Telecom Regulatory Authority of India

Recommendations

on

Delivering Broadband Quickly: What do we need to do?

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Mahanagar Doorsanchar Bhawan, JawaharLal Nehru Marg
New Delhi-110002

CONTENTS

CHAPTER 1

Introduction

1.0 Delivering Broadband (BB) is one of the great challenges of the early 21st century. Like electricity, a century ago, BB will be the foundation for economic growth, job creation, global competitiveness and a better way of life. It will enable the emergence of new industries while unlocking vast new possibilities for existing ones. It will change how we educate children (and other students), deliver health care, manage energy, evolve public safety, engage Government and access, organize and disseminate knowledge.

1.1 The Hon'ble Prime Minister has announced that the realization of '**Digital India**' is one of the major priorities of the Government. A nationwide BB network can be a veritable game changer for a developing country like India. Such connectivity can help in delivering a wide range of services such as communications, governance, health, education as well as entertainment across India. It can empower people - irrespective of their social status, region, income or gender - to actively participate in the development process. In addition, the massive network will encourage new business opportunities and services including e-commerce and entertainment.

1.2 BB can transform the landscape of India more rapidly and more pervasively than earlier infrastructure networks. Like railroads and highways, BB accelerates the velocity of commerce, reducing the costs of distance. Like electricity it creates a facility/utility which leads to developing better ways to solve old problems. Like telephony and broadcasting, it expands our ability to communicate, inform and entertain. But, as with electricity and the telephone, ubiquitous connections are means, not ends. It is what these connections enable

that matters. BB is a platform to create today's high performance India – an India of universal opportunity and increasing innovation, an India with world leading, BB-enabled healthcare, education, energy, job training, civic engagement, Government performance and public safety. BB is helping to deliver a wide range of services, from services directly related to the Millennium Development Goals set by the United Nations, to services in support of broader citizen participation or services leveraged across different sectors to bring more people into the formal economy.

1.3 As per the **State of the Broadband**[1] report of September 2014, India has a 15 per cent Internet user penetration and is ranked 142nd, way below some of its neighbouring countries like Bhutan and Sri Lanka.

1.4 India simply cannot afford to remain behind. The digital revolution is radically transforming economies and societies. Knowledge economies are the new frontier. They will have a competitive advantage over others. And, this is particularly important in the context of globalization. The real information revolution lies in the growing day-by-day use of Internet enabled devices in all parts of our lives. It is this era of mass connectivity - delivering small, but incremental changes to the ways in which each individual does things - that promises to transform development and welfare.

1.5 Obviously, it is vital to prioritize BB policy and mainstream it into our social and economic development. The policy needs to address both supply and demand aspects of the market. Further, it is crucial to evaluate alternatives available for realizing policy goals. Given budgetary resource constraints, it is imperative to explore how to attract private sector investment (and effort) in this national endeavour.

[1] State of the Broadband Report - 2014 by Broadband Commission, ITU

1.6 National Telecom Policy (NTP) - 2012 has a goal of ***Broadband on Demand*** and envisages leveraging telecom infrastructure to enable all citizens and businesses, both in rural and urban areas, to participate in the Internet and web economy thereby ensuring equitable and inclusive development. It provides the enabling framework for enhancing India's competitiveness in all spheres of the economy. The targets and strategies as envisaged in NTP-2012 are:

Target:

"3. Provide affordable and reliable broadband-on-demand by the year 2015 and to achieve 175 million broadband connections by the year 2017 and 600 million by the year 2020 at minimum 2 Mbps download speed and making available higher speeds of at least 100 Mbps on demand.

5. Provide high speed and high quality broadband access to all village panchayats through a combination of technologies by the year 2014 and progressively to all villages and habitations by 2020."

Further, Point 1.5 of part IV strategies contained in the NTP-2012 states that**:**

"To revise the existing broadband download speed of 256 Kbps to 512 Kbps and subsequently to 2 Mbps by 2015 and higher speeds of at least 100 Mbps thereafter."

1.7 The number of Narrowband and BB connections as on 31st December 2014 are given below in Table 1.1.

Table 1.1 Internet Subscribers as on 31st December 2014

(in Millions)

S.No.	Category	Narrowband	Broadband	Total Internet
1.	Wired	3.54	15.32	18.86
2.	Fixed Wireless	0.04	0.43	0.47
3.	Mobile Wireless	178.08	69.99	248.07
	Total	**181.66**	**85.74**	**267.40**

1.8 Against a target of achieving 175 million BB connections by 2017, only 85.74 million have been achieved and that too with the current download speed definition of 512 kbps. At present, the country is nowhere near meeting the target for a service which is considered almost a basic necessity in many developed countries. There is, therefore, an urgent need to review present policies, the current state of implementation of building infrastructure required for penetration of BB (the means) and the supporting software/apps that will provide the content (the ends).

1.9 A Consultation Paper (CP) was issued on 24th September 2014 to solicit stakeholders' views on actions required to be taken both by the Government and the service providers to accelerate the proliferation and use of BB in the country. The spirit of the CP was that the introduction of BB services in India should not be regarded merely as an exercise in providing connectivity for India's vast populace; it has much larger and wider socio-economic ramifications. The realization of larger goals is contingent on a supporting eco-system. A sustainable ecosystem must address interests of all stakeholders ranging from consumers (services), investors (returns) and Government (governance and strategic interests). There is, therefore, a need for taking a holistic approach and leveraging opportunities provided by wireline and wireless technologies in each part of the network i.e. backbone, backhaul and local access, simultaneously balancing them with supply and demand side concerns. Any disparity in the focus will not deliver the results.

1.10 There is a school of thought which goes by the oft challenged law of markets in classical economics i.e. the French economist J.B Say's Law which states that **'production is the source of demand'** i.e. that supply creates its own demand. The CP highlighted that the almost exclusive focus on infrastructure of BB, to the neglect of other dimensions, was a tacit and fatal assumption of prevailing policy. It is

fundamentally flawed in case of BB services as the presumption that supply will indeed create its own demand fails to take into account the customization of the product for the customer, skill sets of potential customers and the availability of suitable business models for individual customers. BB consumption requires a highly individual-oriented (personalized) approach to content, applications and access. The use of BB can thus be promoted by adoption of a pragmatic approach which takes into account the tastes and preferences of consumers and especially large consumer groups such as teachers, doctors, consultants, other professionals, public sector and private sector, who require a sustainable business model. It is also true that unlike consumption of voice, consumption of digital products require greater degree of skill sets to access and operate such products.

1.11 In response to the CP, TRAI received comments and counter comments from stakeholders. These were placed on the TRAI website www.trai.gov.in. An Open House Discussion (OHD) with stakeholders was organized on 30th October 2014. After analyzing the various issues involved and considering the comments received from stakeholders in their written responses and during the OHD, the Authority has finalized this report. The recommendations contained herein directly focus on (a) specific points of action and (b) policy issues that need review.

1.12 The CP illustrated the BB supply chain consisting of the local access network, backhaul link, national backbone network and international connectivity. It highlighted that the different components of the overall BB network need to be synchronized. Without that, one or other component would act as a critical constraint on the overall ability of the network to deliver the required speed of access. These recommendations directly address interconnectedness in terms of the following:

- **Review various technology related issues pertaining to the BB supply chain and the action required.**
- **Ensure an appropriate institutional framework for infrastructure and content delivery.**
- **Debate various policy related issues which are an impediment to BB penetration and recommend policies which can maximize the impact of BB.**
- **Address regulatory and other measures required to create a conducive ecosystem for BB penetration in the country.**

1.13 Chapter 2 discusses the present status of BB in the country. Chapter 3 covers aspects related to spectrum. Chapter 4 dwells on the initiatives required insofar as infrastructure development is concerned. Chapter 5 covers issues pertaining to utility of BB and promotion of the adoption of BB in the country. Chapter 6 is the conclusion.

CHAPTER 2

Where Are We?

A. Introduction

2.0 BB has no single universally agreed definition. And, realizing the ends BB is supposed to meet is even more difficult as it is a complex mix of technologies, infrastructure, devices and products that brings Internet and data services of varying quality to those connected to the network. Yet, BB is rapidly becoming a critical national utility, recognized as enabling socio-economic development on an unprecedented scale; a tool to bridge the digital divide and key to meet the huge capacity need for new skills of the digital economy.

2.1 Understanding India's unique socio–demographics is a pre-requisite to any analysis of BB adoption in the country. India is a land of vast cultural, religious and lingual diversity with approximately 70 per cent of the population residing in rural areas. The literacy rate in the country is 74 per cent with rural and urban literacy rates being 68.9 per cent and 85 per cent respectively[2]; the rural literacy rate is far lower than the urban. There are approximately 400 spoken vernacular languages of which 22 languages are officially recognized.

2.2 Over the past two decades, India has progressively moved away from a "command and control" economy towards a market-based economy. This market orientation has brought faster growth and a significant increase in per capita income. The country is now far more closely integrated with the global economy; in fact, it is considered one of the pillars of global economic growth. Even so, because of the vast urban-rural divide, inclusive development for all remains a major policy priority of the Government (**Sab Ka Saath, Sab Ka Vikas**).

[2]Census of India Report 2011 (http://censusindia.gov.in)

2.3 As brought out in the CP, the revised definition of BB notified on 18th July 2013 stipulates a minimum download speed of 512 kbps. Figure 2.1 depicts the month-wise BB subscribers after the definition was revised. Figure 2.2 gives a breakdown of Narrowband and BB connectivity.

Figure 2.1 Broadband Growth in India

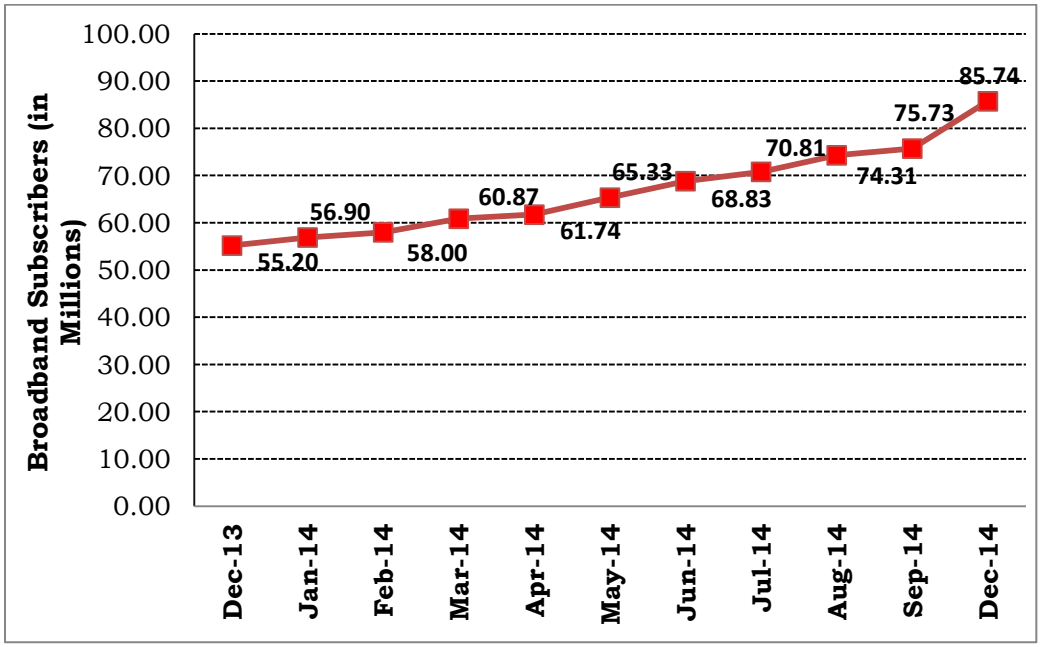
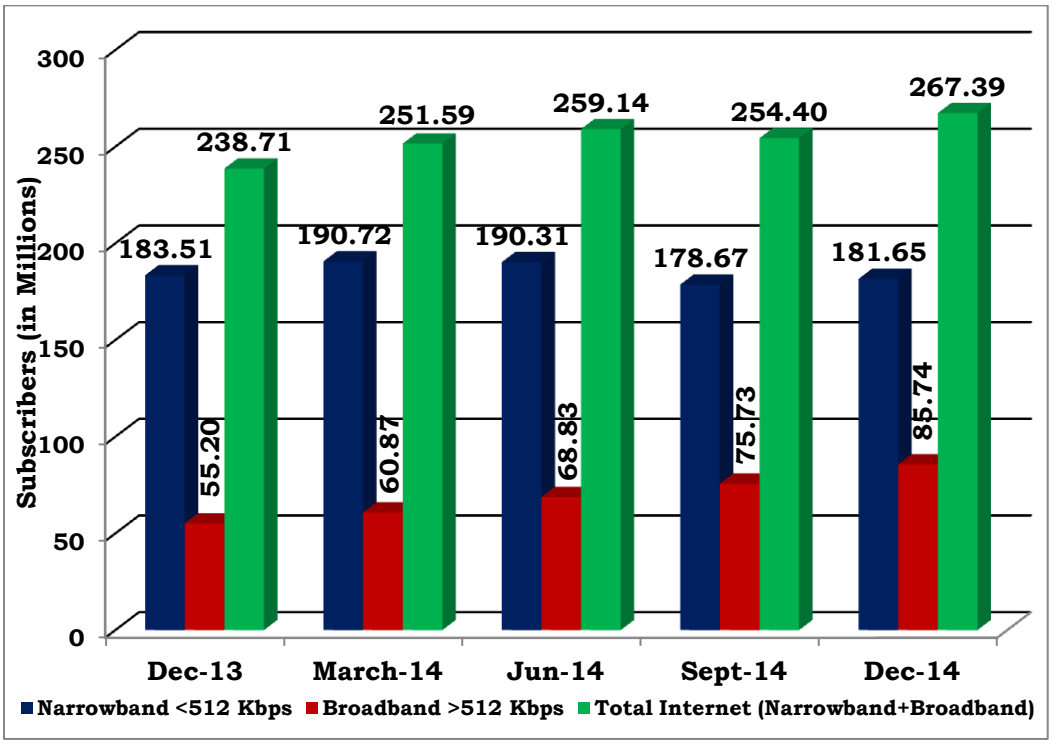
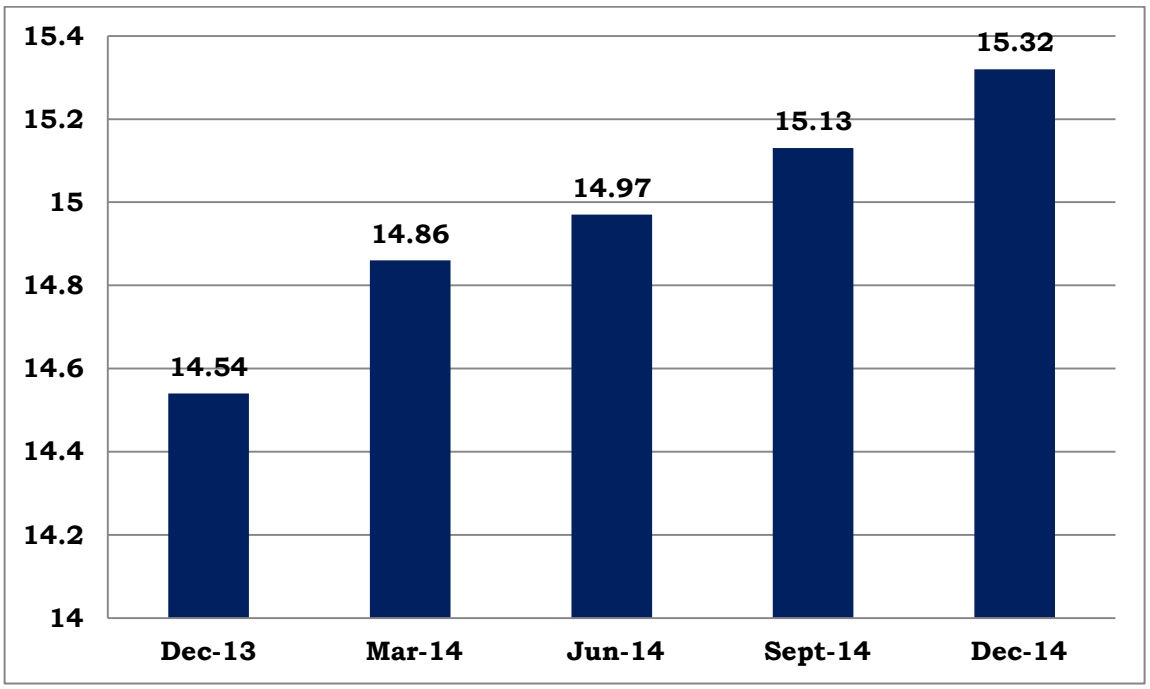


Figure 2.2 Breakdown of Narrowband and Broadband Connectivity



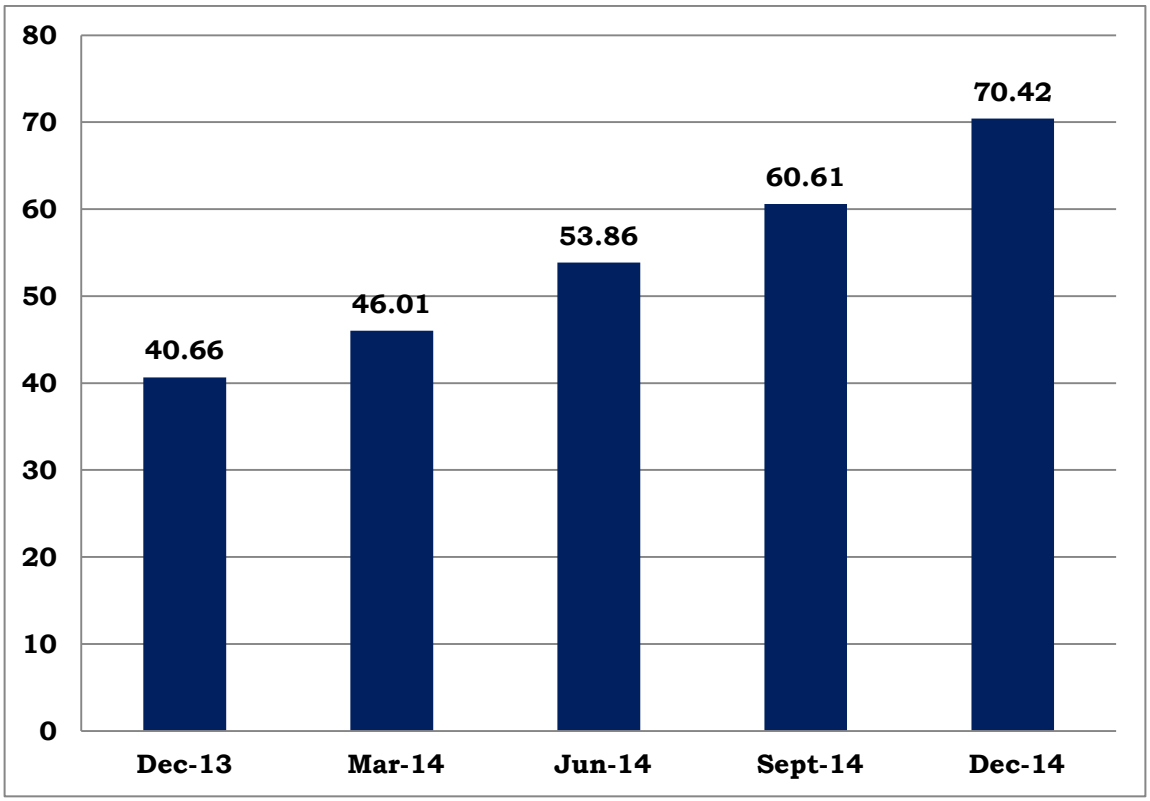
2.4 Wired BB adoption in India has increased steadily (but slowly) over the past two years (see Figure 2.3). At the end of December 2014, there were 15.32 million fixed BB connections. India ranks 125th in the world for fixed BB penetration with only 1.2 per 100 inhabitants having access to fixed BB (see Figure 2.5). With the world average being 9.4 per 100 inhabitants, the country is far below the global average in terms of fixed BB penetration according to the State of Broadband Report of September 2014.

Figure 2.3 Wired Broadband Subscribers (in Millions)



2.5 As for wireless BB, there are a total of 70.42 million connections as of end of December 2014 (see Figure 2.4). This represents a penetration of approximately 7.45 per cent as compared to the estimated 943.97 million mobile connections in India.

Figure 2.4 Wireless Broadband Subscribers (in Millions)



2.6 An ITU report estimated that by the end of 2014, mobile BB subscriptions will exceed fixed BB subscriptions by a ratio of over 3:1. In the case of India this ratio already exceeds 4:1. Since wireline penetration in India is far lower than in most other countries, the ratio ought to have been very much higher. Further, in terms of household penetration within developing countries, India is ranked 75th with a penetration of 13 per cent. In the wireless BB space too, the country's record is not encouraging; India is ranked 113th with a penetration of 3.2 per 100 inhabitants as per the State of Broadband Report of September 2014[3]. In this report use of multiple SIM cards has been factored in.

2.7 The international comparisons in terms of BB penetration (percentage coverage) are shown in Figures 2.5 and 2.6.

[3] State of the Broadband Report - 2014 by Broadband Commission, ITU

Figure 2.5 Wired Broadband Penetration

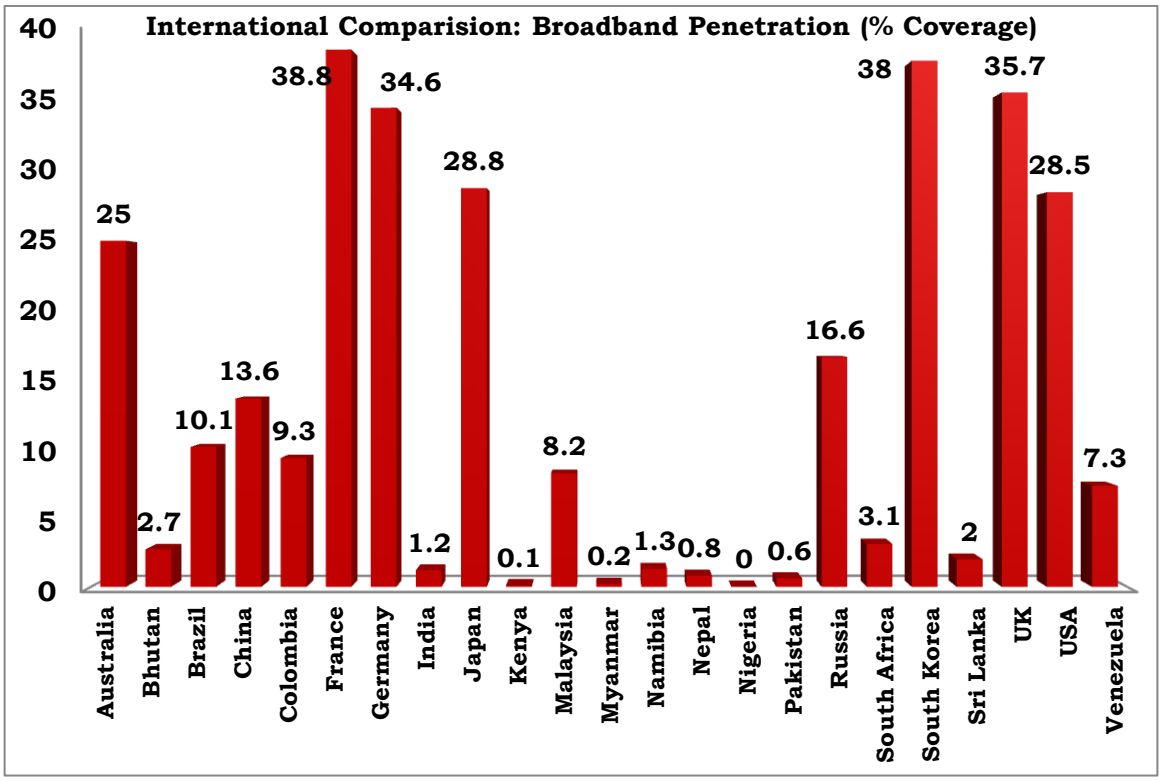
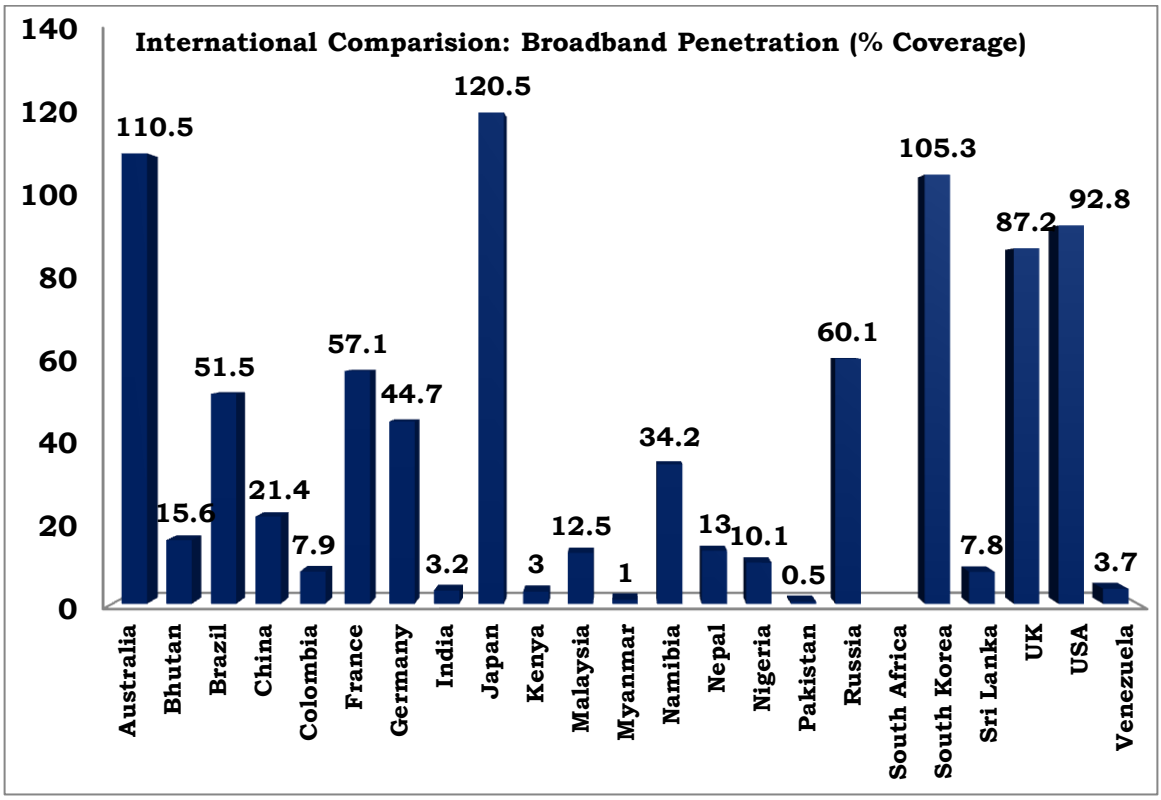


Figure 2.6 Wireless Broadband Penetration



[Source: The State of Broadband 2014: A Report by Broadband Commission]

B. Barriers to BB: Present Status in Indian Context

2.8 BB has been declared a major public policy priority. Hence, all stakeholders in the ICT value chain must be taken into account if the full benefits of BB are to be reaped. A policy focusing solely on either the supply or demand side of the market is unlikely to prove successful. Challenges exist on both supply and demand sides. Moreover, a "One size-fits all" approach is ill-advised.

2.9 Some major supply and demand-side barriers impeding the establishment of a BB ecosystem in India have been identified. These are:

- Slow BB penetration
- Poor BB speed
- Awareness
- Affordability
- Attractiveness (Availability of Relevant Content)

C. Supply Side Constraints

2.10 India, like a number of other developing countries, is a mobile-dominated Internet market. The mobile phone represents one of the biggest technological platforms in history, which has a significant potential to improve the quality of life of the users. Ensuring good-quality BB for all by using this platform holds out immense opportunities for our citizens. However, this will require building a cost-effective physical infrastructure, having flexible and progressive spectrum management policies, developing new business models for delivery of services and making available affordable devices and services for consumers to use. The Government has a critical role to play in creating a stable and appropriate framework for universal BB to succeed, by fostering investment, creating a level-playing field, ensuring sustainable competition and setting a reasonable spectrum policy.

C.1 Slow BB Penetration

2.11 Many resources are required to ensure ubiquitous BB across the country. These include infrastructure (networks, fibre and towers), spectrum for mobile BB, international bandwidth capacity, adequate investment, labour and material resources. Public policies to foster BB should always take into account both sides of the market – namely, supply and demand. According to research by ITU, a good BB plan should comprise[4]:

- Make the case for BB specific to the needs and economic structure of the country, based on thorough contextual market analysis and benchmarking;
- Escape 'Silo Thinking' and apply across a range of different sectors.
- Be engaged in consultation with a broad range of stakeholders. To ensure effective implementation, there should be a coordinating agency responsible for implementing the plan overall, in conjunction with other involved bodies.
- Consider the vital issue of enforceability/execution: Who is responsible for executing the plan? Who will monitor progress? How will implementation be funded?
- Keep in view both demand and supply side considerations. This may mean supporting the development of human skills, literacy and demand among, for example, schools and small and medium enterprises (SMEs), as well as taking into account the role of Government in driving demands.
- Have targets scheduled for a time period of about 3-5 years; targets with longer time horizons are elusive in a fast-changing industry.
- Be broadly technology neutral. Plans should have no major implications in terms of favouring specific technologies.
- Contain detailed measurable goals and strategies to allow evaluation of progress. Plans may also often contain consideration of 'special

[4] ITU/CISCO (2013), "Planning for Progress: Why National Broadband Plans Matter"

interest groups' such as schools, hospitals, universities, diverse languages and access by people with specific needs.

- Address related legislation – e.g. privacy and data protection, security and digital signatures, right of way, interoperability.
- Strike a balance between high-level strategic direction and detail. Plans should allow implementing agencies some flexibility in how they should go about implementation.

C.2 Poor BB Speed

2.12 An international comparison of average BB speed is shown in Figures 2.7 and 2.8.

Figure 2.7 Comparison of Wired Broadband Speed

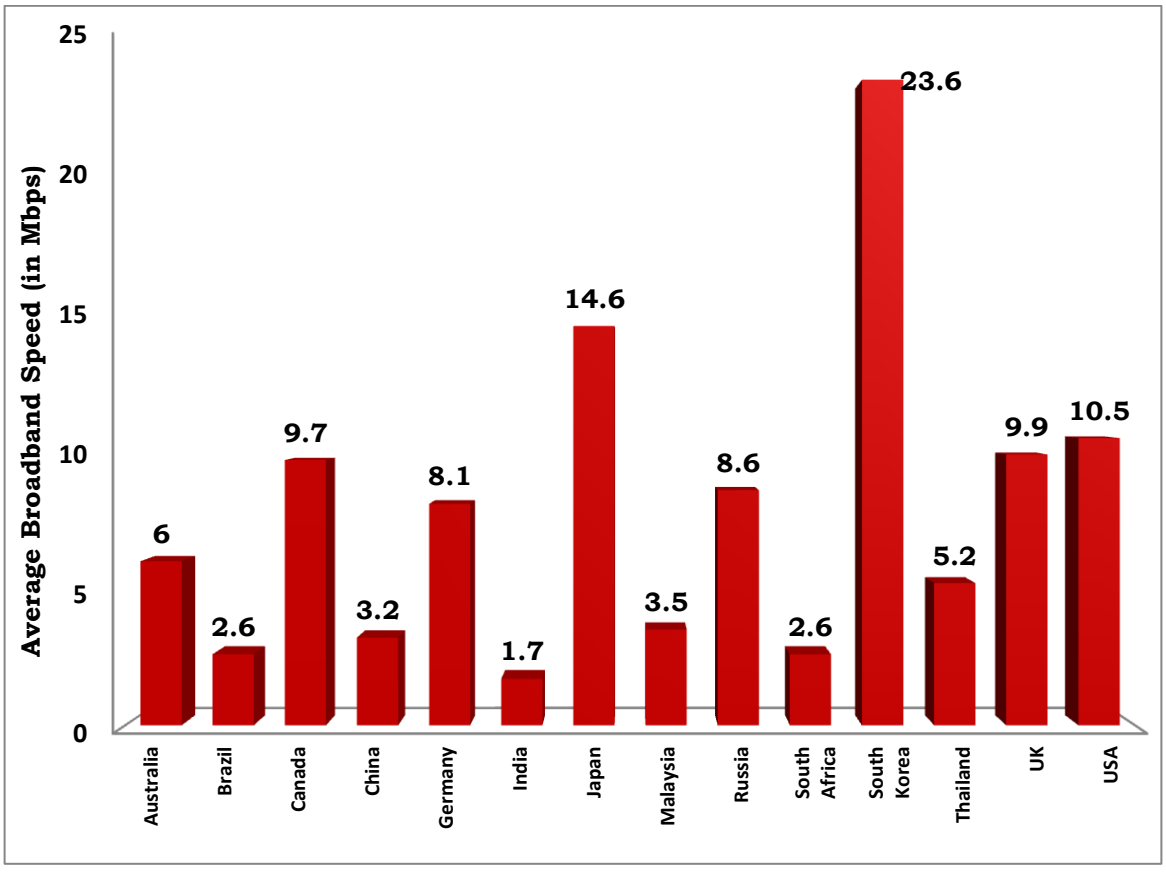
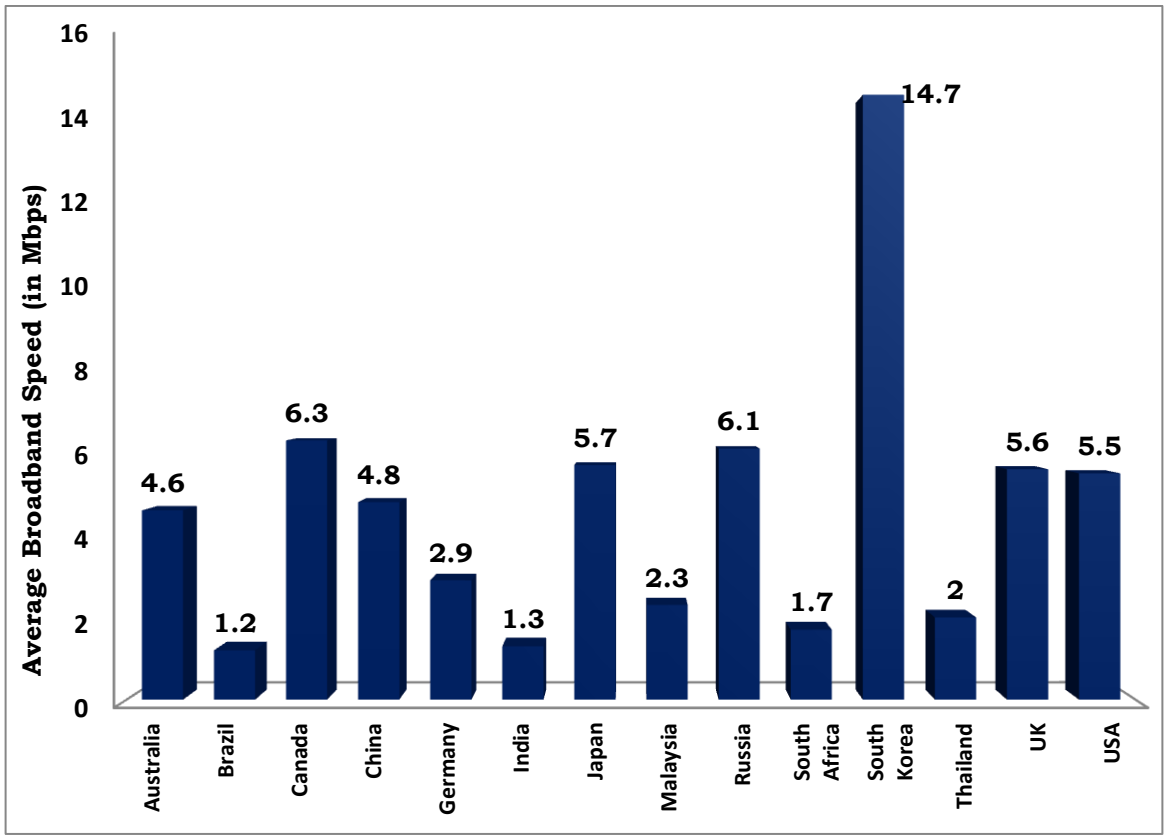


Figure 2.8 Comparison of Wireless Broadband Speed



[Source: Akamai's State of the Internet: Q1 2014 Report]

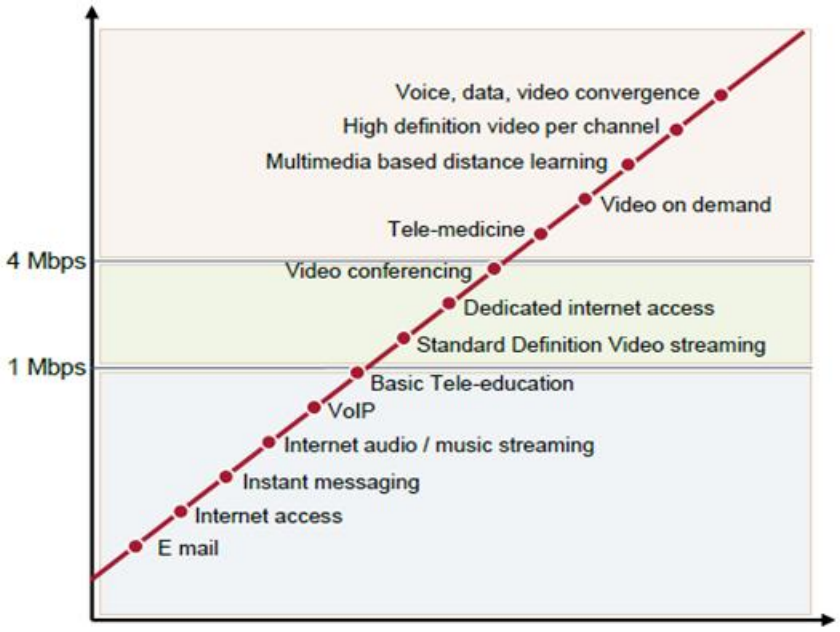
2.13 Speed is one of the key factors which attract potential users to become BB subscribers. Speeds must be above a certain threshold to enable use of desired applications such as video viewing or gaming. A variety of tariff offerings with different speeds provides greater choice to the users. It also expands the size of the subscriber base. A recent study by Ericsson[5] found that doubling of BB speed increases national GDP by nearly 0.3 per cent.

2.14 The ambition to deliver 2 Mbps download speed to users on mobile BB, with speeds of 100 Mbps or more available on demand, has major implications for both network and spectrum requirements. Across all currently available networks in India, the typical average data speed is

[5] "The Socio-economic Effects of Broadband Speed Upgrades" (2013), Ericsson.

as shown in Figures 2.7 and 2.8. How speed directly relates to the user experience can be appreciated from Figure 2.9.

Figure 2.9 Application Evolution and Bandwidth Requirement

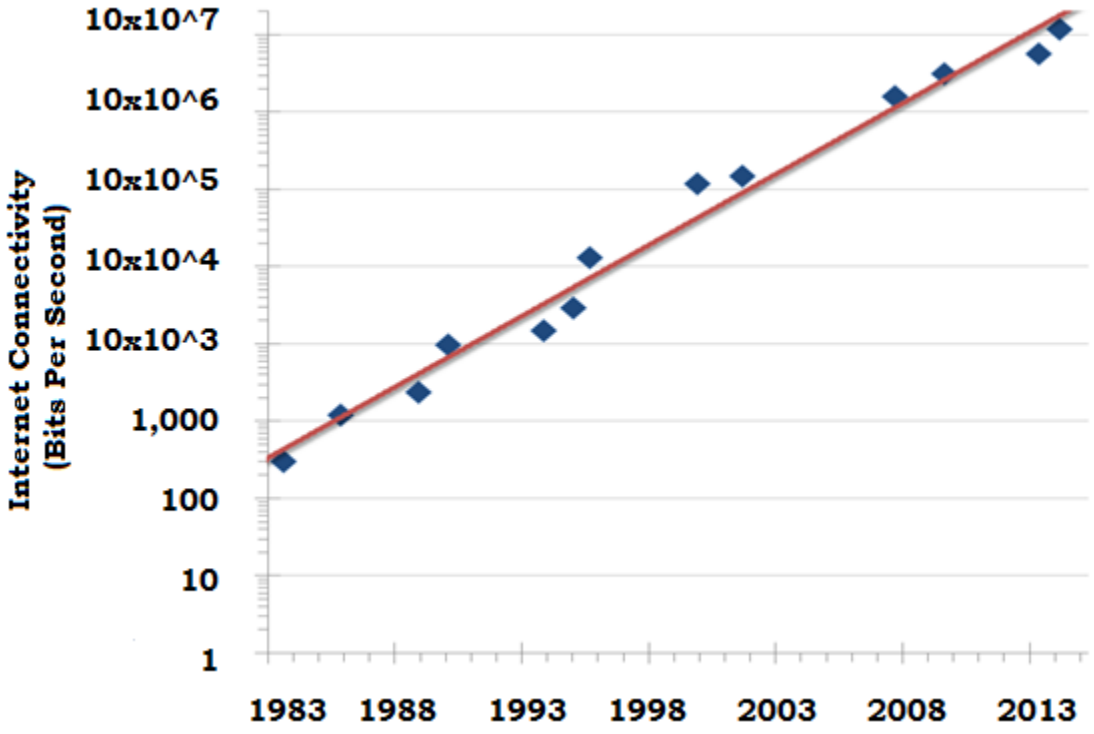


[Source: Analysys Mason, Industry Reports]

C.2.1 The Need for Speed: Nielsen's Law

2.15 Over the past thirty years, Internet connection speeds have steadily increased. Higher speeds have also been driven by the move to higher-resolution displays. On the demand side, the greater use of images and video rather than plain text has also been a driving force. This growth in connection speeds is expected to continue in the foreseeable future. The trend is encapsulated in "Nielsen's law of Internet Bandwidth", an empirical observation which states that a high end user's connection speed grows by 50 percent per year, or doubles every 21 months.

Figure 2.10 Internet Connectivity in Bits Per Second



2.16 Improving and maintaining the quality of user experience will likely be on the top of TSPs' agenda over the coming years. The service providers will also need to invest in their networks to support the expected exponential growth in data traffic. Presently, the increase in average bandwidth consumed is relatively slower for following reasons:

- Telecom companies are conservative.
- Non-availability of adequate spectrum to provide higher data speeds.
- Users are reluctant to spend much money on data usage.
- The user base is getting broader.
- Non-availability of relevant content.

C.3 Access Networks

2.17 There are a myriad of competing technologies which can provide the bandwidth required to deliver BB services. But each technology has its limits in terms of bandwidth, reliability, cost or coverage. Optical fibre offers almost limitless bandwidth capabilities, has excellent reliability

and is becoming increasingly comparatively economical to install. Consequently, fibre seems to be unsurpassed in its superiority over other BB technologies. However, many competitive copper and wireless technologies are also developing at a significant pace and some technologies have so far managed to continually meet the ever increasing bandwidth requirements of the consumer.

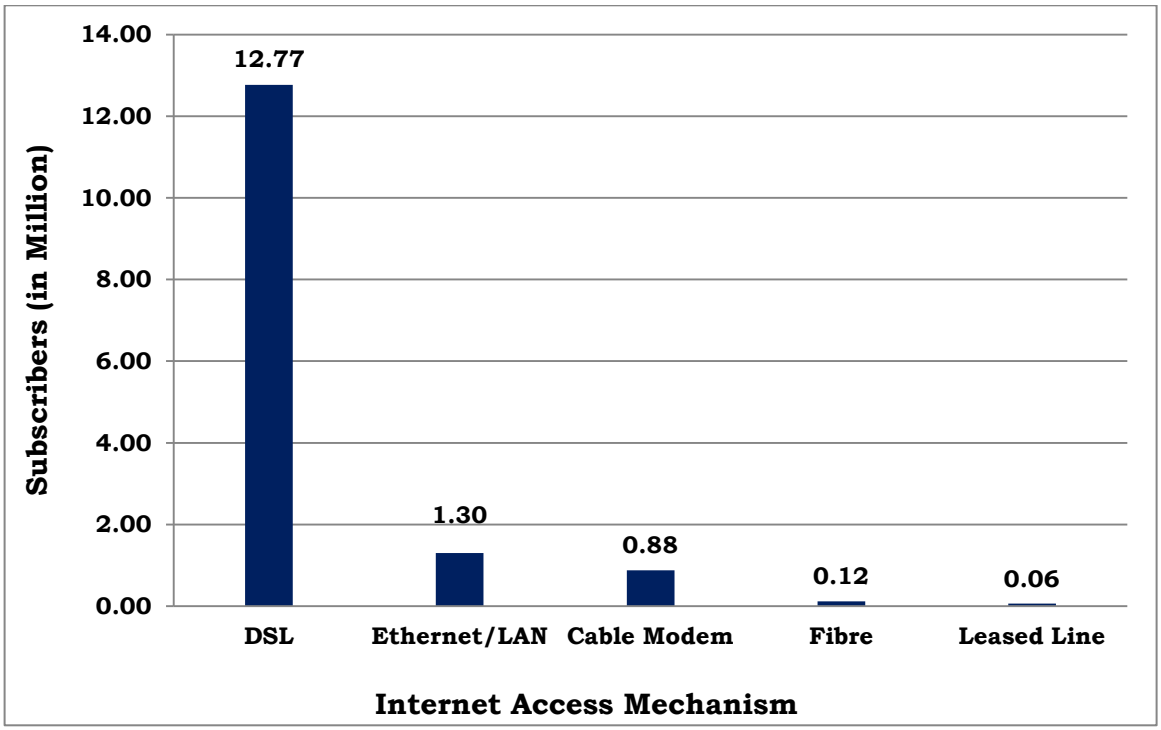
2.18 As discussed in the CP the general access BB solutions can be classified into two broad groups: Wireline technologies and Wireless technologies. Wireline solutions communicate via a physical network that provides a direct "wired" connection from the customer to the service provider. Wireless solutions use radio or microwave frequencies to provide a connection between a customer and the TSPs' network.

C.3.1 Wireline Access

2.19 Wireline BB technologies rely on a direct physical connection to the subscriber's residence or office. Many BB technologies such as cable modem, xDSL (Digital Subscriber Line) and BB powerline have evolved to use an existing form of subscriber connection as the medium for carrying BB. Presently, xDSL is the predominant technology being used in the country to provide wired BB. The total number of Digital Subscriber Lines (DSL) may have peaked; there is the risk that it is now on the decline. It remains to be seen how the most recent developments in VDSL2 (Very-high-bit-rate Digital Subscriber Line) vectoring and new G.fast standards (ITU G series standard) will impact wired BB. These hold out the potential for vastly augmenting speeds on DSL connections. Cable modem systems use existing hybrid fibre - coaxial cable TV networks, while xDSL systems use the twisted copper pair traditionally used for voice services by the POTS. BB powerline technology uses the powerlines feeding into a subscriber's home to carry BB signals. In general, all three aforementioned technologies strive to reach BB to consumers with minimal capital expenditure but

recurring operating expenses. A breakdown of wired BB connections in terms of various technologies is shown in Figure 2.11.

Figure 2.11 Breakdown of Wired Broadband Connections in Terms of Various Technologies in India



2.20 In contrast, Fibre to the Home (FTTH) or Fibre to the curb (FTTC) networks require installation of a new fibre link from the local exchange (central office) directly to or closer to the subscriber. Even though fibre is known to offer the ultimate in BB bandwidth capability and is not very expensive, installation costs of such networks (cost of fibre and Right of Way (RoW)) have, up till recently, been prohibitively high.

2.21 In the CP, stakeholders were requested to give their views on immediate measures required to promote wireline technologies in access networks. The consultation process identified the problem areas for wireline access:

- RoW charges were identified as the single biggest impediment to the adoption of wireline technologies for access networks. What is more, the levies are arbitrary and at times exorbitant. There are wide variations across various municipal corporations in cities and States. Charging mechanisms and rates of RoW fees vary enormously; but, the unifying theme is that the rates are way too high, often in multiples of 10 or more times the value of the fibre being laid. The time taken to obtain RoW clearance is excessive. Further, un-coordinated development activities such as road expansion, laying of electrical cables etc. that are undertaken by multiple agencies and private contractors, results in frequent cuts in cable, leading to depreciated life of the cable and increase in operating costs for the TSPs.
- In case of copper access, which is largely deployed by the PSUs, the quality of cable has deteriorated over time. Due to the exponential growth of mobile phones and declining landline connections, the PSUs have stopped investing in new cables. Moreover, distance is a huge limiting factor in providing fast bandwidth on copper cables.
- In case of an FTTH/FTTC network, high capital investment is required. This investment can vary considerably depending on the geography being served. Sparsely populated rural areas are the most expensive to connect because of the long distances to homes. Urban settlements are more densely populated, but pose construction challenges and expenditure in terms of high RoW charges.
- In the case of cable modem service, upgradation of the networks is required. The growth of cable TV networks in the country has been unstructured and haphazard. The quality of cables installed varies significantly. A snapshot of the cable TV sector is at **Annexure 'I'**. In small cities and towns, cable service providers have very good presence; their coaxial cable reaches all subscriber households of

the city/town. 99 million households have cable TV connections. Clearly, there is a need to harness the cable network for quickly providing BB connections; at minimal investment it will be possible to upgrade the network and provide BB to 169 million households which is the total number of households having TV sets. However, these cable operators are generally local entrepreneurs who do not want to acquire an ISP license to provide Internet services. Even large cable operators/MSOs do not want to enter the business as they would then have to pay 8 per cent License Fee on their AGR (Adjusted Gross Revenue).

- Cable TV operations do not require skilled manpower to deliver TV services at the customer premises. However, for delivering BB, high quality cable connection and skilled manpower is required. Another problem is the widespread use of amplifiers to increase signal strength which, in turn, increases the noise level in the Cable television (CATV) signal. In case of a CATV signal this can be removed by a rectifier, but in the case of BB delivery, special amplifiers which can amplify signal in both directions and improve the signal quality are required. Finally, in case BB has to be provided through the cable network, cable operators will need to acquire the ISP license. For this, they will also have to meet the associated license conditions including rollout and connectivity to LEAs (Law Enforcement Agencies) to meet the provisions of Lawful Interception and Monitoring (LIM).

C.3.2 Wireless Access

2.22 Wireless BB refers to technologies that use point-to-point or point-to-multipoint radio or microwave frequencies to transmit signals between hub sites and an end-user receiver. At the network level, they are suitable for both access and backbone infrastructure. However, proliferation of wireless BB has taken place in the access network. As a consequence, the terms “Wireless BB” and “Wireless

BB Access" are used interchangeably. The immense success of cellular telephone service attests to the attractiveness of wireless technologies as a last mile solution.

2.23 The use of wireless BB is growing rapidly, primarily in areas where mobile connectivity exists. Key drivers include the maturation of third generation (3G) wireless network services, the development of affordable smart phones and other mobile computing devices, the emergence of new classes of connected devices and the rollout of fourth-generation (4G) wireless technologies such as Long Term Evolution (LTE).

2.24 The consultation process identified the following problem areas for wireless access:

(i) The lack of availability of a sufficient quantum of globally harmonized spectrum in contiguous form is the biggest impediment to the deployment of wireless technologies in the access network. The present allocation of spectrum for access networks is shown in Table 2.1. Interlinked is the absence of a predictable short and long term spectrum roadmap. The high costs of spectrum, both upfront as well as a recurring, leads to a huge requirement of funds. Added to this is the delay in notification of spectrum trading and spectrum sharing guidelines. A comparison of average spectrum held by service providers in India vis-à-vis international TSPs is given in Figure 2.12.

(ii) Another major reason for the poor quality of wireless BB is non-availability of adequate bandwidth in the backhaul. For 3G and 4G networks, in the absence of adequate fibre, availability of sufficient quantum of backhaul spectrum is a prerequisite. However, despite the availability of sufficient quantity of Microwave (MW) carriers, the assignment of

backhaul spectrum by the Wireless Planning Coordination (WPC) to the TSPs has been poor and, that too, with considerable delay. The present allocation of backhaul spectrum is shown in Table 2.2.

(iii) Delays in obtaining import licenses and operating licenses from WPC. There is also no openness and transparency in the functioning of the WPC wing of DoT and details of spectrum allocation are simply not made available by them.

(iv) Spectrum trading and sharing are of utmost importance to ensure optimal utilization of the available spectrum. After holding extensive consultations with industry, the Authority had forwarded its recommendations to the DoT on these two important issues on 28 January 2014 and 21 July 2014 respectively. Even after the elapse of more than a year, the Government's decision on these key guidelines is awaited.

(v) Lack of backhaul transmission facilities like xPON (Passive Optical Network), xWDM (Wavelength Division Multiplexing) etc.

(vi) High RoW costs for establishing wireless access PoP (Point of Presence) and backhaul facilities.

(vii) Complex and time consuming process of Standing Advisory Committee on Frequency Allocation (SACFA) approvals.

(viii) Restrictions imposed by State Governments and Municipalities for wireless sites for erecting towers in non-commercial areas.

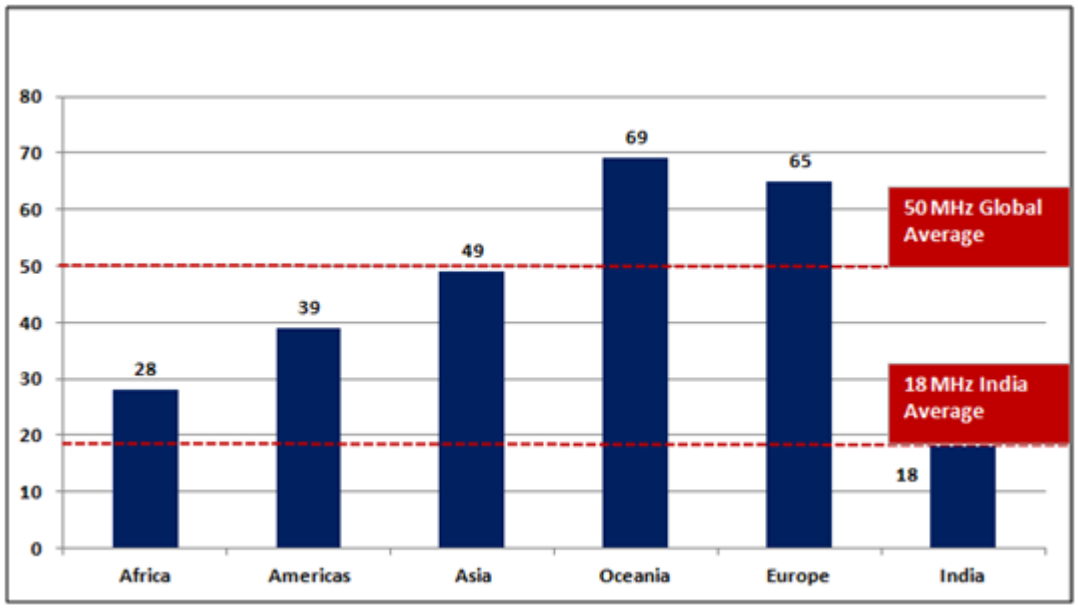
(ix) Customs Duty on equipment.

(x) Non-availability of power connections.

(xi) Inadequate implementation of indoor connectivity solutions.

(xii) Auction in 700 MHz band needs to be undertaken once the ecosystem is fully developed.

Figure 2.12 Global Average of Spectrum (in MHz) per Operator



Bands considered for calculation:

- 700 MHz
- 800 MHz
- 900 MHz
- 1800 MHz
- AWS/1900 MHz
- 2100 MHz
- 2300 MHz
- 2500 MHz

[Source: Qualcomm's submission to TRAI's Consultation Paper on Broadband, October 2014]

Table 2.1 Allocation of Spectrum for Access Networks

S. No.	Spectrum Band	Earmarked/Assigned for commercial telecom services	Assignment for other agencies (Defence, State Police, Public Sector Undertakings, Railways, DoS for satellite networks)	Remarks
1	450-470 MHz	NIL (0 %)	20 MHz for Defence, PSUs and others (100 %)	
2	698-806 MHz	NIL (0 %)	15 + 15 MHz for Defence (33.33 %)	Balance 2x30 MHz will be available for assignment for commercial use.
3	824-844 MHz/ 869-889 MHz	40 MHz (2x20 MHz) (100%)	NIL	
4	890-915 MHz/ 935-960 MHz	Approx. 2x20 MHz (2x18.6 MHz to 2x22.2 MHz) (80 %)	1.6 + 1.6 MHz for railways; 1.2 to 4.8 MHz for defence (20 %)	
5	1710-1785 MHz/ 1805-1880 MHz	110 MHz (2x55 MHz) (73.33 %)	20 + 20 MHz for Defence (26.67 %)	
6	1920-1980 MHz/ 2110-2170 MHz	50 MHz (2x25 MHz) (41.67 %)	2x35 MHz for Defence (58.33 %)	Defence is likely to vacate additional 3 slots of 2x5 MHz for commercial use.
7	2300-2400 MHz	60 MHz (60 %)	20 MHz for Defence 20 MHz for Guard band requirements. (40 %)	
8	2500-2690 MHz	40 MHz (21.05 %)	150 MHz with DoS for satellite networks. (78.95 %)	
9	3300-3400 MHz	100 MHz assigned to ISPs (100 %)	NIL (0 %)	
10	3400-3600 MHz	NIL (0 %)	200 MHz with DoS for satellite networks. (100 %)	
	1078 MHz (Total available Spectrum)	**440 MHz (40.82%)**	**638 MHz (59.18%)**	

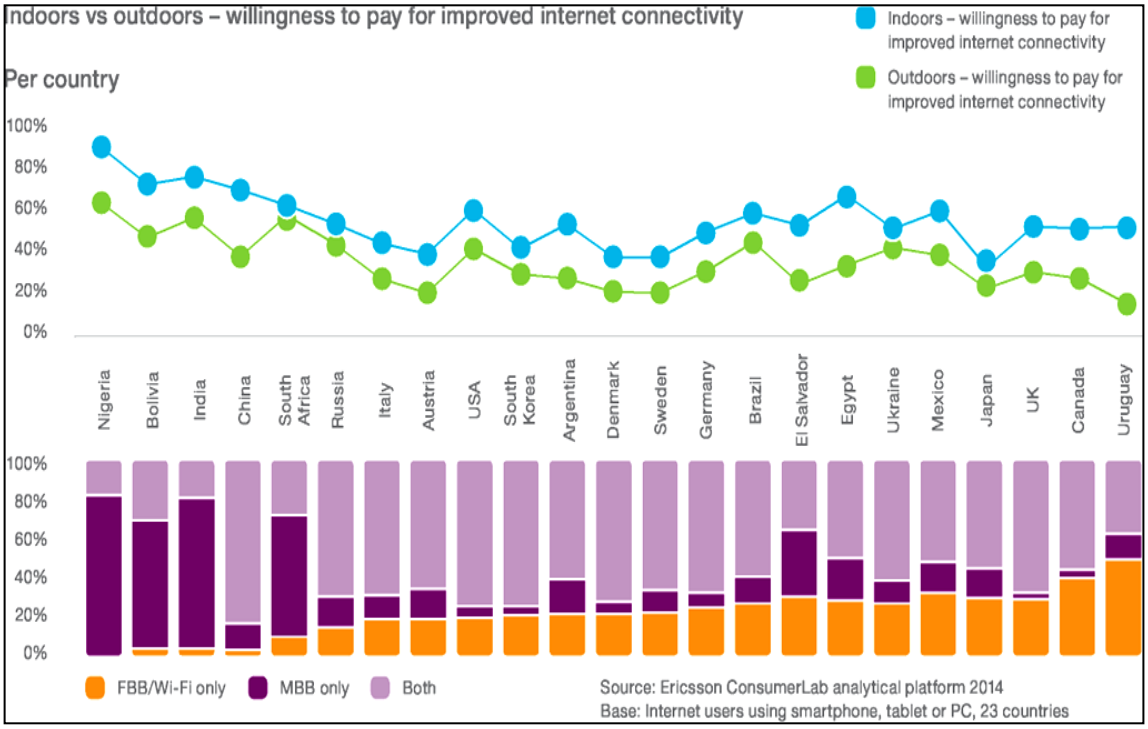
Table 2.2 Allocation of Spectrum for Backhaul Networks

S. No.	Service Area	Availability status of MW Access carriers		
		13/15/18/21 GHz Bands		
		Total number of carriers available	Total allotted carriers	Balance available carriers
1	Delhi	95	41	54
2	Mumbai	95	52	43
3	Kolkata	95	41	54
4	Maharashtra	95	43	52
5	Gujarat	95	41	54
6	A.P.	95	39	56
7	Karnataka	95	41	54
8	Tamil Nadu	95	41	54
9	Kerala	95	35	60
10	Punjab	95	36	59
11	Haryana	95	33	62
12	UP(West)	95	37	58
13	UP(East)	95	37	58
14	Rajasthan	95	37	58
15	M.P.	95	31	64
16	West Bengal	95	30	65
17	H.P.	95	34	61
18	Bihar	95	36	59
19	Orissa	95	30	65
20	Assam	95	32	63
21	North East	95	32	63
22	J&K	95	31	64
	Total	**2090**	**810**	**1280**

2.25 Most consumers access online services when indoors but usage levels depend on age or type of service. Consumers who use Internet services both indoors and outdoors show a higher interest in improving their indoor connectivity when performing a range of online activities. After carrying out a study of 23 countries, Ericsson's mobility report of November 2014 concluded that there is a greater willingness to spend more on improving indoor connectivity compared to outdoor connectivity. The fact that Indian consumers are willing to pay for

improved connectivity clearly reflects the poor indoor connectivity currently being experienced.

Figure 2.13 Indoors Vs Outdoors - Willingness to Pay for Improved Internet connectivity



[Source: Ericsson Consumer Lab analytical platform 2014]

2.26 Wi-Fi technology which uses unlicensed spectrum is one of the major sources for providing BB in commercial establishments and large public places like hotels, malls, airports, railway stations etc. Wi-Fi hotspots help in offloading BB traffic from the cellular networks using licensed spectrum to the unlicensed spectrum. It can enable telecom operators to handle the huge quantity of data traffic that mobile Internet access generates without making massive investments in their own infrastructure. Telecom operators find it less costly to offload traffic to bands reserved for unlicensed use than to build more towers and/or increase the number of cells in their networks. Due to its affordability, scalability and versatility, its popularity has spread to urban as well as rural areas. As part of 'Digital India' initiative, there are plans to create Wi-Fi hotspots in metros/tourist spots across the country. Wi-Fi

services have also recently been introduced at selected railway stations. Suitable business models are still to be firmed up which will enable provision of Wi-Fi services. However, compared to other countries, in India, the quantum of spectrum which has been unlicensed is considerably low. Table 3.4 gives a bird's eye-view of unlicensed spectrum in some countries.

C.3.3 Satellite Access

2.27 Many modern BB applications (such as multimedia video conferencing and software distribution) are based on distributing information to many sites located over a vast geographical area. Satellites are well-suited for delivering these services, as they allow service provisioning over a large geographical footprint, can deliver many services simultaneously and solve the expensive 'last mile' issue. Satellite communication can also be used in conjunction with or as a complement to terrestrial infrastructure to enable complete BB coverage. In India, Satellite technology is specially suited for far flung and difficult terrain areas like North Eastern States, Leh, Ladakh, Andaman & Nicobar Islands, Lakshadweep etc.

2.28 The Indian satellite industry comprises Satellite Service Operators (SSO), Very Small Aperture Terminal (VSAT) service providers, the satellite equipment vendors, the Direct-to-Home (DTH) providers, the Regulator and the Licensor.

2.29 Indian Space Research Organization (ISRO) provides most of the satellite communication transponders in our country. As per the Satellite Communication Policy of 1997, if an Internet Service Provider (ISP) or DTH provider wants capacity from a satellite, it approaches ISRO and its commercial arm, ANTRIX, to provide the capacity. Users can approach a foreign SSO only if ISRO cannot provide the capacity. ISRO hardly provides No Objection Certificate (NOC) to ISP or DTH

providers to acquire capacity directly from a satellite. This process, beset as it is with cumbersome bureaucratic procedures and long delays, has led to a huge shortage of satellite capacity and has slowed down introduction of new services.

2.30 In the case of VSAT services, the BB market is divided into four parts i.e. capacity for rural mobile backhauling, capacity for enterprise applications in non-fibre and microwave sites (such as for remote ATMs), capacity for rural e-Government applications and, finally, for consumer connectivity. According to one of the stakeholders, the C-band and Ku-band prices are in the range of US $ 2800-3500 per MHz per month. The Ka-band which is yet to be licensed in India is priced lower, at less than US $ 1000 per MHz per month.

2.31 DTH and VSAT operators have brought to the notice of the Authority that there are constraints in the space segment capacity because of which they are unable to meet their obligations to their customers. As a result, a number of projects including rural connectivity projects are at a stand-still. They further pointed out that the procurement of satellite capacity on foreign satellites through Department of Space (DoS) often results in long delays and increase in prices due to some process flaws. The Authority brought the concerns of these operators to DoS and requested them to consider permitting these operators to directly negotiate with the foreign satellite operators for arranging satellite capacity. This will not only address the concerns of VSAT and DTH operators, they will be able to serve their customers timely and in cost effective manner which is vital for the growth of VSAT and DTH industry. This will also have positive effect on revenue generation for the industry and, in turn, for the Government.

2.32 Satellites already deliver a Zetabyte of data a year (one thousand billion Gigabytes) to users over the globe, on land, in the air and at sea. It is vitally important to understand the crucial role of satellites in enabling

future capabilities. Initiatives required to exploit the potential of satellite communications in India and the requirement of an 'Open Sky' policy are covered in Chapter 4.

C.4 Infrastructure Issues

2.33 The infrastructure required for BB networks include tangible assets (e.g. towers, OFC, ducts, copper lines) and intangible assets (e.g. spectrum, international bandwidth etc). Access to these assets is vital for TSPs irrespective of whether they are in the private or public sectors. The issues pertaining to the following infrastructure elements, all of which are key components in meeting the requirements of BB infrastructure, are discussed in the succeeding paragraphs

- Towers
- Optical Fibre Cable

C.4.1 Towers:

2.34 As of the end of December 2014, there are 9-13 TSPs in each service area catering to around 943.97 million wireless subscribers. Additionally some TSPs are in the process of rolling out 4G (LTE) networks. As telecom towers are an integral part of the wireless telecom infrastructure, the number of towers will have to increase with network expansion. Currently, there are around 5,85,000 towers; and, it is estimated that approximately 1,00,000 more towers will be required by 2017.

2.35 Several concerns have been raised about aesthetics and health issues arising from radiation hazards and the safety of telecom towers, especially in Metro and urban areas. There are also environmental concerns. The use of power generators (to address the lack of un-interrupted power supply) adds to polluting emissions. For all these reasons, civic authorities have imposed stringent conditions on the 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 the grant of permission. Moreover, there has been a multifold increase in the levies for the grant of permission. The Government has recently ordered a study by 16 leading scientific institutions across the country on the effects of electromagnetic fields (EMF), particularly radiating from cell phone towers, on human health.

C.4.2 Optical Fibre Cable:

2.36 The issue of clearances for infrastructure deployment from local authorities and RoW has been a major constraint in the proliferation of OFC networks in the country. In the absence of uniform, clear and enforceable guidelines for various processes such as RoW and civic clearances, different State Governments have adopted varying rules, criteria, costs and timeframes; this has resulted in burgeoning costs, huge effort and inordinate delays for TSPs. Issues pertaining to RoW permissions are summarized below:

- Arbitrary and ad hoc guidelines/restrictions
- Difficulties in site acquisition
- High incidence of levies and taxes
- Complicated and time consuming procedures

C.5 National Optical Fibre Network (NOFN)

2.37 The Government is in the process of rolling out a nationwide OFC network known as the National Optical Fibre Network (NOFN) project with an aim to extend fibre connectivity from the block level to the panchayat level by connecting 2,50,000 Gram Panchayats (GPs). The project will use the existing OFC of Bharat Sanchar Nigam Limited (BSNL) which is available throughout the country touching most of the 6,543 Blocks in the country. The project plans to build a strong middle mile by laying incremental OFC from Blocks to the GP, an average of

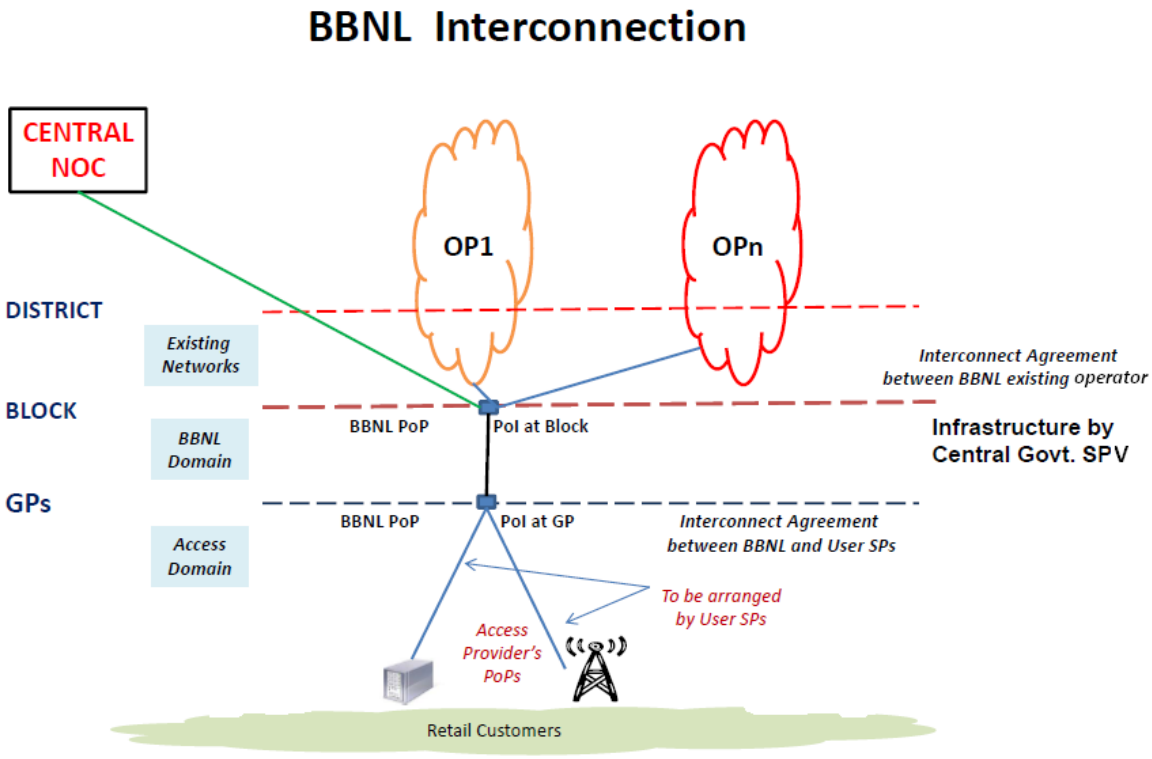
2.4 km per GP. The project was envisaged in 2010 at a cost of about ₹ 20,000 crores to be provided by the USOF. The aim was to complete the project in three phases. The datelines and rollout targets were as follows:

- Phase I completion by 2012 with 1,00,000 GPs
- Phase II completion by 2013 with 1,00,000 GPs
- Phase III completion by March 2014 with 50,000 GPs

2.38 NOFN would enable access to and usage of several e-services such as healthcare, education, financial services, agriculture, e-governance and entertainment. A conceptual diagram of the project is shown at Figure 2.14. It is planned to provide 100 Mbps connectivity at each GP. The project is being implemented by Bharat Broadband Nigam Limited (BBNL), a Special Purpose Vehicle (SPV) of the Government of India. This company is procuring the equipment such as Gigabit Passive Optical Network (GPON) and the OFC. The laying of cable is being done by three PSUs – BSNL, Railtel and Power Grid. They have been assigned the work in the ratio of 70, 15 and 15 respectively. As per the website of BBNL the mission of the project is

- To provide 100 Mbps BB connectivity to all the GPs.
- To provide B2B services in a non-discriminatory manner.
- To facilitate proliferation of G2C, B2C and P2P BB services in rural areas.
- To be a catalyst for increasing BB penetration in rural areas so as to foster socio-economic development.

Figure 2.14 NOFN Concept Diagram



2.39 The date and rollout targets stated above have since been revised twice. The revised targets now are:

- Phase I completion by March 2015 with 50,000 GPs
- Phase II completion by March 2016 with 1,00,000 GPs
- Phase III completion by December 2016 with 1,00,000 GPs.

2.40 As per media reports, connectivity has been provided to only 20,000 GPs by 31st March 2015 against a target of 50,000 GPs thus badly slipping on the intended target. What is more, the cost estimates for completion have almost doubled. The project has been marred by the following shortcomings which are in direct contrast to the ITU specifications for a good BB plan as listed in paragraph 2.11 above:

- Fragmented method of project implementation leading to diffusion of accountability.

- The lack of ownership of project implementation by the three PSUs. The vital issue of enforceability/execution has been left out.
- The phasing of project implementation in a manner that did not cover entire districts but parts of districts inhibiting the ability to adopt a district – led approach in service delivery.
- The perceived uncertainty in supply of GPON equipment and associated accessories and the lack of adequate alternatives in view of the lock-in to a sole supplier i.e. technology neutrality is lacking.
- Lack of involvement of States in project implementation. Also, there is lack of consultation with private service providers who will be subsequently using the network. That is to say that the project plan represents silo-based thinking and a top-down approach with virtually no consultation with stakeholders.
- Lack of adequately skilled manpower at the GP level throwing up difficulties in repair and maintenance of assets at the GP. The development of human skills, literacy and demand has just not been addressed.
- Milestones laid down are very broad in nature and the roadmap is not clearly defined in terms of short-term milestones i.e. no clear benchmarking has been carried out.

2.41 The present architecture of NOFN has also thrown up several shortcomings that require to be addressed, namely:

- The design requiring laying of incremental fibre to close the fibre-gap between Block headquarters to the GP wherein 24 pair fibre being laid under NOFN connects to a single pair of fibre upwards from the point of interconnect to District headquarters i.e. no contextual market analysis has been carried out.
- The lack of redundancy planning at the District, Block and GP level raises doubts about reliability.

- The dependence on BSNL optical fibre infrastructure for upstream bandwidth and the possibility of high cost of bandwidth with poor reliability affecting NOFN fibre utilization and operational economics i.e. implementing agencies have not been allowed any flexibility.
- The inadequate planning for enabling service delivery at the panchayat level and assigning seamless connectivity from District POI to the GP which has resulted in a separate project proposal for a Government User Network (GUN) overlay over NOFN.
- The lack of due attention to utilization of fibre, analysis and development of business models that could promote fibre utilization.

2.42 While National Optical Fibre Network (NOFN) is a step forward in bridging the urban-rural divide in BB penetration, last mile access is critical to realizing the policy objectives of inclusion and universal access. The efficient and timely delivery of certain community services requires extending connectivity to the last mile. Extending last mile access to households would prove conducive to awareness and uptake, as rural users get accustomed to electronic delivery of essential services. This would require collaboration between the Government and private sector enterprises to devise strategies that make the proposition viable for all stakeholders.

2.43 At present, the organization for delivering BB is a multilayered structure with control vesting in the Government. Its head is the USOF Administrator who reports to the Secretary, DoT. Therefore, at the very core of the structure, the decision-making process is stymied by the normal bureaucratic processes (red-tape). The USOF's independence is non-existent; and that too even after the Government takes a policy decision. At the delivery and implementation stage, responsibilities are diffused with far too many executing and supervising agencies. Below the USOF are the BBNL and another layer of three PSUs. Even if the

problems of management and coordination functions in such layering are left aside, the actual decision-making pertaining to execution has been relegated to organizations which are best known for cumbersome administrative procedures, tardy decision-making, frequent review of commercial decisions, and inadequate monitoring and supervision of project execution. There is a disconnect between the agency responsible for implementation of the project and stakeholders including private operators who shall ultimately utilize the fibre for provision of BB to the consumers. This has practically rendered BBNL dysfunctional, defeating the very purpose for which it was set-up – to make independent and quick decisions. Unless this bureaucratic multi-layered structure is dismantled and the SPV given an independent mandate to run the project on a mission mode, the project's success is in serious jeopardy. There is also a need to set up a monitoring mechanism at each stage of the project, perhaps by appointing an independent private agency, so that outcomes are quantitatively measured at each milestone, responsibility fixed for the shortfall and timely corrective action taken. There is, therefore, an urgent need for a wholesale revamp of the fundamentally flawed multi-layered institutional design for implementation of the project.

D. Demand Side Constraints

2.44 Demand facilitation or stimulation refers to efforts to boost the use of BB by raising awareness of its possible benefits as well as making it affordable and more attractive to users. Supply-side strategies focus on availability of BB by promoting investment in BB technologies and infrastructure. Many supply-side strategies are premised on the assumption that there is unsatisfied demand to be met (or that demand will grow). In contrast, demand-side strategies focus on expanding the market through programmes designed to encourage BB adoption and expand use.

D.1 Status on Access and Reachability

2.45 As part of the consultation process, the Authority requested all Access Service Providers to submit details of Optical Fibre Cable (OFC) owned/planned up to March 2016/Leased from IP-1 operators, state wise. All Access Service Providers have forwarded details which are at **Annexure 'II'.**

2.46 An analysis of the response presents an interesting picture. The salient points are:

- There are approximately 12,00,000 route km of OFC already available, enough to wrap the earth 30 times. In addition another service provider likely to launch services in current year has planned to lay approximately 3,00,000 route km of OFC.
- BSNL has a presence in approximately 96 per cent of the districts and 87 per cent of the blocks. If BB could be effectively extended in areas where OFC is at present existing, the subscription figures would be much higher.
- The details of the presence of private TSPs in various districts and blocks are as given in Table 2.4 below. Out of 658 district headquarters at least one private TSP has OFC presence in 588 district headquarters. Out of 6543 block headquarters at least one private TSP has OFC presence in 4084 block headquarters. This shows at least one TSP has OFC presence in more than 62 per cent of block headquarters. **However, unfortunately, this presence has not been translated into provision of fixed BB to consumers.**

Table 2.4 Presence of OFC Owned by Private TSPs at District and Block Level in India

Private Operator	Presence in number of Districts	Presence in number of Blocks
Reliance Communications	486	2547
Bharti Airtel	515	1981
Vodafone	408	1687
TTSL & TTML	357	1660
Idea Cellular	243	574
Aircel	131	208
Tata Communications	233	NA
Hathway Datacom	12	15

Total number of Districts in India: 658
Total number of Blocks in India: 6543

2.47 The above data clearly implies that reachability (in terms of fibre access) i.e. lack of supply is not the only hurdle to BB delivery, thus clearly negating Say's Law. This is also corroborated by the utilization of fixed line telephone connections. Unlike mobiles which are used by individuals, fixed lines are installed in a house and all members of the household use it. Out of around 21.5 million urban fixed lines, there are only 12.77 million DSL connections; i.e. around 8.7 million urban households or around 40% of the urban users of fixed lines do not find it necessary to have BB connections. And most of the urban households still having fixed lines are not in the category of poor or illiterate. Clearly, there are other issues which are responsible for the lack of BB proliferation in the country. It is once after these issues are addressed that BSNL and other private TSPs, whose fibre networks are already present in large parts of the country, will make incremental investments in the existing network and provide BB to the inhabitants of such Districts and Blocks.

2.48 Chapters 5 and 6 of the CP discussed various demand-side issues. Stakeholders were asked to express their views on demand-side issues raised in the CP. The broad consensus that emerged was that the distinction between BB availability and BB adoption needs to be underscored. Mere availability is no assurance of adoption. Therefore, if the socio-economic benefits of BB are to be realized, adoption needs to be actively encouraged.

D.2 Awareness

2.49 Awareness of the benefits of BB and the capability to use BB are critical first steps in building demand for BB services. In order for people to use BB efficiently and gainfully, they must have the necessary interest and competency. This is sometimes referred to as digital literacy. In India, one of the major constraints in awareness and adoption of web technologies is the lack of primary education and high digital illiteracy.

D.3 Affordability

2.50 Policy makers around the world have identified affordability as one of the main reasons why people do not use BB services even where they are available. Various components affect the cost of BB, including installation and ongoing service fees, as well as the prices of devices to access and use BB services. For many potential customers, the costs incurred to acquire a BB device, the costs of connection and the use of the service are large relative to income levels.

2.51 While potential users may have the necessary digital literacy skills, they may not make effective use of BB services because of the lack of affordable connections, services and devices. Lowering entry and usage prices for consumers within a suitable policy framework is essential to ensure a virtuous cycle of growth as was seen in mobile telephony. TSPs will also need to take decisions to upgrade their networks. These decisions will be based on the age of the existing network, capital and

operating costs, competition and demand for services and resource availability. The affordability of BB and its spread will be contingent on all these facets.

D.4 Attractiveness (Availability of Relevant Content)

2.52 In order to generate demand for BB, consumers must not only be aware of and be able to afford BB, but they must also perceive both its relevance and attractiveness. Actions to boost BB demand are generally aimed at both consumers and businesses to encourage them to produce content, services and applications. BB applications are yet to scale up in a wide range of areas that impact society, such as agriculture, education, healthcare and citizen services. Access to online Government services across the country is low, with a large quantity of Government data, such as land or health records yet to be digitized.

2.53 Voice/SMS services will continue to constitute the core connectivity and BB, both wired or wireless, will serve as a major value addition for subscribers. However, for its proper and productive use, augmentation of availability of local content is a pre-requisite. The latter refers to content in the local language, content created and hosted locally or content relevant to the local population. In terms of local language, much of the content currently available is easily translated. But, that is not sufficient. Content has to be tailored to fit local and cultural contexts to derive maximum value. Ideally, local content has to be created by local developers who understand their target market and can generate content to suit local needs. Additionally, local hosting, can bring speed and cost benefits for both end users and content providers. Local relevance depends on customised content that specifically addresses key needs and challenges in communities where consumers live and work, social networking, local news, information on business, health, agriculture and weather. Local relevance and local content has a direct impact on the everyday lives of people. The next wave of Internet adoption in India will be dominated by local language speakers,

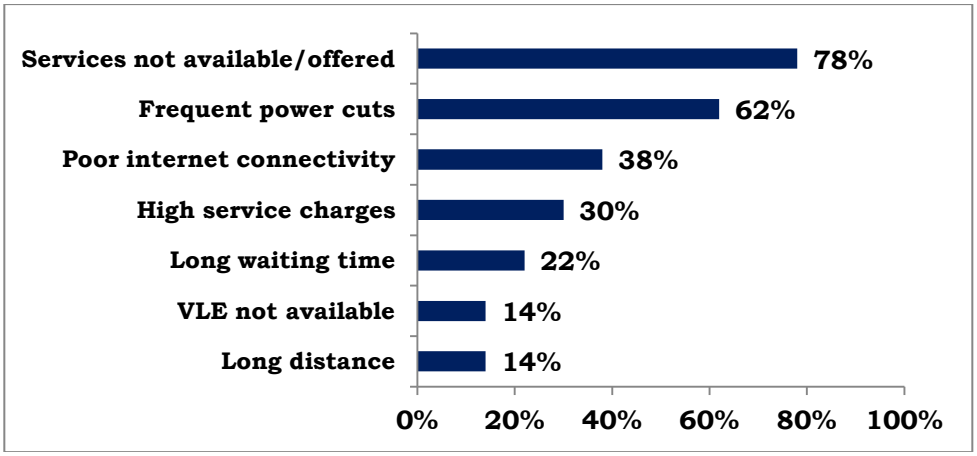
which underscores the need for much more content and application to be offered in local languages.

E. Rural – Urban Divide

2.54 Indian villages account for 70 per cent of the country's total population, 56 per cent of the country's income, 64 per cent of consumption expenditure and 33 per cent of national savings. Currently, 20 per cent of BB connections are in rural areas as compared to about 42 per cent of total mobile connections. The primary cause for the low penetration of BB in rural areas is the non-availability of required transmission channels to villages, which in turn is due to high costs of service rollout and lack of viable business models. This creates a vicious cycle, where, because of the lack of supply, demand remains latent.

2.55 There is a large socio-economic gap between the country's urban and rural populations; and, this is aggravated by inequity in provision of services. Many in rural India lack access to basic education, nutrition, health care, sanitation and are trapped in poverty. This is reflected in statistics of infant mortality rate, literacy rate and average life expectancy. BB connectivity can bridge this divide by improving access to services in rural areas. However, without improved penetration of BB in rural areas, such connectivity cannot be delivered. The barriers to usage of BB in rural areas are illustrated in Figure 2.15.

Figure 2.15 Barriers to Usage of Broadband in Rural ICT Centres



[Source: CISCO IBSG-IMRB Rural India Connected Life Survey, 2012]

2.56 Acquiring rural consumers is financially unattractive for TSPs. The low purchasing power and low population density, leads to limited returns on investment on network for Telecom Service Providers. In addition, infrastructure-related obstacles raise costs, further reducing the attractiveness of the rural market. Providing universal access at the individual user and household levels may not always be possible, particularly in rural or hard to reach areas. Further, it may not even be economically viable. As a result, it may be prudent to give greater attention to institutional solutions for providing BB to end users, especially service to the un-served or underserved areas. These projects are often funded, at least in part, by resources from the Universal Service Obligation Fund (USOF).

2.57 In India the USOF is used to support community access by providing wireline BB connectivity to rural and remote areas of the country from the existing rural wireline exchanges of BSNL. The scheme is being implemented at a pan-India level and BSNL is required to provide 8,88,832 wireline BB connections to individual users and Government institutions and set up 28,672 kiosks over a period of 5 years.

2.58 While the scheme was designed to promote BB growth in rural India and provide high quality Internet connectivity to the remotest of villages, several deficiencies have been noticed at the implementation stage. These are[6]:

- Unsatisfactory user experience due to lack of electricity and fluctuating BB speed.
- Though the charges for Internet browsing at the kiosk are fixed at ₹ 5 per household, customers are being charged at a higher rate.
- Rebate to be passed on to eligible consumers has been claimed by BSNL but not passed on.

[6] Report on "Improvement in Monitoring of USOF WLBBS and its Impact Assessment", November 2012, IIMA Idea Telecom Centre of Excellence (IITCOE)

- Even though some connections have been disconnected, BSNL continues to claim subsidy.
- Low compliance for 'Single Window for Queries and Complaints' which indicates that acquiring customers is given more importance by BSNL than maintaining them.

2.59 The important takeaways from the experience of implementation of such a scheme are that: (i) there is a willingness to pay for services, and (ii) users' perception that value benefit from BB has increased a little over time.

2.60 Leaving BB deployment to market forces and banking on the catalyst of competition is simply not enough especially in remote, rural, under populated and underserved regions where at present no viable business case can be made. Government has to take a lead by stepping in and inducting the private sector for investment, skills, and problem solving. The Government can adopt the strategy of going in for direct public investment in a national BB network infrastructure and competition at services and retail level. However, this is one extreme. The more widely prevalent strategy is the provision of an enabling environment including incentives for investing TSPs, ensuring open, non-discriminatory, affordable access as also ensuring rollout requirements for uneconomic areas and spectrum refarming or the repurposing of underused and digital dividend spectrum. Complementary action across a swathe of areas has to be the foundation on which BB access is delivered.

2.61 Public Private Partnerships (PPPs), innovative BB deployment over and in conjunction with other utility networks (such as power) and educating Government (in-house) and citizens alike on the real benefits of BB-enabled services are important measures. Direct subsidies carry inherent risks of distorting the market. These should be directed not at networks, but at end-users through vouchers, subsidized devices or

subscriptions, digital literacy campaigns and training programmes and provision of locally relevant content.

F. Conclusion

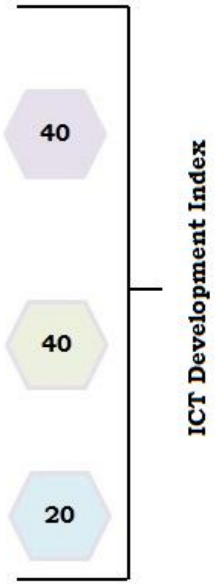
2.62 The present status of BB in India, is reflected in the **ICT Development Index (IDI)**; a composite index combining 11 indicators into one benchmark measure that serves to monitor and compare development in Information and Communication Technology (ICT) across countries. The IDI indicators, references, values and weights are explained in Figure 2.16. **India ranks 129th** out of a total 166 countries with an **IDI value of 2.53** which is way below the **world average of 4.77** as per 'Measuring the Information Society Report' of 2014 published by ITU. **India is ranked 132nd** in the **access sub index**, **133rd** in the **use sub-index** and **121st** in the **skill sub-index**.

Figure 2.16 ICT Development Index: Indicators, References, Values and Weights

ICT access	Reference value	(%)
1. Fixed-telephone subscriptions per 100 inhabitants	60	20
2. Mobile-cellular telephone subscriptions per 100 inhabitants	120	20
3. International Internet bandwidth (bit/s) per Internet user	787'260*	20
4. Percentage of households with a computer	100	20
5. Percentage of households with Internet access	100	20

ICT use	Reference value	(%)
6. Percentage of individuals using the Internet	100	33
7. Fixed (wired) broadband subscriptions per 100 inhabitants	60	33
8. Wireless broadband subscriptions per 100 inhabitants	100	33

ICT skills	Reference value	(%)
9. Adult literacy rate	100	33
10. Secondary gross enrolment ratio	100	33
11. Tertiary gross enrolment ratio	100	33



Note: * This corresponds to a log value of 5.90, which was used in the normalization step.

[Source: Measuring the Information Society Report, 2014 published by ITU]

2.63 The IDI captures the evolution of the information society as it goes through different stages of development, taking into account technology convergence and emergence of new technologies. India is categorized in the **Least Connected Countries (LCCs)** group of 42 countries that fall within the low IDI group, based on categorization that divides the 166 countries into four groups (high, upper, medium and low). There are 11 countries from the African continent which are ranked above India. The report points out the requirement of special policy attention to be directed towards connecting people in LCCs, as these countries' need for improved access to ICTs is most essential and they could benefit the most from ICTs for advancement of socio-economic development.

2.64 BB holds great promise for promoting inclusive growth by extending education, health care and financial inclusion in rural areas and lower income groups. Delivering these services as viable and sustainable outcomes entails meeting ambitious targets for coverage and data speeds. These, in turn, will require focused attention to factors on both the supply and demand sides. On the supply side, policy makers and TSPs need to tackle the constraints of limited spectrum availability, device affordability and networking performance gaps. On the demand side while the Government has to sort out issues pertaining to delivery of e-Governance (including content software), the industry needs to ensure it can stimulate interest in and uptake of services in new markets with suitable new revenue models.

2.65 It has to be appreciated that providing BB services is altogether different from providing mobile services. In the case of mobile, the service providers install their BTSs which cover the targeted area and a retailer sitting at a shop sells SIM cards to the consumers. In case of BB, each connection, whether it is provided through ADSL, FTTH or through fixed wireless technologies (Wi-Fi and Wi-Max) requires handholding, particularly so in rural areas. Similarly, providing BB

requires more manpower, greater skills along with local entrepreneurship (better awareness of local market needs).

2.66 The subsequent chapters of this report bring out the action points, initiatives and policy changes that are urgently required to be undertaken for delivering BB and improving connectedness (and India's IDI). This will be stepping-stone to a real transformation and the realization of '**Digital India**'.

CHAPTER 3

Spectrum

A. Introduction

3.0 The strong growth in mobile data traffic is generating a growing demand for spectrum resources. Notwithstanding, the Government's emphasis on laying of OFC through the NOFN project, wireless BB, in all likelihood, will play a crucial role in the proliferation of BB for end users. Wireless BB will add to the pressure on demand for spectrum. Spectrum policy is fundamental to the successful rollout of wireless BB. This is why NTP-2012 lists as one of the objectives '*Make available additional 300MHz spectrum for IMT services by the year 2017 and another 200MHz by 2020*'.

3.1 Every country has the same amount of radio spectrum. Traditionally certain key Government users were allocated large chunks of spectrum for strategic and operational reasons. Some of these allocations emanated from public policy considerations that are now 30 years old. For instance, the assignment of frequencies to All India Radio (AIR) and Doordarshan served a particular public policy purpose at the time the allocation was made. Since wireless technology is a fast and cheap way to provide access and BB to people all over, especially those in rural and remote areas, it is necessary to review how this precious natural resource is presently being utilized. The key issue here pertains to the quantum of spectrum available for commercial purposes.

3.2 A second but interrelated issue concerns the pricing of access spectrum. Most of the allocations made to public agencies/organizations were free of charge. This may be entirely justifiable in the case of a public good such as defence. However, the justification is considerably weaker when spectrum is allotted to a PSU, say, such as Indian Oil Corporation (IOC). When spectrum is scarce and

has socially valuable alternate uses, it is only proper that users face prices which reflect those opportunity costs. If the marginal cost to the users is zero (as happens when there is no price charge) or inadequate, the spectrum will not be efficiently utilized. From a larger policy perspective, two inescapable conclusions emerge:

a) The need to take stock of **all** existing allocations, determine the efficiency of use and resume spectrum where efficiency is poor.
b) Spectrum must be priced commercially if it is to be used for commercial purposes.

3.3 The US Federal Communications Commission (FCC) has recently (January 2015) closed the AWS-3 spectrum auction after 341 rounds of bidding and a record amount of money was raised. The winning bids totalled $44.89 billion, way over analysts' previous predictions of around $10-20 billion. The auction marked a new era in spectrum policy, where a collaborative and unprecedented effort resulted in new commercial access to federal spectrum bands. A bipartisan group of leaders in Congress, federal agencies – especially NTIA (The National Telecommunications and Information Administration) and DOD (The Department of Defence) – the White House, industry and the team at the FCC all came together to help meet the nations' demand for wireless BB.

3.4 Spectrum policies that were designed for symmetric voice communication at slower rates need to be realigned in view of changed technological circumstances i.e. the requirement for high speed bandwidth consuming video and other content. There is a pressing need to balance claims on spectrum from the Government as against its use for commercial purposes, for licensed and unlicensed applications, for new and old technologies and for terrestrial or Satellite broadcast. Policies on spectrum use such as spectrum trading and spectrum sharing are now simply inescapable. In the backdrop of the need to

ensure universal access and emergency services, major and innovative policy changes are an imperative. They will require political will.

B. Actual Allocation of Spectrum

3.5 The details of actual allocation of spectrum as per information provided by DoT, for access networks and backhaul network have been provided in the previous chapter. Table 3.1 provides an international comparison of spectrum allocation.

Table 3.1 Comparison of Spectrum Assignment: Other Countries vis-à-vis Comparable Size Indian States

Country	Spectrum (in MHz)	MHz/Mn Population (A)	LSA	Spectrum (in MHz)	MHz/Mn Population (B)	B/A
Germany	290	3.60	Andhra Pradesh	126.25	1.44	40.1%
			Rajasthan	120.55	1.68	46.6%
			Tamil Nadu	101.55	1.44	40.0%
UK	294.7	4.60	Gujarat	117.30	1.87	40.7%
Spain	289.6	6.21	Orissa	108.65	2.58	41.6%
Italy	269.5	4.50	Karnataka	124.95	2.03	45.0%
Malaysia	275	9.25	Punjab	129.90	4.26	46.0%
			Haryana	116.45	4.31	46.6%
Netherland	310	18.45	North East	113.90	8.27	44.8%
Belgium	230.4	20.58	Jammu & Kashmir	99.30	8.10	39.3%
Finland	293.2	53.90	Himachal Pradesh	108.95	15.50	28.8%
Comparisons of Spectrum Assignment: China vis-à-vis India						
China	256	0.19	India	118.65	0.095	49.9%

C. Problems in allocation of spectrum

3.6 There have been instances of undue delay in the assignment of spectrum by the WPC wing of DoT to Service Providers. It results in inefficient utilization of spectrum and delays the rollout of networks. For instance, in the February 2014 auction, licencees, whose licenses

were due to expire in Metros in November 2014, participated and regained spectrum. There were differences in the exact frequency spots and the quantum of spectrum as compared to their erstwhile holding. It required at most a few weeks to migrate to the new frequencies. However, due to inordinate delay on the part of the WPC in assigning the new frequency spots, there was the possibility of service disruption to millions of subscribers especially in the national capital Delhi. Ultimately, DoT had to extend the erstwhile frequency usage to avoid such a situation. Similar delays have reportedly dogged the allocation of backhaul spectrum. Anecdotal reports suggest that some TSPs have waited for more than two years for allocation of backhaul spectrum.

3.7 The overall availability of spectrum in sufficient quantum is obviously important. Another vitally critical issue is that the spectrum should be available in contiguous form. Contiguous spectrum blocks are essential for the rollout of newer technologies and for enhanced spectral efficiency. However, the issue of availability of contiguous spectrum has remained largely unaddressed. The Authority had recommended that TSPs should be allowed to swap their spectrum holding to make it contiguous. However, the DoT had not accepted the recommendations in their entirety. Some TSPs have been reporting severe interference in parts of Jammu & Kashmir, Gujarat, Haryana and Punjab LSAs in the 2100 MHz spectrum which they acquired through the 2010 auctions. Even after the elapse of a long period of time, no effective steps have been taken by WPC to resolve the issue.

3.8 WPC is the nodal body of the Government responsible for the management of <u>all</u> spectrum in the country. It is responsible for co-ordinating with all Ministries such as DoT, Defence, Space, MHA, Railways, Broadcasting etc. for identification of spectrum bands for various usage, making it available and ensuring efficient utilization of spectrum. However, presently it has become just one more of the

divisions in the DoT. It has no independent say. This has severely degraded the role and responsibilities for which WPC was created. This has led to a situation, where, in case of inter-Ministerial disputes on allocation of spectrum, it has no say. The role of WPC cannot and should not be confined to allocation of available spectrum with DoT alone. Being the nodal agency, responsible for efficient management of spectrum, it should be the final authority for deciding the efficient usage of all spectrum, irrespective of what any individual Ministry says. Therefore, there is an urgent need for an institutional revamping of the WPC which can no longer be postponed. The measures urgently required are: provide independence to the WPC by delinking it from the present DoT hierarchy and either converting it into a statutory body responsible to Parliament or transferring it under an existing statutory body, mandating it to urgently decide the short-term and long-term plan for all spectrum through public consultations and placing it in the public domain and ensure transparent procedures for the allocation of all spectrum bands. This will encourage stakeholders to come out with innovative solutions and market-driven models for efficient utilization of spectrum. Even if the Government wishes to retain the function of allocating spectrum across different uses, the WPC's advice can and should be sought. Further, even in a more limited role of assigning solely commercially available spectrum there is still a strong case for an institutional overhaul to realize goals of institutional efficiency, transparency in decision-making and full disclosure of decisions.

D. The Growing Demand for Spectrum

3.9 The explosive growth of mobile connections and the sophistication of devices for accessing advanced data-hungry applications and services, has led to strong and continuing growth in mobile data traffic. The surge in mobile data traffic is generating a massive demand for mobile bandwidth and spectrum resource. The latter is finite and in fixed supply, necessitating an increase in spectrum efficiency and flexible use

to accommodate the present growth in demand. While technical studies are being conducted to study the means to achieve spectrum efficiency, flexible-use of spectrum is a key tool for promoting wireless BB development.

3.10 The issues pertaining to spectrum can be classified into three broad categories:

(a) How to use existing spectrum more efficiently.
    (i) Examine allocations to PSUs/Government organizations etc. including defence.
    (ii) Examine how available spectrum with TSPs can be used in a more efficient manner.
(b) Technical and other innovative solutions such as Cognitive radio technologies (CRTs) and Licensed Shared Access (LSA) which lead to a significant increase in the flexible use of spectrum.
(c) Using unlicensed spectrum to offload pressure on commercially allocated spectrum.

3.11 An inventory of actual usage of spectrum, expected traffic, future requirements and spectrally efficient technologies enables the reallocation or reassignment of bands currently lying fallow, or under used by incumbents. New technologies such as carrier aggregation and dynamic spectrum assignment will open up the full potential of spectrum bands.

3.12 Along with ensuring sufficient access spectrum, it is vital to ensure that larger backhaul spectrum is made available for commercial use. For 2G and 3G technologies, average base station capacity is 2-30 Mbps, but the capacity required for deployment of 4G technologies is comparatively high. LTE macro-base stations will require between 30 – 120 Mbps, with very large urban base stations requiring up to 240 Mbps backhaul capacity. Therefore, if sufficient backhaul spectrum is

not made available to transport the data, it may become the bottleneck despite making available enough access spectrum. This Microwave backbone may be used as an alternate to OFC. In its recommendations dated 29th August 2014, the Authority has made elaborate recommendations on the issue of Allocation and pricing of Microwave Access (MWA) and Microwave Backbone (MWB) RF carriers. The Authority has recommended that the assignment of MWA and MWB carriers should continue to be done on administrative basis. It had recommended a ceiling on the number of MWA carriers that can be assigned to a TSP which is based on the quantum of access spectrum held by the TSP. TSP should be assigned MWA carriers as per their request as long as it is within the ceiling limit. It has also recommended that the higher frequency bands viz. 26 GHz, 28 GHz, 32 GHz, 38 GHz and 42 GHz should also be earmarked for fixed point-to-point MW carriers. The Government has not taken a decision on these recommendations. For the proliferation of wireless BB, it is essential that the Government takes an early decision.

E. Spectrum Trading

3.13 Spectrum trading, in effect, creates a secondary market for spectrum, enables aggregation (and consolidation) of spectrum to meet demand requirements by permitting existing licensees to transfer all or a part of their spectrum assignments to third parties with little or no Government involvement in the process. It allows new entrants to obtain spectrum rights and reduces constraints with regard to the timing of their market entry. In the absence of spectrum trading, potential entrants and existing TSPs seeking to build out their networks further must wait for the Government to assign new spectrum. Presently, no mechanism exists for a telecom company to exit the sector after selling its spectrum holding. Thus, companies (investors) who entered the industry are locked-in: there is no way out (surrendering spectrum to the Government without receiving any refund is a

commercial non-option). **Spectrum trading, therefore, provides the opportunity for secondary markets to emerge, that can improve the rollout of new services, increase the potential for competitive service provision and encourage investments in the sector.**

F. Spectrum Sharing

3.14 **The basic objective of spectrum sharing is to enhance spectral efficiency by combining/pooling the spectrum holding of two licensees.** The gain in spectral efficiency increases non-linearly with the quantum of spectrum. As an example, with 5 MHz of paired spectrum (for GSM technology), it is possible to carry 33.03 Erlang traffic, whereas 10 MHz of paired spectrum can carry 138.6 Erlang traffic. Spectrum sharing refers to an arrangement between two access licensees (CMTS/UASL/UL(AS)/UL) in a LSA, where both licensees having access spectrum in the same band, pool their respective spectrum in that LSA for their simultaneous use, using a common Radio Access Network (RAN)[7]. The shared RAN will be connected to the core networks of each of the licensee. Both licensees will continue to hold their primary right over their own spectrum. In India, spectrum is fragmented due to the presence of a large number of service providers. Thus, spectrum sharing, in the Indian context, is a way to alleviate the constraints imposed on an operator by the fragmentation of spectrum.

G. License Exempt (Unlicensed) Spectrum

3.15 In an effort to provide maximum flexibility for innovation and lower entry costs for some type of ubiquitous wireless devices, many countries have set aside certain bands exclusively for unlicensed users. **The use and growth of Wi-Fi to offload mobile data traffic and free up licensed spectrum for use of the huge growth in mobile data traffic**

[7] TRAI's Recommendations on Guidelines on Spectrum Sharing dated 21 July, 2014.

has been a key development. A summary of the unlicensed spectrum in USA and Europe is shown in Table 3.4 below:

Table 3.4 Unlicensed Spectrum in USA and Europe (in MHz)

Band	USA	Europe
TV White Spaces	0-150	-
863-870 MHz	-	7
902-928 MHz	26	-
1880-1930 MHz	10	20
2400-2483.5 MHz	83.5	83.5
3550-3700 MHz	50 + 100 (In pipeline)	-
5150-5350 & 5470-5825 MHz	555	555
5350-5470 & 5850-5925 MHz	195 (In pipeline)	-

[Source: FCC White Paper - The Mobile Broadband Spectrum Challenge: International Comparisons]

3.16 Unlicensed/inclusive use also provides important social value, for example, public service, free access and easy entry for newcomers, which encourages new technologies. The details of unlicensed spectrum in India in the IMT and IMT Advance bands are shown in Table 3.5 below.

Table 3.5 Main Unlicensed Spectrum Bands in India

Frequency range (MHz)	Class of Transmitter	Maximum EIRP	Remarks
2400-2483.5	Low power equipment. (IND62)	4 Watt	Can be used Indoor as well as outdoor.
5150-5350	Low power equipment for indoor applications only.(IND67)	200 mW	Low power (max EIRP 200 mW). Outdoor use permitted in 5150-5250 MHz range, but it is not license-exempt. (IND68)
5725-5875	Wireless access system including RLAN indoor only.(IND67)	200 mW	Low power (max EIRP 4 W) outdoor use for Wireless Access System incl. RLAN and DSCR permitted in 5725-5825 MHz, but it is not license-exempt. (IND71)
5825-5875	Low power equipment. (IND 72)	4 Watt	Indoor as well as Outdoor.

3.17 The use of unlicensed bands greatly helps in offload. At present, in India only a limited quantum of unlicensed band spectrum has been made available. In its Recommendations on "Broadband India: Recommendations on Accelerating Growth of Internet and Broadband Penetration" of 29th April 2004 the Authority stated that *"The Authority feels that 2.4 – 2.48 GHz should be opened for outdoor usage immediately, with the same applying for 5.725 – 5.85 GHz. In the 5.15 – 5.35 GHz range, current users should be migrated to other bands as expeditiously as possible so that this band may also be de- licensed for indoor and outdoor usage to further boost the effort of Internet and broadband deployment."* Accordingly, the Authority recommended that

"The 2.4 – 2.48 GHz band should be de-licensed for low-power outdoor usage, and on the basis of non-interference, non-protection and non-exclusiveness. This de-licensing should be technology-neutral. Similarly, de -licensing should also be done for the 5.725 – 5.85 GHz band to facilitate deployment of Wireless Access technologies for BB. Additionally, the 5.15 – 5.35 GHz band should be vacated expeditiously and de-licensed to further facilitate the objectives."

3.18 The Authority's recommendations on the 2.4 - 2.48 GHz band were accepted and the band was de-licensed in September 2004. However, outdoor use of 5.725 - 5.825 GHz band is still licensed.

3.19 Most countries have already de-licensed the 60 GHz band and this band has a good device ecosystem; India should also de-license the 60 GHz band immediately and make it available for consumers. The 60 GHz band is also known as V-band or WiGig band (Wi-Fi at 60 GHz) using IEEE 802.11ad protocol. In its Recommendations on "Allocation and Pricing of Microwave Access (MWA) and Microwave Backbone (MWB) RF carriers" dated 29 August 2014, the Authority recommended that, *in order to increase BB penetration in India, the usage of high capacity*

backhaul E-band (71-76 / 81-86 GHz) and V-band (57-64 GHz) may be explored for allocation to the telecom service providers.

H. New Spectrum Bands

3.20 In November 2015, the ITU's World Radio Communication Conference (WRC) will determine access to additional future spectrum for mobile BB for the coming decade under its Agenda Item 1.1. It will address the need to identify additional spectrum for IMT-based mobile BB in harmonised global bands to meet rising data demands worldwide. For its preparation, a Task Group of various Study Groups (SG 4, 5, 6 and 7) was formed which is referred to as JTG 4-5-6-7. It had identified potential candidate bands for IMT at WRC-15 in the range 470-694/698 MHz, 1350-1525 MHz (except 1400-1427 MHz which is allocated to radio astronomy), 2700-2900 MHz, 3300-4200 MHz, 4400- 4950 MHz 5350-5470 MHz and 5725-5850 MHz. The DoT, in its inputs as contribution to JTG, suggested 1429-1518 MHz, 2015-2100 MHz, 2200-2290 MHz, 4400-4500 MHz and 4800-5000 MHz for carrying out sharing and compatibility studies.

I. Action Points

3.21 As is emerging, wireless BB will be the pre-dominant mode of last mile data service access. Sufficient spectrum will play a central role in keeping tariffs low and enabling mass adoption of BB. **Spectrum licensing should be considered as a lever to drive penetration, efficiency and reinvestment in the industry rather than a convenient source of income for the Government**. Action points on various dimensions including the previous recommendations made by the Authority on spectrum are listed as under:

- **Availability: Align spectrum bands with globally harmonized bands to achieve interference-free coexistence and economies of scale. The Authority has been recommending that more**

spectrum in the existing spectrum bands (viz. 900/1800/2100/2300/2500 MHz bands) should be assigned for commercial operation. In its recommendations on 'Spectrum Management and Licensing Framework' dated 11th May 2010, the Authority had estimated that *there would be a total requirement of 500 MHz -660 MHz for voice and data services by the year 2014*. As brought out, current availability of spectrum in our LSAs is about 40% of that available in comparable countries elsewhere. Clearly, there is a crying need for assignment of additional spectrum for commercial telecom services.

- **Roadmap: There is a need to lay down a clear roadmap for spectrum management which should state the requirement and availability of spectrum for each LSA as well as for the whole country. This roadmap should be made available publicly to ensure transparency.**
- **Institutional Revamping: WPC should be converted into an independent body by delinking it from the present DoT hierarchy and either converting it into a statutory body responsible to Parliament or transferring it to an existing statutory body.**
- **Disclosure and Transparency: WPC should be mandated to urgently decide the short-term and long-term plan for all spectrum through public consultations and putting it in public domain to ensure transparent procedures for the allocation of all spectrum bands. This shall allow innovative solutions and market-driven models for efficient utilization of spectrum.**
- **Even in a more limited role of assigning solely commercially available spectrum, there is a strong case for an institutional overhaul of WPC to realize goals of institutional efficiency,**

transparency in decision-making and full disclosure of decisions.

- **Commensurate Pricing: It is very important that spectrum is reasonably priced and made available in significant quantities so that a balance can be maintained in the payments to the Government for spectrum and the investment required for network expansion and equipment.**
- **Audit: There is an urgent need for audit by an independent agency of all allocated spectrum both commercial as well as spectrum allocated to various PSUs/Government organizations. This ought to be a national priority and must be undertaken within 3 months.**
- **Refarming: There is a need to review the present usage of spectrum available with Government agencies so as to identify the possible areas where spectrum can be refarmed, and to draw up a suitable schedule. This too ought to be a major priority. This exercise too should be undertaken immediately, starting within 6 months.**
- **Spectrum Trading: After holding extensive consultations with industry, on 28 January 2014 the Authority made recommendations on 'Working Guidelines for Spectrum Trading'. The Government's decision on this matter is awaited. Since industry consultations have already been held it should be possible to move on this very quickly. For reasons ascribed in this chapter, it is strongly urged that a decision is taken no later than 3 months from now.**
- **Spectrum Sharing: After holding extensive consultations with industry, on 21 July 2014 the Authority made recommendations on 'Guidelines on Spectrum Sharing'. The Government's decision on this matter is awaited. Since industry consultations have already been held it should be possible to**

move on this very quickly. For reasons ascribed in this chapter, it is strongly urged that a decision is taken no later than 3 months from now.

- **Microwave Access and Backbone Spectrum: The Recommendations of the Authority on 'Allocating and Pricing of Microwave Access (MWA)' and 'Microwave Backbone (RF)' carriers were made on 29th August 2014. The recommendations on E and V band are included in this document. The Government's decision on the matter is awaited. Here too it is imperative that a decision be taken on priority, within 6 months.**
- **Annual Royalty Charges for 3.3-3.4 GHz band for last mile access are excessive. These need to be reviewed and rationalized in line with the recommendations of the Authority on E-band. The maximum EIRP of the band also needs to be increased to enable its use in rural areas. This decision also needs priority attention and should be taken within 6 months.**
- **In its Recommendations on auction of spectrum dated 23 April 2012, the Authority recommended that the auction of spectrum in 700 *MHz band may be carried out at a later date, preferably in 2014, as and when the ecosystem for LTE in the 700 MHz is reasonably developed, so as to be able to realize the full market value of the spectrum.* Therefore, the use of 700 MHz band has to be decided within 3 months so that auction of the spectrum can be planned accordingly.**
- **Unlicensed Band: The de-licensing of the 5.725 - 5.825 GHz band for outdoor usage needs to be carried out in the next 6 months. DoT must release larger quantities of unlicensed spectrum (as has been done in many parts of the world) for better quality of service and reducing the strain on existing networks.**

- **New Spectrum Bands: It would not be prudent to make recommendations in isolation on the possible candidate bands for IMT applications. It is better to wait for the outcome of WRC-15. India needs to work in tandem with member countries to ensure a successful outcome of WRC-15.**

J. Conclusion

3.22 Ensuring universal BB access requires a sound and supportive spectrum policy which includes assigning spectrum in a technology and service-neutral manner. The Government needs to re-design and restructure its policy frameworks to realise the larger goal of BB access and delivery. This will enable efficient usage of spectrum through a range of different but coordinated initiatives to achieve greater rural coverage, boost digital inclusion and serve as a springboard for future economic growth, particularly so in remote areas.

CHAPTER 4

Infrastructure – Initiatives Required

A. Introduction

4.0 International experience suggests that growth in the BB market goes through the following three phases of sequential (and, partly in parallel) development:

- Phase I: Network deployment
- Phase II: Ecosystem development (and maturing)
- Phase III: Universal access and welfare

4.1 Depending upon the role of the Government in each of the above market evolution stages, there exist three investment models, namely, Ownership, Public Private Partnership (PPP) and Financial Incentives, which are detailed below:

- The ownership model has the highest level of Government involvement with the Government deploying and owning the BB core and / or access infrastructure.

Box 4.1 Ownership Model

*In **Ghana**, NBP has been completely implemented by Government. The Government launched "Wiring Ghana" project with the objectives of expansion of the fibre backbone to facilitate broadband availability across country and support e-governance programme. The network is being deployed by equipment vendors in two phases with complete funding from Government. The total cost of the project is partially supported by loans from the Government of China.*

- The PPP model envisages a somewhat smaller role for the Government, with Government partnering with one or more private operators in developing the BB infrastructure.

Box 4.2 Public Private Partnership Model

*The broadband market in **Australia** has been developed under the PPP model supported by financial incentives from Government. Government's focus has been on reforming the current telecommunication regulatory regime which has been in place since 1997, and the competition regime, which was due for review in 2009. With the new network and competition reforms, Government is expecting an increase in competition leading to lower prices and better quality of service. The key objectives of the National Broadband Plan are:*

- *To improve Australia's productivity, economic prosperity and service delivery in the areas of education & healthcare and combating the impact of climate change.*
- *Wholesale-open access broadband coverage to 90% of households with speed of 100 Mbps using FTTP and 12 Mbps to 10%, using next generation wireless and satellite technologies by 2018.*
- *Provide equal, wholesale access to retailers enabling them to deliver advanced digital services and applications and create 25k jobs every year.*

- The financial incentives model defines Government's role as a facilitator for providing incentives and grants to public and private sector companies for deploying BB infrastructure, but without entailing any Government ownership.

Box 4.3 Financial Incentives Model

*In **Japan**, the Government used financial incentives in the growth phase of industry to develop core and access infrastructure. The government established the IT New Reform Strategy to solve social problems through utilizing ICT and included 15 areas such as environment and e-government services. The following objectives have been defined in the BB plan:*

- *To enable ubiquitous connectivity, user friendliness and access to unique content with a focus on development of ubiquitous networks, advanced ICT usage, upgrading enabling environment and technology strategies.*
- *Promotion of key projects by digital special zones and vitalization of industries/communities and development of new industries and digital infrastructure through a three year Emergency Plan.*
- *To cover whole economic system enabling a high standard of living and connecting people. The three priority areas include e-government (national/local), medicine/ healthcare and education/human resources through the i-Japan strategy.*

4.2 Normally, the Government plays the most crucial role in the network deployment stage to ensure availability of infrastructure for BB services. The direct role of the Government is considerably less in the ecosystem development stage as service providers' start focusing on offering BB services only in viable areas. However, again in the last stage, the role of the Government assumes great importance; it has to ensure availability of services even in non-viable business areas.

4.3 India is currently in the initial phase (Phase I) of the global BB evolution and growth framework. In order to catch up with other leading economies, these three phases need to be compressed into two for faster deployment and adoption of BB in the country. The first and third phases, at least as far as network deployment and coverage are concerned, need to be simultaneous for realizing NTP objectives.

4.4 Digital infrastructure will power the next round of mega changes as connected devices converge bringing greater efficiency and opening new possibilities for the future. Industry players and society at large are expected to leverage digital infrastructure to create new and additional economic value. With a renewed and concentrated focus on digital infrastructure under the new Government, India can look forward to squarely addressing the current social and economic challenges, apart from bridging the digital divide. In addition, digital infrastructure can also be expected to play a big role in the success of the **'Make in India'** initiative.

4.5 The development of the telecom infrastructure depends on four key factors: **rollout**, **competition**, **price**, **safety** and **aesthetic concerns**. The rollout of services by TSPs depends on a robust and reliable telecom infrastructure which also has extensive coverage. Competition further drives the development of this infrastructure. Affordable and reasonable prices of telecom services, achieved through competitive

pressures, will drive the demand for more services. That, in turn, will translate into accelerated development of telecom infrastructure, completing the virtuous circle.

4.6 Chapter 2 discussed various issues plaguing the telecom infrastructure sector. And, **fibre**, **towers**, **networks** and **spectrum** are the key components of this infrastructure. **Spectrum** has been covered in detail in the previous chapter. This chapter, therefore, focuses on the initiatives required to ensure that the cost and speed of rollout of both fixed and mobile telecom infrastructure are optimized.

B. Deployment of Optical Fibre Cable

4.7 At present, the bulk of Internet/BB applications and services in India, such as e-mail, Internet browsing and instant messaging, consume very low bandwidth. However, in future, high bandwidth applications such as video-on-demand, tele-medicine etc. both in rural as well as urban areas, will require much higher BB speeds. To ensure quality of service, delivery of high bandwidth applications and data usage growth, a strong backbone and backhaul infrastructure is essential. It also needs to be scalable at low CAPEX and low OPEX. OFC, due to its ability to carry high data volumes, is, therefore, ideally suited to meet long-term data requirements.

4.8 As highlighted in Chapter 2, RoW charges are the single biggest impediment to adoption of any wireline technology. The RoW charges being levied by various States and Urban Local Bodies are shown in Figures 4.1 and 4.2 respectively. As can be seen, the RoW charges vary from anywhere between ₹1.75 lakh per km to ₹192.375 lakh per km. In addition, certain States are demanding free bandwidth to all Government institutions whereas some other States are even levying annual rentals. A rough approximation of the cost of fibre works out to ₹65,000 per km whereas the average cost of laying works out to ₹2-2.5

lakh per km i.e. 3-4 times the cost of the fibre. In some urban settings or major metropolitan areas the cost of laying the fibre is anywhere between 10-20 (if not more) times the cost of the fibre.

Figure 4.1 Right of Way Charges Levied by Various States

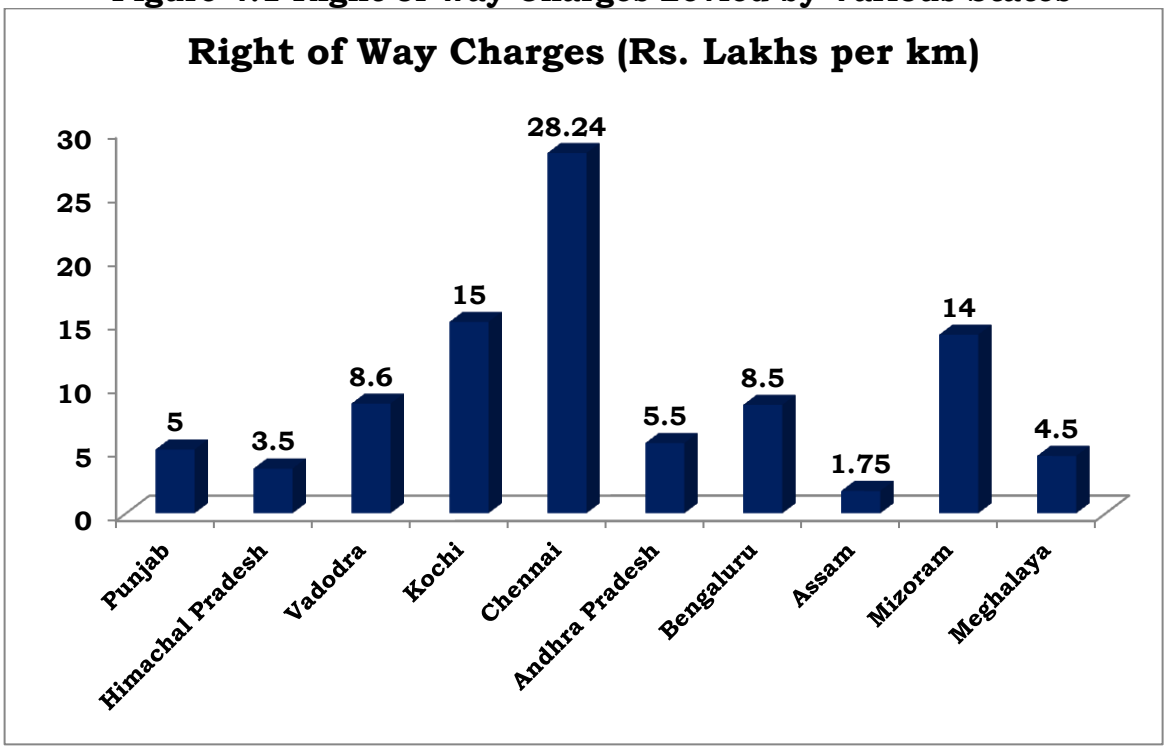
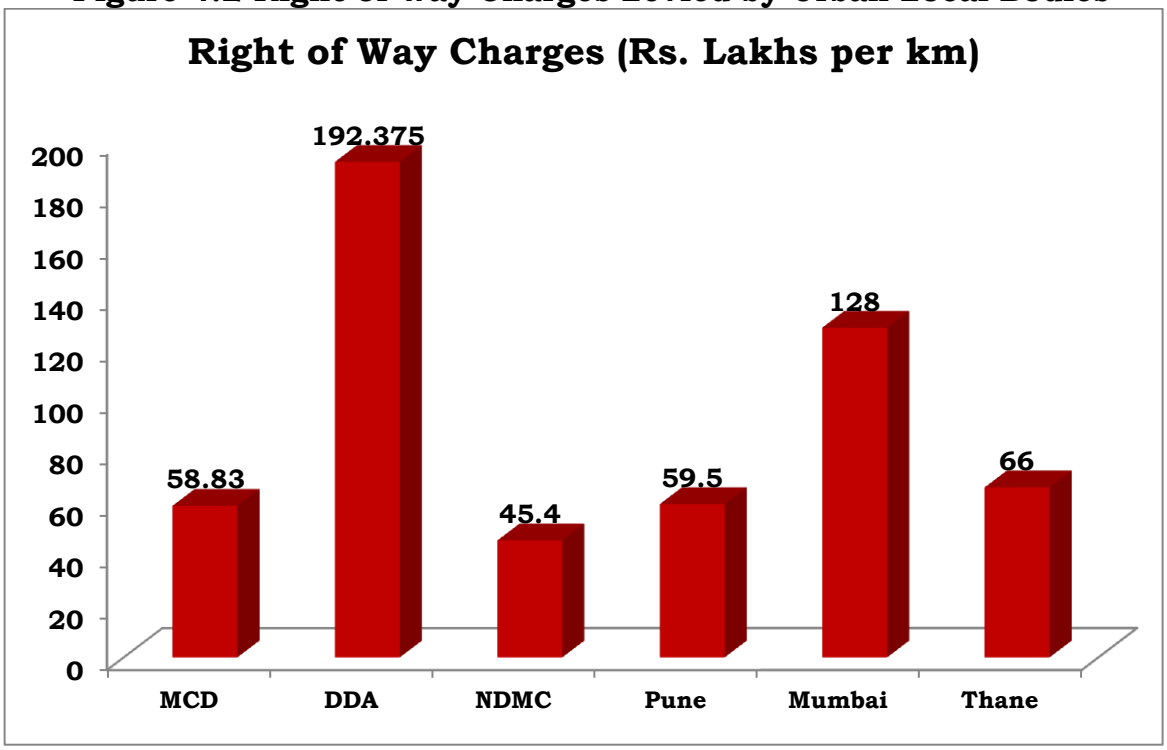


Figure 4.2 Right of Way Charges Levied by Urban Local Bodies



4.9 Fibre based networks, which are capable of providing near-limitless capacity, offer the most future-proof approach in meeting BB demand over the long term, not only for fixed services, but also for mobile network services.

Action Points

- **Single-window clearance is an imperative for all RoW proposals at the level of the States and in the Central Government. All such clearances have to be time-bound so that TSPs and infrastructure providers can move rapidly to project execution. Ideally, single-window clearance should be administered online with a defined turnaround time. The reasons for denial of RoW permission should be recorded in writing.**

- **All infrastructure sectors such as road construction authorities/agencies like NHAI/SH/PP Projects must include, in their construction design policy, a provision for a utility duct to enable laying of OFC for all new infrastructure and also adopt similar measures in existing projects in a "Dig Only Once" policy approach.**

- **RoW agencies/authorities should mark the area for laying of underground cables at a significant distance from roads considering expansion plans over the next 10 years to protect the investment in fibre infrastructure and avoid service disruption during expansions.**

- **Strong administrative and legal provisions (even contractual) need to be put in place for payment of compensation in case of cable cut or cable damage by any agency including Government agencies, private agencies or private third party agencies executing the digging work.**

- **The only charges levied should be towards restoration or reinstatement which should be directly linked to restoring the surroundings to their original state. The RoW rates should therefore be standardized and fixed and uniform procedures must be brought into practice for all agencies.**

4.10 There is a need for enunciating a National RoW Policy to ensure uniformity in costs and processes. The policy should encompass the following actions:

- **RoW Rules can be notified in exercise of powers under Section 7 of The Indian Telegraph Act**
  - **Principles on which reinstatement charges can be demanded by local authority for underground telecom infrastructure.**
  - **Specifically prohibiting other forms of charges/levies/ demands.**
  - **Rentals chargeable only if ducts are constructed by local authority.**
  - **Process and reasonable time limits for approval.**

- **Invoking powers under Section 15 of the Indian Telegraph Act for dispute resolution with local authority.**

- **Work out a mechanism with States for use of electricity poles for last mile access infrastructure.**

- **There is a need to change building by-laws which currently deem only electricity, water and fire safety as necessary infrastructure for the issue of a completion certificate. Including mandatory inclusion of either ducts/optical fibre with well defined access mechanisms in all upcoming office complexes, commercial spaces and residential complexes would have a significant and measurable net positive impact on BB penetration.**

- **Fibre network of a TSP should be awarded a critical infrastructure status.**
- **Standard processes and rules for laying overhead fibre should be laid down by the Central Government that can be adopted by State Governments and State bodies.**

B.1 National Optical Fibre Network (NOFN)

4.11 As discussed in Chapter 2, the NOFN project is swamped with a large number of problems. The present network planning for providing 100 Mbps bandwidth connectivity to all GPs irrespective of the GP population may not be correct. Last mile access planning is critical for realizing the policy objectives of inclusion and universal access. BBNL has been created as a SPV. However, it is also executing installation work directly for 50,000 GPs. Also, it has acquired an NLD license and therefore, has become a natural competitor to the other three PSUs who have been entrusted with the work. The shortcomings both in terms of architecture and implementation have been discussed at length in Chapter 2 and need to be addressed.

Action Points

- **Institutional change: The multi-layered structure for decision-making is just not suitable for a project that needs to be executed in mission mode. The structure needs immediate overhaul. Quarterly timelines should be prescribed for each milestone to ensure timely corrective measures. It is also imperative to set up a monitoring mechanism for each stage of the project so that the outcomes are quantitatively measured after completion of each milestone. Stakeholders should be co-opted both for execution and most definitely for monitoring. In any event, full and transparent public disclosure of monitoring outcomes must be mandated.**

- **The bandwidth equipment for network planning needs to be re-assessed considering GP population and other relevant factors.**

- **BBNL needs to be professionally managed. The Delhi Metro Rail Corporation (DMRC) model is worthy of emulation.**

- **Project implementation on Centre State Public-Private Partnership (CSPPP) mode by involving State Governments and the private sector.**

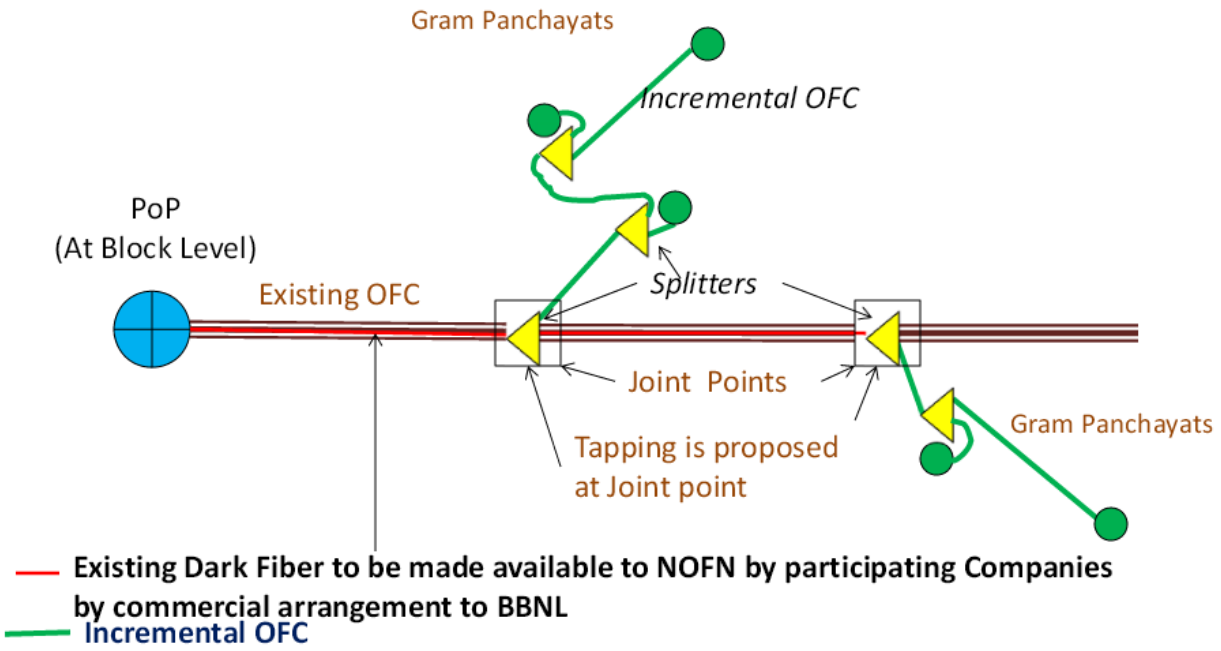
- **To ensure redundancy and reliability, network planning would consider ring architecture for Districts in the first stage followed by Block rings and GP rings at subsequent stages.**

- **The sizing of Optical Fibre i.e. 24/48/96 core needs to be finalized based on requirement and carrying out a cost-benefit analysis.**

- **Award of EPC (turnkey) contracts by BBNL to private parties through international competitive bidding needs to be planned. Such contracts can be given region-wise with clear requirements for interconnection with other networks, as well as infrastructure sharing with other operators who would like to utilize this network. A commercial model around this will need to be suitably deployed.**

- **NOFN involves laying of incremental OFC only (as indicated in green below). However, at various places, the problem of existing OFC (as indicated in red below) being in an unusable condition is being encountered which renders the OFC being laid of no use. Therefore, there is a need to cater for connecting the NOFN OFC directly to the PoP at District level in such cases.**

Figure 4.3 OFC Layout Details: NOFN



C. Installation of Towers

4.12 The essence of wireless communication is radio communication. This radio communication for ubiquitous coverage is dependent on telecom towers. Without towers there can be no mobile wireless communication. The recent activism with regard to EMF radiation has resulted in directions from courts to remove towers from residential areas, hospitals and other public spaces. The NIMBY problem, i.e. not in my backyard, has led to a situation where consumers on the one hand are not allowing towers to be installed in their neighbourhood but on the other hand are demanding better quality of service. In this regard there is a need for extensive consumer awareness and education programmes so that consumers fully understand the latest scientific information on EMF radiation and its potential impact on health. The Authority has already issued an information paper on "Effects of Electromagnetic Field Radiation from Mobile Towers and Handsets" dated July 30, 2014 which is available on the website of TRAI. The recent initiative of the Government of Kerala to allow towers to be installed on Government buildings is significant and worthy of emulation elsewhere.

4.13 As demand for mobile services grows, additional coverage and capacity sites will have to be deployed. Telecom towers, which greatly serve this purpose, are broadly classified as ground-based and rooftop towers. Ground based towers (GBT) are mostly present in rural and semi-urban areas because of easy availability of real estate. GBTs can accommodate up to six tenants. Rooftop Towers (RTTs) are placed on the roofs of high rise buildings and are common in urban and highly populated areas, where there is paucity of real-estate space. RTTs can accommodate two or three tenants. Some of the major problems being faced by the TSPs are – (a) availability of space for installation of towers, especially in urban areas, and, (b) getting timely permission from the local bodies. For example, in the national capital, New Delhi, it is very difficult for a TSP to get permission for installation of a tower in Lutyens Delhi.

Action Points

- **Single-window, time-bound clearance should be encouraged for installation of towers to ensure the rapid development of national networks.**

- **A nominal one-time administrative fee covering the cost of administration of the clearance/permit should be levied.**

- **Electricity may be provided to BTS sites on priority.**

- **Extensive consumer awareness and education programmes should be organized so that consumers fully understand the latest scientific information on EMF radiation and its potential impact on health.**

D. Last Mile Access

D.1 Fixed line BB

4.14 Several wireline and wireless BB technologies are used today to support local access networks. Different technology options have their own advantages and limitations and are suitable for different requirements. IP traffic is set to increase with the emergence of new applications and services and ultra high quality video, all driving user demand for more data anytime, anywhere and on any device. The growth of the Internet of Things (IoT) and the movement towards a connected world will also drive more traffic. No single technology can sustainably meet this demand and trying to do so would have severe technical and economic consequences. To ensure that users can access the services they need, hybrid solutions are essential. Only by building on the strengths of all technologies can we develop solutions that will provide services that are inclusive and, to the extent possible, future-proof.

4.15 Fixed Networks have traditionally carried the bulk of the data globally. Even if the future is mobile, fixed BB will still play a vital role. Despite sizeable investments in mobile networks and spectrum for data, connection speed remains a concern. With a greater focus on service quality and connectivity, as in Europe and North America, markets will focus on fixed lines as a way to enhance access and speed. Content will also grow in line with the available bandwidth causing high definition videos to become the norm.

4.16 While the growth of telecom services is being driven by mobile phones, in a number of countries, fixed line service has also registered simultaneous growth. For instance, in China, fixed line connections are more than 255 million along with 1267 million mobile connections. In striking contrast, India has merely 27 million fixed line connections as compared to 943.97 million mobile connections. Thus, India needs at least 200 million more fixed lines. As the cost of installation and

maintenance of a fixed line is much higher than mobile telephony, there is a need to create incentives for TSPs to invest in the fixed line business. In a bid to promote investment in, and adoption of, wireline networks (so that they become an effective vehicle for the delivery of high-speed Internet in the country), the Authority has prescribed 'ZERO' Fixed Termination Charges as well as Mobile Termination Charges for wireline to wireless calls through the Telecommunication Interconnection Usage Charges (Eleventh Amendment) Regulations, 2015 (1 of 2015).

4.17 At present, the infrastructure of PSUs - the outside plant (OSP) - is lying under-utilized. This can play a very vital role in penetration of BB especially in urban areas as last mile access in such areas remains a cause of concern.

Action Points

- **To promote fixed line BB, the license fee on the revenues earned on fixed line BB should be exempted for at least 5 years.**

- **There is a need to mandate city developers and builders to have properly demarcated sections within buildings and on rooftops for housing BB infrastructure and antenna. These areas should have uninterrupted power supply for reliable, always-on services.**

- **The infrastructure of PSUs is lying unutilized and thus they should be mandated to unbundle their network and allow sharing of outside plant (OSP).**

D.2 Cable (BB through Cable TV networks)

4.18 Although some countries have a significant number of Cable TV (CATV) subscribers, cable BB penetration on a worldwide basis remains relatively low, particularly in developing countries, because cable

operators have not made the necessary investment in upgrading their network. Upgradation of the cable TV network per line requires significant investment. There are apprehensions on the part of cable TV operators that providing only BB services over the cable TV network may not give them a commensurate rate of return on the investment necessary for upgradation.

4.19 There are 99 million households having Cable TV Access i.e. 37 per cent of the total households in India. The Multi System Operators (MSOs) and the Local Cable Operators (LCOs) have an inherent strength in providing last mile access. The sheer reach of the cable network to large number of households renders this infrastructure both amenable and ideally suited to the delivery of BB to a large segment of the population very quickly. Internationally, the growing convergence of broadcasting and BB is being recognized, yet the two have distinct markets for their own respective industries. In many developed countries BB is, in effect, delivered through the cable system. The MSOs and LCOs can play an important role in the delivery of BB as we move towards convergence. Some of the initiatives required for the rapidly evolving value chain are:

- **Cable operators should be allowed to function as resellers of ISP license holders to enable them to take advantage of their cable network to provide BB.**

- **Implementation of digitization of cable services to tier 2 and tier 3 cities in a time-bound manner. The digitization implementation schedule is given at '<u>Annexure I</u>'. This timeline needs to be brought forward urgently if we are serious about quick BB delivery. In any event under no circumstances should it be further postponed (to expand outreach and hasten delivering of BB).**

- **Lower the costs of infrastructure investment by lowering customs duty on Hybrid Fibre Coaxial (HFC) based network equipment and Customer Premises Equipment (CPE).**

- **Viable business models need to be created by encouraging LCOs' entrepreneurship skills and guiding them to handle the new business.**

- **Financial support through banks/institutions and USO Fund.**

- **Provision of bandwidth at a subsidized price to operators serving underserved areas to ensure affordable BB.**

D.3 Satellite

4.20 Considering the topography of India, there exist about 10-15 per cent of places which cannot be reached by optical fibre. Satellite communication can serve as communication solution for such areas. A key concern in the deployment of BB services through satellite in India is the restrictions imposed on providing satellite bandwidth competitively. As per present practice if any ISP or DTH provider wants capacity from a satellite, it approaches ISRO and its commercial arm, ANTRIX, to provide capacity even if capacity for the India region is available with an international satellite. More often than not, ISRO has no transponders to offer. And, yet, does not permit commercial organizations to lease capacity from available international satellites. This is a Catch-22 situation. If we are serious about harnessing satellites for BB services such a stance is simply not justifiable. Through its recommendations on 'Accelerating Growth of Internet and Broadband Penetration' dated 29th April 2004, the Authority had recommended that an *'Open Sky' policy should be adopted for VSAT operators similar to what is available to ISPs and broadcasters. VSAT service providers should be allowed to work directly with any international satellite.* Ten years later we are no closer to such an 'Open

Sky' policy for space. As per industry inputs a total of about 140+ transponders are presently available over Indian skies. An **'Open Sky'** policy will permit exploitation of this resource and facilitate expeditious proliferation of BB especially in regions which till now have been termed as **'Technically Not Feasible (TNF)'**. In addition, satellite communication technology is experiencing various changes such as the use of Ka band satellites, which can provide large capacity and higher speeds.

Action Points

- **A decision on the recommendation of the Authority on 'Open Sky' policy needs to be taken in the next 6 months. This will allow TSP/DTH/VSAT operators access to International Satellite Operators. This is the only way forward if we are serious about delivery access to otherwise remote and inaccessible areas or those with difficult terrains.**

- **Separation of Licensor, Regulator and Operator functions in the satellite space domain to conform to best international practices of free markets.**

- **The issue of coordination of additional spectrum in the 2500-2690 MHz band with DoS needs to be addressed urgently, so that this band can be optimally utilized for commercial as well as strategic purposes.**

- **Time-bound award of licenses for operating satellite services.**

- **Regulating/Opening of Ka - band.**

E. Hosting of Content in India: Saving of Cost of International Bandwidth

4.21 The BB network consists of three elements viz., international, national and last mile connectivity. International bandwidth is upstream connectivity either through submarine cable or satellites which

constitutes a major network operating cost. Today, majority of the BB traffic in the country uses the international bandwidth as most of the popular sites are hosted outside the country. The reasons cited by the stakeholders for not hosting the sites in the country are lack of robust infrastructure including availability of 24x7 power supply and air-conditioning; RoW for the backbone; non-transparent regulatory framework and excessive security conditions.

4.22 As per a report[8] India ranked 29th among 30 countries in terms of the Data Centre Risk Index which gives the country ranking according to risks likely to affect successful data operations, which has Asian countries like Malaysia, Thailand and Indonesia having less risk as compared to India. It is imperative that the Government should take steps to address the above infirmities so that the web companies are incentivized to host their servers in the country; not only to cater to the Indian traffic but also for the traffic for at least South Asia. This can reduce Internet traffic that leaves the country and also results in reduction of international bandwidth charges. This will also have a positive impact on the speed (low latency) and delivery. Latency in availability of the Internet based content plays an important part in the kind of experience a user has while accessing the same.

4.23 The Government should look at providing tax-holidays for companies (on the lines of industrial parks, SEZs etc.) that deliver digital content or services through servers based in India. There is thus a need to facilitate a '**Host in India**' campaign in the spirit of '**Make in India**'.

Action Points

- **The Government needs to encourage local and foreign companies to build 'Data Centre Parks' on the lines of industrial**

[8] Data Centre Risk Index Report, 2013 by Cushman and Wakfield

parks, SEZs etc. by providing them land, infrastructure and uninterrupted power supply at affordable rates.

- **Presently, telecom companies are subject to license fee on data centres but non-telecom companies are not. The anomaly needs to be addressed at the earliest.**

- **Adequate policy initiatives for attracting global content hosting should be formulated. The global data hosting which does not pertain to India should be kept beyond the purview of Indian laws.**

F. License Fee on ISP License

4.24 There are at present, 438 ISP licensees (99 at All India Level, 210 at State/Metro Level and 129 at the District Level). Only 150 of these licensees are reportedly operational. In terms of revenue, the top 10 ISPs (having revenue more than ₹ 100 crore) have garnered nearly 90 per cent of total revenue of ISPs. With a view to promote and incentivize smaller ISPs, the Authority in its recommendations on "Definition of Revenue Base (AGR) for the Reckoning of License Fee and Spectrum Usage Charges' dated 06th January 2015, has recommended *'ISPs having AGR less than ₹ 5 crore in a year should pay license fee or ₹ 10 lakh or actual LF based on the applicable rate, whichever is less'*

Action Point

- **A decision on the recommendation dated 06 January 2015 of the Authority to incentivize small ISPs with a view to provide an impetus to BB penetration needs to be taken in the next 6 months. This is a relatively simple matter with no serious revenue implications; yet, it is a decision which will bring in necessary investments and outreach to unconnected areas.**

G. Infrastructure Sharing

4.25 Massive network investments are required to meet the ever increasing demand for data usage. However, this also comes at a time when there is pressure on the TSP's revenues, ever increasing bandwidth requirements for Over-the-Top (OTTs) applications, and unbalanced data connection agreements. This has left the industry reluctant to invest in long-term financing that is necessary for network upgrades.

4.26 Rather than investing on basic infrastructure and creating duplicate networks, the service providers need to concentrate on deriving optimal efficiency by investing on research on higher network layers. Duplicate passive networks make no sense in terms of competing for innovation, service quality and differentiation.

4.27 Infrastructure Provider – 1 (IP-1) provide assets such as dark fibre and towers. The key beneficiary of infrastructure sharing is the subscriber as it leads to optimal use of scare resources and cost savings in terms of CAPEX and OPEX of TSPs. The sizeable capital and investment required to further develop telecom infrastructure is a big deterrent for many small TSPs. The problem has been further aggravated by fast-evolving telecom technology that requires supporting infrastructure to be constantly upgraded to keep pace. Therefore, there is a need for appropriate policies to encourage sharing of passive and active infrastructure among TSPs to improve penetration and competition.

4.28 To adopt policy measures to minimize infrastructure duplication by ISPs, the Authority in its recommendations on 'Issues related to Telecommunications Infrastructure Policy' dated 12th April 2011, recommended:

(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 licensee should also be permitted to possess and maintain wireless telegraphy equipment.

(iii) Such unified licensee may also be assigned spectrum for providing backhaul through microwave system.

Action Point

- **The Government's decision on the Authority's recommendation on 'Issues related to Telecommunications Infrastructure Policy' dated 12th April 2011 is awaited. The global trend is a move towards infrastructure sharing. This is not a complicated matter and needs to be finalized in the next 6 months.**

CHAPTER 5

Making Broadband Useful: The Potential of Applications

A. Introduction

A.1 Demand for BB

5.1 India has a huge latent demand for BB services that can bring numerous benefits to its huge populace such as opportunities for education, governance, entrepreneurship and delivery of services. Clearly, they can act as an impetus to accelerate the growth of the economy. In particular, these opportunities hold out great promise for India's large low- income population.

5.2 Governments can increase BB demand by acting as model users or anchor tenants and by promoting e-Government services and BB related standards, putting content online, and supporting the development and distribution of digital content by other players.

5.3 Increased public awareness and the ability to use BB services are driving demand for BB services and applications. A highly local approach to content, applications, skills and affordable access such as shared use models will drive demand and adoption in local communities, encouraging a sustainable ecosystem open to entrepreneurs and service and product developers. The challenge of providing sufficient power in many remote areas may be overcome through judicious use of renewable energy sources or access to the grid with the TSP acting as anchor tenant. Easy availability of affordable international connectivity is vital to support future data demands, access international content and ensuring security and reliability. The Government can provide incentives for apps developer communities to encourage the development of apps particularly in high social impact areas of health and education.

5.4 India's focus on inclusive growth underscores the importance of achieving broader and deeper Internet penetration in the coming years. The Government is making a concerted effort towards equitable development through programmes that will increase the access of rural and urban populations to employment, education, nutrition, infrastructure and financial services. Public sector banks are rolling out financial inclusion programmes such as the 'Pradhan Mantri Jan Dhan Yojana' on a large scale. This will provide financial service access to the poorest segments of the population. The Union Budget 2015 builds on the JAM (Jan Dhan, AADHAR, Mobile) trinity representing the confluence of money, identity and mobility.

A.2 Ecosystem for BB

5.5 The country thus needs digital inclusion to make a success of all these efforts and efficiently target them towards intended beneficiaries. For example, financial inclusion in rural areas, aided by web technologies, can help channelize Government resources directly to the intended beneficiaries without leakage. There is, therefore, a compelling economic and social rationale for widespread BB adoption in terms of connectivity, devices, and content applications. As discussed in the report earlier, for potential customers, affordability of devices, the cost of connection and cost of service are large relative to income levels. A suitable policy framework providing lower entry and usage prices for consumers is vital for ensuring a virtuous cycle of growth similar to mobile telephony.

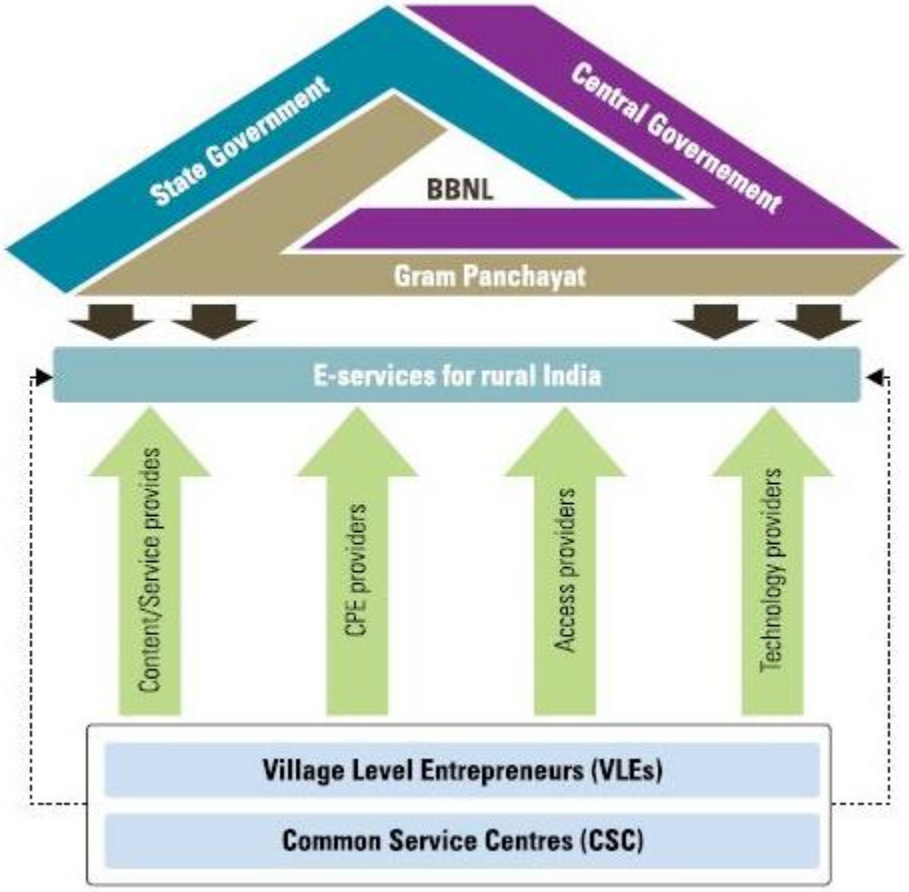
Table 5.1 Key Ecosystem Participants and their Roles

Ecosystem participant	Role	Entities
Government	• Provide enabling infrastructure • Provide G2C services • Endorse and certify e-offerings, wherever applicable (e.g. e-learning courses) • Provide financial support, wherever necessary • Provide and monitor overall regulatory framework	• State Governments • Central Government, BBNL
Public/private businesses	• Offer last mile access • Offer technology platforms and infrastructure • Provide content and applications in local languages • Offer delivery points for e-services	• Access and technology providers • Hospitals • Banks • Niche content providers (e.g. weather alerts, crop pricing information, etc.) • Private education service providers • Agri- cooperatives/suppliers • Trading and financing companies • Common Service Centres (CSCs) and Village Level Entrepreneurs (VLE)
Local governing bodies	• Spread awareness • Push G2C services • Facilitate training and adoption • Collect user feedback • Monitor progress of projects	• Gram Panchayats

5.6 There is an urgent need to move beyond motherhood statements about National e-governance. The pressing need is to expand and expedite the actual rollout of easy-to-use applications which deliver public services. The Government's ₹ 1,13,000 crore Digital India initiative has set the stage for offering a one-stop shop for Government services. As the fibre content of NOFN gets ready, it is important to ensure that there is a steady supply of relevant content and applications in key growth sectors such as education, healthcare, banking and agriculture etc. To this effect, the need of the hour is to create scalable, commercially feasible business models underpinning a public-private-panchayat ecosystem.

Figure 5.1 The NOFN Ecosystem and Participants

[Source: KPMG Analysis]



5.7 The NOFN infrastructure is likely to pave the way for relevant e-services. But to operationalise those services, various stakeholders need to come together. There is a clear need for cost-effective devices, vernacular content and low-cost applications relevant to local users. The ideal NOFN ecosystem is one that will involve the Central and State Governments, the providers of enabling products and services (both public and private), and local governing bodies to drive and monitor these services at the grass-root level.

5.8 **The need for Public-Private Partnership (PPP) in delivering BB to the masses**. BB networks cannot deliver value without active Government partnership with private players. The nature and extent of services possible using the infrastructure are diverse and often of vital importance

to deliver on the Government's agenda of social inclusion. The Government and private players bring unique value to the table. The Government brings legitimacy and facilitates economies of scale. Private players, on the other hand, bring efficiencies resulting from devising practical and commercially viable approaches. They complement the Government's investment often with comparable resources of their own. This makes active mutual cooperation and support a priority. It requires recognition of the potential of joint efforts of Government and private players and their importance for ensuring that BB networks are created and commissioned speedily and its huge potential delivered to citizens of India. The private sector is a significant contributor to research, technology, skills, investment and new business models necessary to scale innovative solutions. PPP is widely recognized as a key tool in tackling sustainable development issues. An example of industry participation in delivering e-governance services is given below.

Box 5.1: NASSCOM's Contribution

*The **National Association of Software and Services Companies (NASSCOM)** is a trade association of Indian Information Technology (IT) and Business Process Outsourcing (BPO) industry. It has more than 1,500 members out of which 250 are from developed countries. NASSCOM, as the chamber of commerce for this sector, has been keenly engaging with the Government as a facilitator and advisor in e-governance initiatives, to enable smoother execution and more positive and concrete outcomes.*

MCA21, the Aadhaar Project (UIDAI), Customs and Central Excise, Integrated Citizen Services like MP Online, Karnataka One, CSCs, NREGA, eProcurement, HRMS, SWANs and SDCs are a small sample of the e-governance initiatives that have been launched with support of the Indian IT-BPO sector. NASSCOM studies state that the challenges to ICT are focused around the following issues:

- *Project execution, project conceptualization and scope of work*
- *Absence of a project champion of issues*
- *Delays in deliverables from the Government in timely sign offs to vendors by departments*
- *Project bids incorporating many non-IT items that increase project cost*
- *Absence of counter guarantees in SLAs, to deal with defaults by Government and Government agencies*

NASSCOM can play a pivotal role in policy advocacy in the case of e-governance standards and mobile governance. It is part of several core advisory committees of the Government of India. NASSCOM works closely with DIT to provide necessary industry feedback for all its policies and initiatives.

5.9 **Utilization of Universal Service Obligation Fund (USOF) to bridge the Urban-Rural Divide**. The rural wireline BB connectivity scheme aims to bridge the Urban-Rural divide. The Rural USOF BB plans providing subsidized BB for rural homes and all rural areas needs to be opened up to private TSPs, while ensuring that leakages and gaps are plugged. **Pahal** (DBTL) a scheme providing direct LPG subsidy in the bank accounts of citizens has been launched in all districts of the country on 1st January 2015 and is drawing a positive response. This could act as a model for subsidizing BB on rural connections. The Government therefore must work more diligently to disburse the funds collected, ensuring that the USOF meets the mandate of enabling marginalized and underserved citizens to get online.

5.10 Besides building and providing the necessary infrastructure and ecosystem, content is key to proliferation of BB use. Content is the currency of the Internet; better content means high visibility, more visitors, and results in increased revenue. Therefore, relevant and local content is the strongest vehicle to increase BB demand. Online content can be produced by traditional methods or generated collaboratively by the users themselves – it can be a song played by an Internet radio station, a viral video in an embedded 'YouTube' clip, a blog post, or a news article published by a news website. BB has enabled the easy transfer of all kinds of voice, data, video and multimedia content. The ability to disseminate and access legal content online is critical to development of BB. It affects the deployment of new services and applications, the launch of innovative online businesses and services, and active participation of individuals in social and political spheres.

5.11 While connectivity is important to deliver BB, and has been discussed at length in the previous chapter, focus on connectivity infrastructure to the exclusion of all else is just not workable as a strategy. To build a robust ecosystem for BB penetration, affordable devices, relevant content and the

delivery of Government and public services through specific applications, is of even greater importance. Demand creation for a product is as important as creation of supply.

B. Devices

5.12 The massive growth of mobile telephony would have been impossible without access to affordable handsets and Internet enabled community devices. The massive surge in mobile phone users coincided with the entry of sub - ₹ 1000 handsets. This enabled subscribers with very low income to use mobile phones in their social and work life. A similar challenge exists for BB data services. The prices of Personal Computers (PCs) and laptops traditionally used for access to the Internet have been out of reach for the typical user with a relatively low income. However, mobile phones, especially smart phones, offering much the same functionality for a fraction of the price, have now become the key device to access the Internet.

5.13 India's telecom equipment companies and handset manufacturers have been late entrants into the market and have not been able to achieve economies of scale. Lack of fabrication facilities and a non-existent Research & Development (R&D) ecosystem have stymied the evolution of the nascent equipment manufacturing industry. Telecom equipment imports grew 20 per cent to ₹ 74,116 crores. A study estimates that these are likely to surpass oil imports in the coming years.

5.14 The Government is now providing an impetus to manufacturing telecom equipment by implementing the Preferential Market Access (PMA) policy as part of '**Make in India**' initiative. This policy provides for preferential sourcing of telecom and electronic equipment from local manufacturers. The policy makes it mandatory for the Government to procure a part of its requirements from local manufacturers. However, PMA cannot be the sole driver for developing local industry. Kick-starting local

manufacturing – aimed at global markets – calls for developing specialized telecom clusters while addressing infrastructural, fiscal and legal issues including labour laws.

C. Content

C.1 Content to Drive BB Demand:

5.15 What motivates people to buy BB services and devices is that they believe that BB will enrich their lives, offer convenience, provide entertainment, and improve their economic opportunities. For an end-user perspective what is critical is the availability of relevant and useful online services and applications that allow them to access, create, and share content. Useful content and, importantly, context (such as location-based services, requiring BB access) are perhaps the most important underlying elements for universal BB adoption.

5.16 India's mobile-dominated Internet market composition demonstrates some unique usage characteristics. Mobile-based users tend to consume more information and content designed for small screens, social networking updates, audio - visual interactions, entertainment, chat etc. They are less likely to browse through and research content for long periods of time, as one might when using a PC. Even as mobile-based Internet access devices gain greater share, not all consumers – particularly those in rural areas will be able to afford sophisticated smart-phones. It is, therefore, essential that the new wave of application and services, especially those targeted at rural users, takes into account this changing Internet usage pattern and becomes more mobile friendly.

C.2 Promoting Digital Content:

5.17 Digital content is essentially to be created and delivered by the private sector. Today, innovation and advancement in technology has enabled entrepreneurs to create applications which have resulted in easy to understand interface, ease of use and propagation of Internet to the

masses. The Government, which is one of the biggest users of such technological innovation, is also potentially a large content provider. e-governance and Government service delivery has to be delivered through these applications. Finally, citizens too can drive growth of digital content through use of such services both from the private sector and the Government and user-created content.

5.18 Digital content is the catchword for all the websites, applications, and services available to BB users. It can be based on text, video, audio, or a combination of these. Much of the content available on websites today can be divided into three broad categories: (a) User-generated, (b) Proprietary or commercial, and (c) Open source. User-generated content includes social networking, blogs, podcasts, 'Twitter' updates, 'YouTube' videos, and photos. These forms of social media help drive BB demand by engaging users and ensuring local and personal relevance of content. Government today is also promoting such services by becoming an active user of such applications and services; more and more Government agencies are realizing the value of such tools in reaching out to citizens. As opposed to copyright materials, open-source content is available free-of-charge. In addition, the source code is also freely available to allow anyone wanting to incorporate the content or application into new forms of media.

C.3 Promoting Local Content:

5.19 Native English speakers currently account for the majority of Internet users around the world; thus, most web content is in English. English continues to dominate, but the number of Internet users in China is rising quickly and expected to exceed the number of English language users in the next five years. Despite this shift, a significant obstacle to Internet and BB use by non-English speakers is the scarcity of content in their own languages. Efforts undertaken to create content that is relevant and interesting, using the local language and character sets, are expected

to increase the demand for BB services in local areas. The goal of all such programmes to develop local content is to enhance Internet penetration and promote adoption, leading to an increased demand for BB usage and, hence, potential new revenue streams. In addition to provision of direct grants for the production of local content, Governments can support development of local content and applications in other ways, such as development of standardized keyboard, character sets, and character encoding. This type of indirect intervention would enable users to create content in their own languages.

5.20 Additionally, translation and standardization of operating systems into local languages can help facilitate the development of local applications that are relevant to local users. Some forms of user-generated content, such as 'YouTube' videos, face fewer barriers to expression, as the speaker is recorded directly in his or her own language. 'YouTube' has launched a localization system, where 'YouTube' is available in 31 local versions and a worldwide version.

5.21 Governments can also play an important role in developing local content and local applications by directly creating local content in the form of e-governance applications.

D. Applications to Drive BB Demand

5.22 Within the BB ecosystem, the availability of applications is an important factor that critically impacts and drives demand. Socially relevant applications for banking, education, health and governance will be a major factor driving growth of BB usage in India.

5.23 Government services and applications fall into the following broad categories:

- Making information on Government policies, programmes and projects available
- Enabling citizens to conduct transactions pertaining to Government

services

- Participating in the political process

5.24 With increasing penetration of BB and mobile services, communication technology provides a platform using which the country can leapfrog into providing affordable quality education and healthcare to the masses. BB availability will also open up significant commercial opportunities. Service growth is expected in the following fields also:

- **m-banking:** For the 2.5 billion people estimated to be unbanked worldwide, mobile phones can enable access to credit and banking services, such as M-Pesa launched in Kenya in 2007. By making small transactions possible at low cost, they provide financial inclusion for the poor. India has a large unbanked population with limited access to formal financial institutions. The main challenge preventing financial inclusion in rural areas has been the lack of access to bank facilities. Mobile phones have the power to deliver financial services to this unbanked population.
- **m-health:** Use of BB has the potential to save millions of lives a year. As smartphones become more widespread, a growing number of healthcare apps will be developed. These apps can make a real difference on the ground. For example, there are simple but revolutionary apps that can be used to diagnose malaria on the spot. These apps typically process a picture taken by the phone of a blood sample, detect malaria parasites, quantify how many parasites are there in the sample and even highlight the parasites in the phone. Once these data are uploaded online by phone, they can then be used to spot and monitor disease trends, helping to play a vital role in prevention as well as in treatment. An important part of the programme consists of educating health workers about the disease. Similarly, information on public health can be made available through these apps. Diagnostics for tuberculosis and oral

rehydration therapy (ORT) schedules including reminders for dosages can be given to patients. India has 0.5 physicians per 1000 patients, which is much lower than the global average of 1.9 per 1000, posing a major challenge in healthcare delivery, especially in rural areas. m-health can provide education and awareness, remote data collection, monitoring diseases and epidemic tracking and diagnostic and treatment support. An example of the success of a similar m-health programme in Senegal is presented below.

Box 5.2: m-health in Senegal

***Senegal**, a country from the African continent which has jumped three spots last year to be **ranked 130th (just behind India) in the IDI index of ITU** for the year 2014 has a **mDiabetes** health project in coordination with ITU and WHO. Diabetes has traditionally been viewed as a disease of rich countries. However, estimates of diabetes prevalence show that four out of five people with diabetes live in low and middle income countries. The **mDiabetes** project in Senegal aims to address the challenge by using mobile phones to increase awareness among the population about diabetes symptoms and sending preventive messages, as well as educating parents about how to better manage their disease.*

- **e- and m-**education**:** 85 per cent of Indian schools are in rural areas and they lack adequate facilities and infrastructure. e- and m-education initiatives can bypass infrastructure roadblocks and open avenues for greater awareness and dissemination of education in remote areas. Educational effectiveness can be improved through the use of ICT. The focus could be on bolstering school education as well as building skill-sets to address the significant need for rural employment. Besides the Central Board of Secondary Education (CBSE) most States have got their own education boards. For example, the Central Government through its e-education programme can create standardized modules in Science, Maths and English for students of Class VIII-X. Similar modules in Physics, Chemistry, Maths, Commerce and English can be made for Class XI and Class XII students. For this efficient resource persons can be

identified, standard content created and a procedure to monitor progress of students' mandated. These modules can be used both for teaching as well as self-learning. Similar initiatives would be required at the State level. This would lead to improved quality, coverage and penetration of education. In the long term lower drop-out rates can be expected. Funds for such schemes can be channelized through allocation from some of the Government schemes like the Rashtriya Madhyamik Shiksha Abhiyan (RMSA) which aims at providing universal access to secondary level education by 2017 and achieving universal retention by 2020. In this context, the example of Zambia adopting a similar successful model presents an interesting case study.

Box 5.3: e- and m-education in Zambia

Zambia *a country* ***ranked 144th*** *as regards to IDI has a complete blended e-learning solution* ***iSchool*** *that covers the entire Zambian primary curriculum. It provides detailed lesson plans for teachers (some 6000 in total) guiding them towards interactive enquiry based learning.* ***iSchool*** *uses the* ***ZEduPad****, a low-cost low-power tablet, which comes pre-loaded with all the* ***iSchool*** *learning content and which can be run off solar power. The same* ***iSchool*** *content is also available via free standing purpose-built notebook devices, or via the web. There are home, school and teacher versions. BB can now bring modern e-learning to isolated locations. It is estimated that close to 1,60,000 of direct beneficiaries by 2015 will be children of low-income families, with around 50 per cent of these beneficiaries being girls.*

- **e- and m-governance:** e-Government falls into four categories based on delivery model. These are:
  - Government-to-Consumers (G2C)
  - Government-to-Business (G2B)
  - Government-to-Government (G2G), and
  - Government-to-Employee (G2E)

Most applications and services largely fall under G2C. e-Government services offer rich, local, real-time information accessible by everyone, resulting in more transparent Governments, businesses and other institutions, increasing trust and forging a sense of community on

unprecedented levels. e-Government services and online forums provide people with a platform to engage and interact with Governments when previously it would have been difficult for them to do so. e- and m-governance have emerged as tools for improving the quality of Government services and offering greater transparency.

5.25 There have been scattered (and sporadic) initiatives in developing; (i) socially and economically useful apps (ii) content apps that actually deliver Government services at the citizens' doorstep. However, these initiatives fall far short of what is required to enable and facilitate pick-up (demand) for BB. There are a number of factors that have limited the growth and adoption of BB in the country. They are:

- **Connectivity:** Impeding the uptake of digital service is the lack of connectivity.
- **Fragmented initiatives:** Although the Government, private players and Non-Governmental Organisations (NGOs) have undertaken several initiatives to increase the use of m-services, these efforts have been fragmented and only targeted towards specific communities or groups or States, districts or panchayats.
- **Financial feasibility:** There is a lack of a proven business model that can ensure economic feasibility for private TSPs.

E. Business Models for Delivering BB

5.26 Providing relevant BB enabled services through a Public-Private ecosystem requires strong business models with clear returns for each stakeholder. While the state would demand tangible social returns in the form of employment generation and skill building for the rural population, private sector enterprises would seek long-term commercial viability. There are a number of pilot projects implemented across the country as Corporate Social Responsibility (CSR) or for rural development. Most of these have been tested in trials successfully on a limited scale and with a

non-profit motive. Some of these are listed in Table 5.2:

Table 5.2: e - Initiatives in India

Sector	Provider	Project	Motive
Education	Microsoft	Project Shiksha (Teacher training)	CSR: Not for profit
	SREI Sahaj	e-Shiksha	For profit (through CSC scheme)
Healthcare	ISRO	Telemedicine Network	Rural development: Not for profit
	Cisco	Project Samudaya	CSR: Not for profit
Banking	Cisco	Bank on Wheels (branchless banking)	CSR: Not for profit
Agriculture	ITC	e-Choupal	CSR: Not for profit
	TCS	mKrishi	CSR: Not for profit

5.27 A business model for delivering telemedicine services in rural areas has been explained at **'Annexure III'**.

Box 5.4: Model for Telemedicine Delivery

A model for wider access quality primary healthcare at the panchayat level through telemedicine centres that can facilitate real-time two-way video calls between rural patients and doctors operating from urban hospitals has been proposed at 'Annexure III'. In this manner quality medical advice can be delivered to rural patients at their doorstep. The training and manpower for the same can be provided by the private health care service providers. It will operate with basic minimum physical infrastructure of a building/premises, telemedicine equipment, medical equipment and power backup. The premises could even be a Government school building during off shift hours. Procuring basic infrastructure would constitute CAPEX whereas salaries for personnel, power and fuel expenses, consumables etc. would constitute OPEX. The success of the model could be accelerated through partial reimbursement of the consultation fee incurred by the patients. The revenue for the private service provider will be generated by the consultation fee charged from the patients who would be more than willing to pay since the facility will be available at their doorstep.

Similar models based on PPP can be envisaged and channeled through Working Groups with a well defined set of objectives and responsibilities.

F. Action Points

5.28 In conclusion, for developing a sustainable business model for ubiquitous and universal adoption of BB, the following action points need to be undertaken:

- **Increased public awareness and ability to use BB services will spur demand for BB services and applications**

- **Governments, both Central and State shall have to act as model users and anchor tenants through delivery of e-Government services including e-education, e-governance, m-health, m-banking and other such services.**

- **Schools are the ideal and convenient point for early initiation to BB services. Government schools in the rural and remote areas can be provided subsidy from the USOF for BB connectivity.**

- **Cost of CPE (desktop/laptop/tabs etc.) are major barriers to the adoption of BB services. TSPs may be allowed to offer CPE bundled tariff schemes. Revenues from such offers ought to be exempted from the applicable license fee at least for a certain number of years (say for three years).**

- **The ecosystem for BB delivery should involve participation of the private sector for technology, skills, research, investments and developing new business models necessary to scale innovative solutions. PPP models can also be adopted for sustainable development issues.**

- **e-governance and delivery of Government services through Internet has to be through applications that are created by private/public enterprise and entrepreneurs.**

- **The NOFN infrastructure should be utilized for delivery of relevant content and applications in key sectors such as education, healthcare, banking and agriculture. For this a scalable, commercially feasible business model involving a public-private-panchayat level organization needs to be developed.**

- **There is a clear need for cost-effective devices, regional language content and low-cost applications relevant to local users. Use and creation of locally relevant content by Governments drives demand for BB and helps in delivery of services in a transparent manner to citizens.**

- **USOF Funds need to be better targeted towards adoption of BB in underserved and unserved areas. Subsidy under USOF BB Plans for rural areas and rural homes should be extended to private TSPs.**

- **Develop specific clusters for telecom manufacturing addressing infrastructure, fiscal and legal issues including labour laws.**

- **Mandate e-Government models for delivery of all Government services at the Central, State and Panchayat levels.**

5.29 There have been isolated instances of tangible benefits in programmes such as the e-bhoomi project of Karnataka Government or the e-chaupal model of ITC, but such success has to be replicated and scaled to reach every citizen of this country. To create a strong ecosystem and supporting framework for BB adoption, the Government needs to play a more proactive role. A well-defined plan needs to be developed for delivery of specific Government services through applications developed by private/public sector. Universal adoption of BB can be ensured through delivery of relevant content, such as programmes for e-education for school children and m-medicine for rural patients. The example regarding

the e-education programme for creating modules for students of secondary and higher secondary grades discussed earlier may need to be scaled and replicated for the benefit of all students. Such efforts developed in collaboration with trained resource persons and academia, although created in isolation by a university or a State may then be adopted for the entire country.

CHAPTER 6

Conclusion

"Time and tide wait for no man"

--Geoffrey Chaucer

1. Delivering Broadband (BB) is one of the major declared public policy priorities of the Government. This is primarily because it is seen as instrumental to the furtherance of the public policy agenda of social and economic inclusion. What is more, there are spillover effects (positive externalities) arising from the expansion in coverage of BB; and, these can contribute significantly to raising India's rate of economic growth.

2. For the past 7 years or more, issues concerning convergence and BB have been repeatedly discussed at length in Conferences and Seminars. More often than not, such deliberations have focused attention on the public good that would accrue from establishing a BB network. Unfortunately, by comparison, the attention devoted to what needs to be done to make BB a reality has been far from adequate.

3. BB adoption in India has increased very slowly over the past few years. As brought out in earlier chapters India ranks very poorly in terms of indicators. Some of the facts are as follows:

   - India ranks 125th in the world for fixed BB penetration with only 1.2 per 100 inhabitants having access to fixed BB; the global average is 9.4 per 100 inhabitants.

   - In terms of household penetration within developing countries, India is ranked 75th with a penetration of 13%.

   - In the wireless BB space too, India is ranked 113th with a penetration of 3.2 per 100 inhabitants.

- In terms of the 'ICT access, ICT use and ICT skills' India ranks 129th out of total 166 countries. Indonesia (106), Sri Lanka (116), Sudan (122), Bhutan (123), Kenya (124) are ranked above India.

- India is categorized in the Least Connected Countries Group of 42 countries that fall within the low IDI group.

4. BB penetration and adoption in India is unsatisfactory. It is in this backdrop that the Authority issued the Consultation Paper (CP) which has led to these recommendations. The first order of business was to assess where we are in terms of actual achievements and then to turn to the big issue at hand: What do we need to do?

5. For the past 3 years, much of the Government's resources and attention have been devoted to the achievement of the ambitious national project – the National Optic Fibre Network (NOFN). The project was originally conceived to be executed over three years. However, there is a vast chasm between targets and achievements. Three years on, less than 5 per cent of the overall goal has been achieved. And, this is a generously optimistic estimate; actual realization is likely to be far lower. Targets were revised recently towards the end of 2014. By all accounts, as of 31st March 2015, there has been a slippage even in the achievement of these revised targets! Setting over-unachievable targets has seriously jeopardized the project and is not good practice for important reasons. First, the lack of a reality check merely provides the basis for a false delusion of comfort and, invariably, leads to short-term post mortems which, as usual, end up in mutual assignment of blame to one or the other party. Second, it is an open invitation for public criticism. It is terribly demoralizing for the institutions charged with the responsibility for the project.

6. As stated above, the prime motivation for addressing the BB issue was to identify areas that need priority attention. In tangible terms, this meant

taking a thorough relook at the multi-faceted dimensions of the problem. Some of these are: (1) Do we have the right policy framework? Are changes necessary? If so, where? (2) Is the institutional design for execution and delivering BB efficient? If there are serious efficiency problems, what changes are needed at the institutional level to ensure a quantum jump in efficiency? (3) How do we enhance the efficiency of existing institutions charged with different aspects of the national endeavour? How can various stake holders be co-opted to realize the larger objective to delivering BB?

7. While infrastructure is indeed important, it is of vital concern to address issues of adoption of BB and factors impeding such adoption. Solutions have to be devised to the many diverse problems on hand. For instance, on applications software that is intended to ride on the NOFN how do we move beyond simple motherhood statements and public exhortations on e-Governance? So far, much of the focus has been on a single project, the NOFN, to almost the exclusion of all else. It is presumed that supply will create its own demand. Nothing could be further from the truth. If indeed it was merely a supply problem, then surely BSNL's network and fibre which already exists up to the block level (all blocks) ought to have been able to, at least, reach BB at that level. And, we all know that has not happened.

8. One of the major takeaways from this extensive review is that delivering BB in a meaningful manner to the digital have-nots (which constitute the vast majority of India) requires a far more holistic approach than has been taken hitherto. And, the scope of this national endeavour is most certainly much broader and larger than the mere execution of the NOFN project. This is not to argue that NOFN is not relevant. It is to make the point that on its own, it is far from sufficient (a necessary but not a sufficient condition). Important policy decisions pertaining to spectrum, other infrastructure, institutional aspects and design, co-opting relevant

stakeholders, carefully planning and designing e-governance services that will ride on the network are a slew of the principal areas where priority attention needs to be devoted immediately. Without this, Digital India will remain a dream. And, even if the NOFN project is executed properly and within a reasonable time frame (certainly longer than that projected today) it would still not be sufficient to deliver the desired outcomes. In this backdrop herein the Authority has recommended on change in the institutional framework of WPC, need of putting national RoW policy in place, transparent procedures for spectrum allocation and measures towards universal adoption of BB. The Government's serious policy concern on social and economic inclusion requires a sharper focus (and commitment of resources) on application design for delivering e-governance and other services such as e-education and e-health. The first step in achieving this much larger agenda, is to address the pressing issues outlined above.

9. The second major takeaway is that this national endeavour has to engage the attention of not only the Central Government including Ministries of the Central Government other than the DoT, but other principal stakeholders such as the State Governments. Of necessity, it is imperative to involve the private sector in deliberations and harness its problem solving abilities and investments to actually realize the goals of social and economic inclusion.

10. The recommendations contained herein have been listed in at some length in each of the preceding chapters. There is little purpose in recounting those in detail at this point. It is, perhaps, better to provide a broad overview of the tasks/action areas that need priority attention.

- WPC should be converted into an independent body by de-linking it from the present DoT hierarchy and either converting it into a statutory body responsible to Parliament or transferring it to an existing statutory body.

- Even in a more limited role of assigning solely commercially available spectrum, there is a strong case for an institutional overhaul of WPC to realize goals of institutional efficiency, transparency in decision-making and full disclosure of decisions.
- The multi-layered structure for decision making for the national project NOFN is just not suitable for a project that needs to be executed in mission-mode. The structure needs immediate overhaul.
- Align spectrum bands with globally harmonized bands to achieve interference-free coexistence and economies of scale.
- There is a need to lay down a clear roadmap for spectrum management which should state the requirement and availability of spectrum for each LSA as well as for the whole country.
- There is an urgent need for audit by an independent agency of all allocated spectrum both commercial as well as spectrum allocated to various PSUs/Government organizations.
- Single-window clearance is an imperative for all (Right of Way) RoW proposals at the level of the States and in the Central Government.
- Single-window, time-bound clearance should be encouraged for installation of towers to ensure the rapid development of national networks.
- Extensive consumer awareness and education programmes should be organized so that consumers fully understand the latest scientific information on EMF radiation and its potential impact on health.
- Cable operators should be allowed to function as resellers of ISP license holders to enable them to take advantage of their cable network to provide BB.

- Implementation of digitization of cable services to tier 2 and tier 3 cities in a time-bound manner.

- The Government needs to encourage local and foreign companies to build 'Data Centre Parks' on the lines of industrial parks, SEZs etc. by providing them land, infrastructure and uninterrupted power supply at affordable rates.

- Governments, both Central and State shall have to act as model users and anchor tenants through delivery of e-Government services including e-education, e-governance, m-health, m-banking and other such services

11. In addition, there are a large number of recommendations of the Authority on which decisions of the Government are still awaited. The Government needs to act quickly on these recommendations as we have already lost too much time. These include, inter alia, on Spectrum Trading, Spectrum Sharing, Open Sky Policy, Infrastructure Sharing, Microwave Access and Backbone Spectrum.

It is, perhaps, apt to conclude these Recommendations with the following quote:

"The one who adapts his policy to the times prospers, and likewise that the one whose policy clashes with the demands of the times does not."

--Niccolo Machiavelli

List of Action Points and Recommendations

1. **Spectrum licensing should be considered as a lever to drive penetration, efficiency and reinvestment in the industry rather than a convenient source of income for the Government**.

   - **Availability: Align spectrum bands with globally harmonized bands to achieve interference-free coexistence and economies of scale. The Authority has been recommending that more spectrum in the existing spectrum bands (viz. 900/1800/2100/2300/2500 MHz bands) should be assigned for commercial operation. In its recommendations on 'Spectrum Management and Licensing Framework' dated 11th May 2010, the Authority had estimated that *there would be a total requirement of 500 MHz -660 MHz for voice and data services by the year 2014*. As brought out, current availability of spectrum in our LSAs is about 40% of that available in comparable countries elsewhere. Clearly, there is a crying need for assignment of additional spectrum for commercial telecom services.**

   - **Roadmap: There is a need to lay down a clear roadmap for spectrum management which should state the requirement and availability of spectrum for each LSA as well as for the whole country. This roadmap should be made available publicly to ensure transparency.**

   - **Institutional Revamping: WPC should be converted into an independent body by delinking it from the present DoT hierarchy and either converting it into a statutory body responsible to Parliament or transferring it to an existing statutory body.**

- **Disclosure and Transparency: WPC should be mandated to urgently decide the short-term and long-term plan for all spectrum through public consultations and putting it in public domain to ensure transparent procedures for the allocation of all spectrum bands. This shall allow innovative solutions and market-driven models for efficient utilization of spectrum.**

- **Even in a more limited role of assigning solely commercially available spectrum, there is a strong case for an institutional overhaul of WPC to realize goals of institutional efficiency, transparency in decision-making and full disclosure of decisions.**

- **Commensurate Pricing: It is very important that spectrum is reasonably priced and made available in significant quantities so that a balance can be maintained in the payments to the Government for spectrum and the investment required for network expansion and equipment.**

- **Audit: There is an urgent need for audit by an independent agency of all allocated spectrum both commercial as well as spectrum allocated to various PSUs/Government organizations. This ought to be a national priority and must be undertaken within 3 months.**

- **Refarming: There is a need to review the present usage of spectrum available with Government agencies so as to identify the possible areas where spectrum can be refarmed, and to draw up a suitable schedule. This too ought to be a major priority. This exercise too should be undertaken immediately, starting within 6 months.**

- **Spectrum Trading: After holding extensive consultations with industry, on 28 January 2014 the Authority made**

recommendations on 'Working Guidelines for Spectrum Trading'. The Government's decision on this matter is awaited. Since industry consultations have already been held it should be possible to move on this very quickly. For reasons ascribed in this chapter, it is strongly urged that a decision is taken no later than 3 months from now.

- **Spectrum Sharing: After holding extensive consultations with industry, on 21 July 2014 the Authority made recommendations on 'Guidelines on Spectrum Sharing'. The Government's decision on this matter is awaited. Since industry consultations have already been held it should be possible to move on this very quickly. For reasons ascribed in this chapter, it is strongly urged that a decision is taken no later than 3 months from now.**

- **Microwave Access and Backbone Spectrum: The Recommendations of the Authority on 'Allocating and Pricing of Microwave Access (MWA)' and 'Microwave Backbone (RF)' carriers were made on 29th August 2014. The recommendations on E and V band are included in this document. The Government's decision on the matter is awaited. Here too it is imperative that a decision be taken on priority, within 6 months.**

- **Annual Royalty Charges for 3.3-3.4 GHz band for last mile access are excessive. These need to be reviewed and rationalized in line with the recommendations of the Authority on E-band. The maximum EIRP of the band also needs to be increased to enable its use in rural areas. This decision also needs priority attention and should be taken within 6 months.**

- **In its Recommendations on auction of spectrum dated 23 April 2012, the Authority recommended that the auction of spectrum in 700 *MHz band may be carried out at a later date, preferably in 2014, as and when the ecosystem for LTE in the 700 MHz is reasonably developed, so as to be able to realize the full market value of the spectrum.* Therefore, the use of 700 MHz band has to be decided within 3 months so that auction of the spectrum can be planned accordingly.**

- **Unlicensed Band: The de-licensing of the 5.725 - 5.825 GHz band for outdoor usage needs to be carried out in the next 6 months. DoT must release larger quantities of unlicensed spectrum (as has been done in many parts of the world) for better quality of service and reducing the strain on existing networks.**

- **New Spectrum Bands: It would not be prudent to make recommendations in isolation on the possible candidate bands for IMT applications. It is better to wait for the outcome of WRC-15. India needs to work in tandem with member countries to ensure a successful outcome of WRC-15.**

(Para 3.21)

2. Right of Way (RoW)

- **Single-window clearance is an imperative for all RoW proposals at the level of the States and in the Central Government. All such clearances have to be time-bound so that TSPs and infrastructure providers can move rapidly to project execution. Ideally, single-window clearance should be administered online with a defined turnaround time. The reasons for denial of RoW permission should be recorded in writing.**

- **All infrastructure sectors such as road construction authorities/agencies like NHAI/SH/PP Projects must include, in their construction design policy, a provision for a utility duct to enable laying of OFC for all new infrastructure and also adopt similar measures in existing projects in a "Dig Only Once" policy approach.**

- **RoW agencies/authorities should mark the area for laying of underground cables at a significant distance from roads considering expansion plans over the next 10 years to protect the investment in fibre infrastructure and avoid service disruption during expansions.**

- **Strong administrative and legal provisions (even contractual) need to be put in place for payment of compensation in case of cable cut or cable damage by any agency including Government agencies, private agencies or private third party agencies executing the digging work.**

- **The only charges levied should be towards restoration or reinstatement which should be directly linked to restoring the surroundings to their original state. The RoW rates should therefore be standardized and fixed and uniform procedures must be brought into practice for all agencies.**

(Para 4.9)

3. **There is a need for enunciating a National RoW Policy to ensure uniformity in costs and processes. The policy should encompass the following actions:**

    - **RoW Rules can be notified in exercise of powers under Section 7 of The Indian Telegraph Act**

- **Principles on which reinstatement charges can be demanded by local authority for underground telecom infrastructure.**
- **Specifically prohibiting other forms of charges/levies/ demands.**
- **Rentals chargeable only if ducts are constructed by local authority.**
- **Process and reasonable time limits for approval.**

- **Invoking powers under Section 15 of the Indian Telegraph Act for dispute resolution with local authority.**

- **Work out a mechanism with States for use of electricity poles for last mile access infrastructure.**

- **There is a need to change building by-laws which currently deem only electricity, water and fire safety as necessary infrastructure for the issue of a completion certificate. Including mandatory inclusion of either ducts/optical fibre with well defined access mechanisms in all upcoming office complexes, commercial spaces and residential complexes would have a significant and measurable net positive impact on BB penetration.**

- **Fibre network of a TSP should be awarded a critical infrastructure status.**
- **Standard processes and rules for laying overhead fibre should be laid down by the Central Government that can be adopted by State Governments and State bodies.**

(Para 4.10)

4. NOFN

- **Institutional change: The multi-layered structure for decision-making is just not suitable for a project that needs to be**

executed in mission mode. The structure needs immediate overhaul. Quarterly timelines should be prescribed for each milestone to ensure timely corrective measures. It is also imperative to set up a monitoring mechanism for each stage of the project so that the outcomes are quantitatively measured after completion of each milestone. Stakeholders should be co-opted both for execution and most definitely for monitoring. In any event, full and transparent public disclosure of monitoring outcomes must be mandated.

- **The bandwidth equipment for network planning needs to be re-assessed considering GP population and other relevant factors.**

- **BBNL needs to be professionally managed. The Delhi Metro Rail Corporation (DMRC) model is worthy of emulation.**

- **Project implementation on Centre State Public-Private Partnership (CSPPP) mode by involving State Governments and the private sector.**

- **To ensure redundancy and reliability, network planning would consider ring architecture for Districts in the first stage followed by Block rings and GP rings at subsequent stages.**

- **The sizing of Optical Fibre i.e. 24/48/96 core needs to be finalized based on requirement and carrying out a cost-benefit analysis.**

- **Award of EPC (turnkey) contracts by BBNL to private parties through international competitive bidding needs to be planned. Such contracts can be given region-wise with clear requirements for interconnection with other networks, as well as infrastructure sharing with other operators who would like to**

utilize this network. A commercial model around this will need to be suitably deployed.

- **NOFN involves laying of incremental OFC only (as indicated in green below). However, at various places, the problem of existing OFC (as indicated in red below) being in an unusable condition is being encountered which renders the OFC being laid of no use. Therefore, there is a need to cater for connecting the NOFN OFC directly to the PoP at District level in such cases.**

(Para 4.11)

5. Towers

- **Single-window, time-bound clearance should be encouraged for installation of towers to ensure the rapid development of national networks.**

- **A nominal one-time administrative fee covering the cost of administration of the clearance/permit should be levied.**

- **Electricity may be provided to BTS sites on priority.**

- **Extensive consumer awareness and education programmes should be organized so that consumers fully understand the latest scientific information on EMF radiation and its potential impact on health.**

(Para 4.13)

6. Fixed line BB

- **To promote fixed line BB, the license fee on the revenues earned on fixed line BB should be exempted for at least 5 years.**

- **There is a need to mandate city developers and builders to have properly demarcated sections within buildings and on rooftops**

for housing BB infrastructure and antenna. These areas should have uninterrupted power supply for reliable, always-on services.

- **The infrastructure of PSUs is lying unutilized and thus they should be mandated to unbundle their network and allow sharing of outside plant (OSP).**

(Para 4.17)

7. CATV

- **Cable operators should be allowed to function as resellers of ISP license holders to enable them to take advantage of their cable network to provide BB.**

- **Implementation of digitization of cable services to tier 2 and tier 3 cities in a time-bound manner. The digitization implementation schedule is given at 'Annexure I'. This timeline needs to be brought forward urgently if we are serious about quick BB delivery. In any event under no circumstances should it be further postponed (to expand outreach and hasten delivering of BB).**

- **Lower the costs of infrastructure investment by lowering customs duty on Hybrid Fibre Coaxial (HFC) based network equipment and Customer Premises Equipment (CPE).**

- **Viable business models need to be created by encouraging LCOs' entrepreneurship skills and guiding them to handle the new business.**

- **Financial support through banks/institutions and USO Fund.**

- **Provision of bandwidth at a subsidized price to operators serving underserved areas to ensure affordable BB.**

(Para 4.19)

8. Satellite

- **A decision on the recommendation of the Authority on 'Open Sky' policy needs to be taken in the next 6 months. This will allow TSP/DTH/VSAT operators access to International Satellite Operators. This is the only way forward if we are serious about delivery access to otherwise remote and inaccessible areas or those with difficult terrains.**

- **Separation of Licensor, Regulator and Operator functions in the satellite space domain to conform to best international practices of free markets.**

- **The issue of coordination of additional spectrum in the 2500-2690 MHz band with DoS needs to be addressed urgently, so that this band can be optimally utilized for commercial as well as strategic purposes.**

- **Time-bound award of licenses for operating satellite services.**

- **Regulating/Opening of Ka - band.**

(Para 4.20)

9. Hosting of Content in India: Saving of Cost of International Bandwidth

- **The Government needs to encourage local and foreign companies to build 'Data Centre Parks' on the lines of industrial parks, SEZs etc. by providing them land, infrastructure and uninterrupted power supply at affordable rates.**

- **Presently, telecom companies are subject to license fee on data centres but non-telecom companies are not. The anomaly needs to be addressed at the earliest.**

- **Adequate policy initiatives for attracting global content hosting should be formulated. The global data hosting which does not pertain to India should be kept beyond the purview of Indian laws.**

(Para 4.23)

10. **License Fee on ISP License: A decision on the recommendation dated 06 January 2015 of the Authority to incentivize small ISPs with a view to provide an impetus to BB penetration needs to be taken in the next 6 months. This is a relatively simple matter with no serious revenue implications; yet, it is a decision which will bring in necessary investments and outreach to unconnected areas.**

(Para 4.24)

11. **Infrastructure Sharing: The Government's decision on the Authority's recommendation on 'Issues related to Telecommunications Infrastructure Policy' dated 12th April 2011 is awaited. The global trend is a move towards infrastructure sharing. This is not a complicated matter and needs to be finalized in the next 6 months.**

(Para 4.28)

12. **Promoting Adoption of BB**

- **Increased public awareness and ability to use BB services will spur demand for BB services and applications**

- **Governments, both Central and State shall have to act as model users and anchor tenants through delivery of e-Government**

services including e-education, e-governance, m-health, m-banking and other such services.

- **Schools are the ideal and convenient point for early initiation to BB services. Government schools in the rural and remote areas can be provided subsidy from the USOF for BB connectivity.**

- **Cost of CPE (desktop/laptop/tabs etc.) are major barriers to the adoption of BB services. TSPs may be allowed to offer CPE bundled tariff schemes. Revenues from such offers ought to be exempted from the applicable license fee at least for a certain number of years (say for three years).**

- **The ecosystem for BB delivery should involve participation of the private sector for technology, skills, research, investments and developing new business models necessary to scale innovative solutions. PPP models can also be adopted for sustainable development issues.**

- **e-governance and delivery of Government services through Internet has to be through applications that are created by private/public enterprise and entrepreneurs.**

- **The NOFN infrastructure should be utilized for delivery of relevant content and applications in key sectors such as education, healthcare, banking and agriculture. For this a scalable, commercially feasible business model involving a public-private-panchayat level organization needs to be developed.**

- **There is a clear need for cost-effective devices, regional language content and low-cost applications relevant to local users. Use and creation of locally relevant content by**

Governments drives demand for BB and helps in delivery of services in a transparent manner to citizens.

- **USOF Funds need to be better targeted towards adoption of BB in underserved and unserved areas. Subsidy under USOF BB Plans for rural areas and rural homes should be extended to private TSPs.**

- **Develop specific clusters for telecom manufacturing addressing infrastructure, fiscal and legal issues including labour laws.**

- **Mandate e-Government models for delivery of all Government services at the Central, State and Panchayat levels.**

(Para 5.28)

ANNEXURE 'I'

Cable TV Sector: A Snapshot

Total households in India	**270 Million**
TV households in India	**169 Million (62.6% penetration)**
Cable TV households in India	**99 Million (58.6% of total TV households)**
Number of TV Channels presently being carried in Digital Cable Networks	**250 to 300 channels**
Number of Multi System Operators registered in DAS	**142**
Number of Cable TV operators in the country	**60000**

Digitization Implementation Schedule

SI	Phases	Areas	Cut off dates	Number of STB installed/ required	Status
1	Phase-I	4 Metros	31.10.2012	9 Million	Completed
2	Phase-II	38 cities having population more than 1 million (as per 2001 census)	31.03.2013	15 Million	Completed
3	Phase-III	All other urban areas municipal corporation/municipalities except cities/towns/areas specified for the corresponding Phase I and Phase II above (Approximately 600 locations)	31.12.2015	30 Million (estimated)	In progress
4	Phase-IV	Rest of India	31.12.2016	45 Million (estimated)	In progress
			Total	**99 Million**	

Leading Multi-System Operators are:

- M/s Hathway and Cable Datacom Ltd.
- M/s Siticable Networks Ltd.
- M/s DEN Networks Ltd.
- M/s GTPL Hathway
- M/s Digicable Networks Ltd.

ANNEXURE 'II'

Status of OFC:
Total OFC (in route km) Owned, Leased, Planned up to March 2016

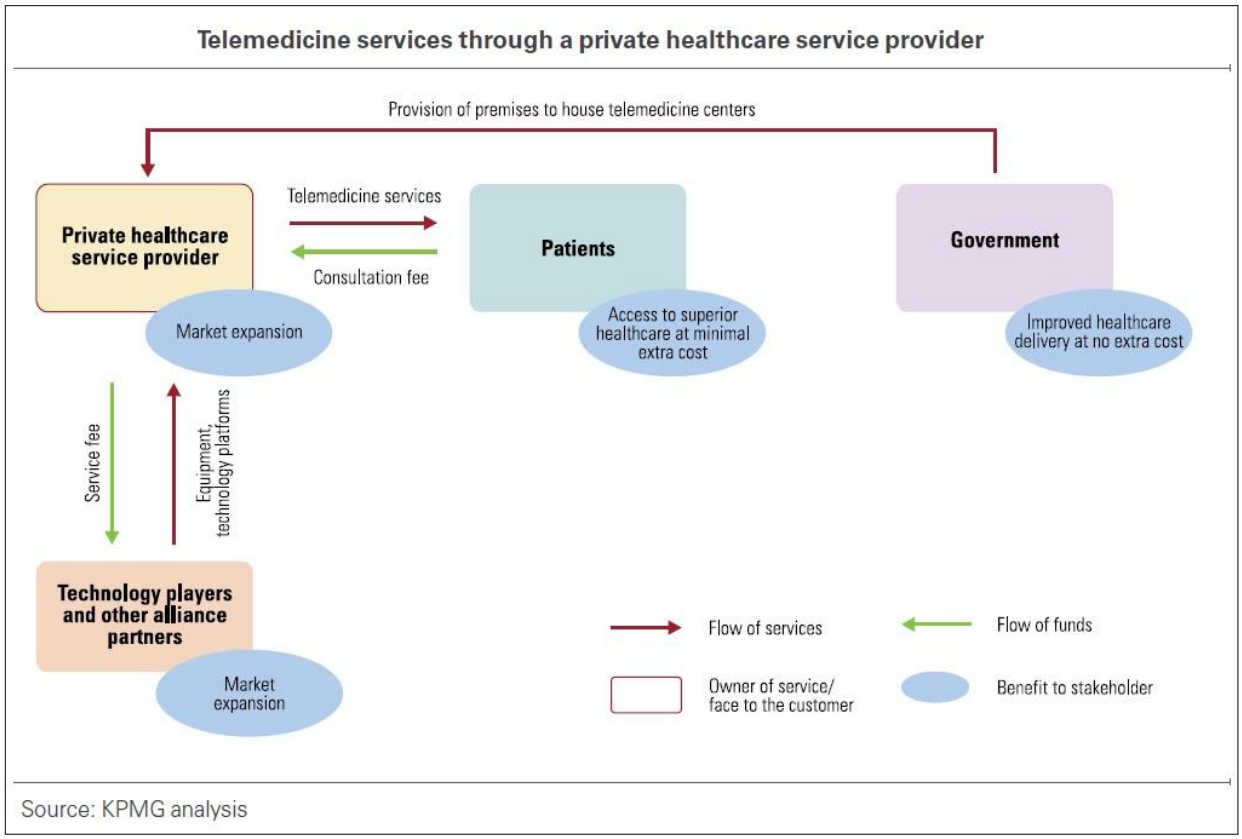
Name of the Operator	OFC (in Route Km)		
	Owned	Leased from IP-1	Planned up to March-16
Private Operators			
Reliance Communications	180853	0	NA
Bharti Airtel	125390	430	NA
Vodafone	79104	56427	NA
TTML/TTSL	52565	69218	NA
Idea Cellular	28740	1349	11086
Aircel	13406	1302	NA
Tata Communications	10487	38741	NA
You Broadband	8604	NA	NA
Quadrant Televentures	4395	NA	NA
Hathway Datacom	2513	672.2	0
Beam	484	129.6	NA
Sify	NA	985	100
Public Operators			
BSNL	676319	907	--
Railtel	40947	NA	11224
MTNL	16612	0	723
Power Grid	21129	8512	0
BBNL	205	0	539198

ANNEXURE 'III'

Model for Telemedicine in Rural Areas

(Source: CII/KPMG Analysis)

1. A model for wider access quality primary healthcare at the panchayat level through telemedicine centres that can facilitate real-time two-way video calls between rural patients and doctors operating from urban hospital is given below



2. **Proposition:** Delivering of quality medical advice to rural patients at their doorstep.

3. **Input**

- **Connectivity:** Fibre connectivity.
- **Training and Manpower:** To be provided by the private healthcare service provider.

- **Ongoing management and maintenance:** To be provided by the private healthcare service provider.
- **Physical infrastructure**: Building/Premises, telemedicine equipment (PC, Scanner, router, microphone, web-camera etc.), medical equipment, power supply and back up (including alternative renewable energy sources such as solar power).
- **Marketing**: To be undertaken by the private healthcare service provider, in collaboration with the Gram Panchayats.

4. **Cost**
   - **Capital expenditure**: Private healthcare providers can invest in setting up the facility. Capital cost heads include telemedicine equipment (e.g. router, PC, Camera, Scanner), Peripheral medical devices (basic diagnosis and treatment equipment), and software (electronic health record card management). The Government can possibly provide the premises free of charge (e.g. allow the centre to be set up in a connected Government – run school after school hours).
   - **Operational expenditure**: Operational expenses would include salaries for personnel, power and fuel expenses, consumables etc.

5. **Revenue stream**:
   - **Tele consultation fee**: The private healthcare service provider recovers the cost of service from patients in the form of a consultation fee. Since most of the cost elements are fixed, scale is of the essence to generate positive ROI.

6. **Government Support**: The success of this model could be accelerated through partial reimbursement of the consultation fee incurred by the patients. The Government may consider issuing cash-like investments such as health coupons for this purpose. Alternatively, there could be monthly settlement between the

private healthcare provider and the Gram Panchayat with no consultation fee charged to the patient. Funds from existing schemes could be channeled towards the service.

7. **Benefits**:

- **Government**: Enhanced primary healthcare delivery, rural skill development.
- **Private healthcare service provider**: New market segment.

8. **Critical success factors**:

- Viability gap funding.
- Scale (Volume of Consultations).
- Awareness and word of mouth.