEL GUIDELINES FOR STREAMLINING THE PROVISION OF RIGHT OF WAY TO TELECOM SERVICE LICENSEES /INFRASTRUCTURE PROVIDERS.

Government has realized the need for creating a robust telecommunication infrastructure with adequate bandwidth at affordable rates in order to promote development and proliferation of Information Technology, Electronic Governance, E-Commerce, convergence of Information, Communication and Entertainment sectors so as to improve the state of economy, enhance the quality of life of the citizens and to ensure development of urban and rural areas with equity throughout the country.

Keeping the above objectives in view, this Committee recommends the following broad guidelines under which Right of Way permissions may be granted to licensed telecom operators and registered infrastructure providers for laying telecom cables/ ducts under, over, along, across, in or upon a property vested in or under the control or management of a local authority or of any other person including public authority, public corporation, autonomous body, State Government or Central Government in their respective licensed service area during the currency of their licence:-

1. Any authorized licensee of Department of Telecom /Registered Infrastructure Provider is eligible to seek/avail Right of Way facility/permission. However, enforceability of the permission so granted shall be restricted to the extent of provisions/scope of service contained /defined in the licence agreement of that licensee & for the purpose for which it is granted.

2. Either by content or by intent, the purpose of extending Right of Way facility is not to enhance the scope of licence of a licensee and such Right of Way permissions are only enabling /facilitating in nature.

3. The facility of right of way for laying underground telecom cables, shall be available to all licensees (irrespective of existing or future) and

registered/ licensed infrastructure providers, without discrimination and without payment of any compensatory charges/ levy/ lease rentals /licence fee/ free band width/revenue share/ cashless equity etc. subject to the condition that this right of way facility shall be available to licensees to the extent of provisions contained in their licence agreements and the reinstatement charges shall be borne by such licensees.

4. A performance bank guarantee @ Rs 25 per route metre with a validity of one year initially (extendable if required till satisfactory completion of work) shall have to be furnished by each licensee as a security against improper filling /unsatisfactory compaction / restoration and damages caused to other underground installations / utility services and interference, interruption, disruption or failure caused thereof to any services. Notwithstanding this, licensee shall be liable to pay full compensation to the aggrieved owners for any damage sustained by them by reason of the exercise of Right of Way facility. However, in case of NH land, instead of furnishing the said bank guarantee, the payment of restoration charges would have to be made in advance by the licensee to the owner i.e. MOST or its designated agency before permission is granted.

5. In order to expedite Right of Way clearances to the licensees in a time-bound manner through an appropriate and effective approval mechanism, a committee under the chairmanship of Chief Secretary to the respective State Governments may act as single window to co-ordinate all activities in this regard. Each State Government may select a Nodal Point/ Secretary of a department to function as Secretary to this Single Window Clearance Committee. However, in case of NH land, licensees would be required to take permission from the Regional officers of MOST stationed at different States for laying of cables. As regards NH routes executed by the State PWD, the concerned State Chief Engineer (NH) may act as nodal

point/ single window to coordinate the activities whereas in respect of the NH routes held by NHAI & BRDB, the designated officers of NHAI & BRDB may be assigned this task.

6. The Right of Way permissions may be granted by the said nodal office to a licensee within a period of two weeks subject to the licensee's application being complete with route details (including authority/ownership of concerned sections of the route) and compliance to eligibility requirement, payment of reinstatement charges, furnishing of requisite bank guarantee and execution of an agreement having operational details. The above stated Single Window Clearance Committee may be responsible to co-ordinate in case of any dispute for ownership of property and to expedite grant of Right of Way clearance thereof so as to adhere to the stipulated time-frame.

7. In case any shifting or alteration in the position of the laid telephone cables is required due to widening of highways and constructing of flyovers or bridges, the licensee shall do the same at his own cost at a later date within specified period indicated by the respective agency.

8. In order to avoid repeated digging on the same routes, if possible, the first incumbent is free to lay voluntarily extra ducts/conduits with extra capacity so as to take care of future needs. The capacity/excess capacity can be commercialized by the incumbent with suitable mutual agreements with the respective State Government /utility agencies. However, the creation of excess capacity by the first incumbent shall not be a pre-condition for giving Right of Way clearances. The Central/ State roadways authorities may consider laying ducts/conduits at the time of construction of roads to facilitate laying telephone cables for which suitable charges could be imposed.

9. Licensee shall ensure safety and security of all underground installations/ utilities/ facilities and shall be solely responsible for compensation/indemnification of concerned authority for damage caused/claims or replacements sought for at the cost and risk of licensee.

10. Licensee shall be liable to give a notice of 15 days with route details prior to trenching for fresh or maintenance/repair works. A separate performance bank guarantee for maintenance/repair works shall be furnished by licensee.

11. The period of validity of Right of Way permission shall be co-terminus with the validity of licence.

LIST OF ACRONYMS

2G	2ND GENERATION
3G	3RD GENERATION
AGR	ADJUSTED GROSS REVENUE
APNIC	ASIA PACIFIC NETWORK INFORMATION CENTRE
ATM	ASYNCHRONOUS TRANSFER MACHINE
BHQ	BLOCK HEAD QUARTER
BIS	BUREAU OF INDIAN STANDARD
BSNL	BHARAT SANCHAR NIGAM LTD.
BSS	BASE STATION SUBSYSTEM
BTS	BASE TRANSCEIVER STATION
BWA	BROADBAND WIRELESS ACCESS
CAGR	COMPOUND ANNUAL GROWTH RATE
CAPEX	CAPITAL EXPENDITURE
CDMA	CODE DIVISION MULTIPLE ACCESS
CLS	CABLE LANDING STATION
CMSP	CELLULAR MOBILE SERVICE PROVIDER
CMTS	CELLULAR MOBILE TELEPHONE SERVICE
CPE	CUSTOMER PREMISES EQUIPMENT
CPRI	CENTRAL POWER RESEARCH INSTITUTE
CSC	COMMON SERVICE CENTRE
DAS	DISTRIBUTED ANTENNAE SYSTEM
DHQ	DISTRICT HEAD QUARTER
DID	DIRECT INWARD DIALING
DIT	DEPARTMENT OF INFORMATION TECHNOLOGY
DLC	DOMESTIC LEASED CIRCUITS
DoT	DEPARTMENT OF TELECOMMUNICATIONS

DSLAM	DIGITAL SUBSCRIBER LINE ACCESS MULTIPLEXER
DWDM	DENSE WAVELENGTH DIVISION MULTIPLEXING
EPABX	ELECTRONIC PRIVATE AUTOMATIC BRANCH EXCHANGE
FR	FRAME RELAY
FTTB	FIBRE TO THE BUILDING/CURB
FTTX	FIBRE TO THE X
GBT	GROUND BASED TOWER
GDP	GROSS DOMESTIC PRODUCT
GMPCS	GLOBAL MOBILE PERSONAL COMMUNICATION BY SATELLITE
GOT-IT	GROUP ON TELECOM AND IT
GSM	GLOBAL STANDARD FOR MOBILE
HLR	HOME LOCATION REGISTER
HSDPA	HIGH SPEED DOWNLOAD PACKET ACCESS
IANA	INTERNET ASSIGNED NUMBERS AUTHORITY
IBS	IN BUILDING SOLUTIONS
ICT	INFORMATION AND COMMUNICATION TECHNOLOGY
IETF	INTERNET ENGINEERING TASK FORCE
IIB	INTERNATIONAL INTERNET BANDWIDTH
IISc	INDIAN INSTITUTE OF SCIENCE
IIT	INDIAN INSTITUTE OF TECHNOLOGY
ILD	INTERNATIONAL LONG DISTANCE
ILDO	INTERNATIONAL LONG DISTANCE OPERATOR
IP	INTERNET PROTOCOL
IP-I	INFRASTRUCTURE PROVIDER CATEGORY-I
IPTV	INTERNET PROTOCOL TELEVISION
IPv4	INTERNET PROTOCOL VERSION 4
IPv6	INTERNET PROTOCOL VERSION 6
ISP	INTERNET SERVICE PROVIDER
IT	INFORMATION TECHNOLOGY

ITES	INFORMATION TECHNOLOGY ENABLED SERVICES
ITU	INTERNATIONAL TELECOMMUNICATION UNION
IXP	INTERNET EXCHANGE POINT
JNNURM	JAWAHAR LAL NEHRU NATIONAL URBAN RENEWABLE MISSION
LAN	LOCAL AREA NETWORK
LBZ	LUTYENS BUNGLOW ZONE
LTE	LONG TERM EVOLUTION
M2M	MACHINE TO MACHINE
MHA	MINISTRY OF HOME AFFAIRS
MIB	MINISTRY OF INFORMATION AND BROADCASTING
MMP	MISSION MODE PROJECT
MNO	MOBILE NETWORK OPERATOR
MSC	MOBILE SWITCHING CENTRE
MVNO	MOBILE VIRTUAL NETWORK OPERATOR
NDPL	NON-DEALER POSSESSION LICENCE
NeGP	NATIONAL e-GOVERNANCE PLAN
NGN	NEXT GENERATION NETWORK
NIR	NATIONAL INTERNET REGISTRY
NIT	NATIONAL INSTITUTE OF TECHNOLOGY
NIXI	NATIONAL INTERNET EXCHANGE OF INDIA
NLD	NATIONAL LONG DISTANCE
NMS	NETWORK MANAGEMENT SYSTEM
NOC	NO OBJECTION CERTIFICATE
NOFA	NATIONAL OPTICAL FIBRE AGENCY
NTP-99	NATIONAL TELECOM POLICY-1999
OECD	ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
OFC	OPTICAL FIBRE CABLE
OPEX	OPERATIONAL EXPENDITURE
OSS	OPERATIONAL SUPPORT SYSTEM

P2M	PERSON TO MACHINE
P2P	PERSON TO PERSON
PDA	PERSONAL DATA ASSISTANCE
PON	PASSIVE OPTICAL NETWORK
PSTN	PUBLIC SWITCH TELEPHONE NETWORK
QoE	QUALITY OF EXPERIENCE
QoS	QUALITY OF SERVICE
RAN	RADIO ACCESS NETWORK
RF	RADIO FREQUENCY
RIO	REFERENCE INTERCONNECT OFFER
RIR	REGIONAL INTERNET REGISTRY
RoW	RIGHT OF WAY
RTT	ROOF TOP TOWERS
RWA	RESIDENTS WELFARE ASSOCIATION
SACFA	STANDING ADVISORY COMMITTEE FOR FREQUENCY ALLOCATION
SDCA	SHORT DISTANCE CHARGING AREA
SERC	STRUCTURAL ENGINEERING RESEARCH CENTRE
SIM	SUBSCRIBER IDENTIFICATION MODULE
SLA	SERVICE LEVEL AGREEMENT
SMP	SIGNIFICANT MARKET POWER
SOFA	STATE OPTICAL FIBRE AGENCY
STD	STANDARD TERMS DETERMINATION
SWAN	STATE WIDE AREA NETWORK
TDM	TIME DIVISION MULTIPLEXING
TEC	TELECOM ENGINEERING CENTRE
TSP	TELECOM SERVICE PROVIDER
UAS	UNIFIED ACCESS SERVICE
UASL	UNIFIED ACCESS SERVICE LICENCEE
UMTS	UNIVERSAL MOBILE TELECOMMUNICATIONS SYSTEM

USOF	UNIVERSAL SERVICE OBLIGATION FUND
UT	UNION TERRITORY
VAS	VALUE ADDED SERVICE
VoIP	VOICE OVER INTERNET PROTOCOL
VSAT	VERY SMALL APERTURE TERMINAL
W-CDMA	WIDEBAND CODE DIVISION MULTIPLE ACCESS
WT	WIRELESS TELEGRAPHY
WIMAX	WORLDWIDE INTEROPERABILITY FOR MICROWAVE ACCESS
WLAN	WIRELESS LOCAL AREA NETWORK