A Study of Issues and Challenges in Last Mile Connectivity for the Utilization of BharatNet

A Dissertation submitted to the Punjab University, Chandigrah for the award of Master in Philosophy in Social Science, in partial fulfillment of the requirements of the Advanced Professional Programme in Public Administration (APPPA)

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48th ADVANCED PROFESSIONAL PROGRAMME IN PUBLIC ADMINISTRATION

(2022-23)

INDIAN INSTITUTE OF PUBLIC ADMINISTRATION

NEW DELHI

CERTIFICATE

I am pleased to certify that **Shri Sandeep Kumar Gupta** worked under my guidance and supervision to complete his research and prepared the current dissertation titled **"A Study of Issues and Challenges in Last Mile Connectivity for the Utilization of BharatNet ".** The dissertation is the outcome of his own research, and no part of it has appeared in any other monograph, dissertation, or book to my knowledge. This is being submitted to Indian Institute of Public Administration (IIPA), New Delhi for the aim of obtaining the Master in Philosophy in Social Science in partial fulfillment of the requirements for the Advanced Professional Programme in Public Administration (APPPA) of Indian Institute of Public Administration (IIPA), New Delhi

I recommend that the dissertation of **Shri Sandeep Kumar Gupta** is worthy of consideration for the award of Master in Philosophy in Social Science degree of Punjab University, Chandigarh

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ACKNOWLEDGEMENT

First and foremost, I'd want to express my heartfelt appreciation to my mentor, Dr. Saket Bihari, for his unwavering support, gracious guidance, tolerance, encouragement, enthusiasm, and vast expertise in helping me complete my study in such a short time. His advice was invaluable during the research and writing of this dissertation. For my M.Phil dissertation, I could not have asked for a better guide and mentor.

I'd also like to express my gratitude to the IIPA as an institution for providing me with the opportunity to study a topic that is both interesting and relevant, as well as for providing much needed infrastructural support to complete the job. I'd want to express my gratitude to the IIPA library personnel for their assistance and for making the necessary resources available. I am grateful to all of the experts for their insightful remarks during the research proposal presentations, which have greatly aided me in carrying out this study. I would like to thank Dr. V.N. Alok and Dr. Kusum Lata, Program Director and Program Director Co-Director, respectively of the 48th APPPA, for their invaluable guidance in the preparation of the dissertation. I am grateful to the entire IIPA faculty and other affiliated personnel for establishing a very conducive and pleasant environment during the course, as well as for being extremely attentive of deadlines for various assignments, particularly the dissertation work. I'd like to express my gratitude to the APPPA office, particularly Shri Anil Sharma, Shri Manish Rawat, and Shri Rajesh Kumar, for their outstanding assistance.

I profusely acknowledge the help extended in getting relevant data and assistance by Shri V.P. Singh, Director (OP), BBNL, Department of Telecommunications, and Government of India.

Further I'd also like to thank the Universal Service Obligation Fund (USOF), particularly Director USOF, for responding positively to the questionnaire.

I am grateful to colleagues at the Department of Telecom, BBNL, BSNL and CSC for providing pertinent data and other necessary assistance.

I would also like to express my gratitude to the Department of Personnel and Training, Government of India for providing me with this wonderful opportunity to participate in the 48th APPPA course, thereby broadening my horizons and deepening my understanding of public policymaking, as well as meeting wonderful and bright officers from various streams of the Indian Civil Services and Indian Armed Forces with varied and enriching experience. I will treasure my friendship with all of India's brilliant minds

Finally, I want to express my gratitude to my wonderful wife and son for their unwavering support and for allowing me sufficient time to complete this dissertation.

New Delhi **(Sandeep Kumar Gupta)**

ABBREVIATIONS

Abbreviation	Definition
BBNL	Bharat Broadband Network Limited
BHQ	Block Headquarters
BSNL	Bharat Sanchar Nigam Limited
CPSU	Central Public Sector Undertakings
DBT	Direct Benefit Transfer
DHQ	District Headquarters
DoT	Department of Telecommunications
FTTH	Fibre to the Home
Gbps	Giga bytes per second
GoI	Government of India
GPs	Gram Panchayats
ICT	Information and Communication Technologies
IIPA	Indian Institute of Public Administration
ISP	Internet Service Providers
ITU	International Telecommunication Union
LMC	Last Mile Connectivity
NDCP	National Digital Communications Policy
NOFN	National Optical Fibre Network
NTP	New Telecom Policy
OFC	Optical Fibre Cable
PGCIL	Power Grid Corporation of India Limited
PPP	Public-Private Partnership

RailTel	RailTel Corporation Limited
SPV	Special Purpose Vehicle
TSP	Telecom Service Providers
USF	Universal Service Funds
USO	Universal Service Obligation
USOF	Universal Service Obligation Fund
USP	Universal Service Providers
Wi-Fi	Wireless Fidelity

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Chapter-1

Introduction

1.1 Overview

The work titled "A Study of Issues and Challenges in Last Mile Connectivity for the Utilization of BharatNet" has identified issues and challenges in last mile connectivity for the utilization of BharatNet. The shift from digitization to digitalization has leveraged good governance wherein rule to role based is also coupled with. Keeping in view 'Connect India: Creating Robust Digital Communications Infrastructure', the study has been conducted. The work undertaken has studied the issues and challenges which are affecting the BharatNet Phase-I Network UP time and the intensity to which they are affecting the service level agreement (SLA) requirement of the ISP/ TSP in utilization of the BharatNet Phase-I Network. The study has also identified the issues and challenges in providing the last mile connectivity (i.e FTTH Connections) by the ISP/TSP in BharatNet Phase-I. The work has also described the issues and challenges in government institutions at GPs for not utilization of BharatNet connectivity. However, the study also suggests suitable Last mile connectivity for utilizing of BharatNet Phase-I by TSP/ISP and also suitable measures to improve the network up time of BharatNet Phase-I.

For the purpose of study, research strategy has been developed containing both descriptive and exploratory research designs. A mixed research strategy has been

employed to complete the study. Both qualitative and quantitative data points have been garnered from primary and secondary sources. The cases studies / personal interviews have also been used while collecting the first hand information.

The study of pilot project on the last mile connectivity in BharatNet given by the USOF to the BSNL has also been carried out through consultation (PRA) with officers in USOF and BSNL. The primary data is also based on focus group discussion/ consultation/interview with different stakeholders like BSNL,BBNL HQ,USOF division handling the policies on BharatNet utilization.

In fact, currently India is one of the biggest telecom markets in the world, having billion subscribers and more than 80% mobile penetration. The increase of mobile traffic over the last two decades has been a real game changer. India has made significant progress in wireless narrowband. The country is now moving towards a digital revolution aimed at providing quality broadband to every citizen and harnessing the significant potential for economic growth and social inclusion. The effect of broadband penetration can also effect on other sectors like education, healthcare to disaster management, financial inclusion, e-commerce and public safety to entertainment. From the implementation of Uni-level plans to district-level administration**,** broadband has the strength to make services and applications accessible to all, making our country a digitally capable society and information economy

It is worth mentioning that the world is on the threshold of the fourth industrial revolution, which includes cyber-physical systems, cutting-edge research on artificial intelligence and biotechnology, robotics, etc. This can cause great disruption in our time. everyday life and can empower individuals and communities because it creates new

opportunities for economic, social and personal development. India must seize the opportunity presented by the digital revolution by ensuring fast, scalable and reliable deployment of broadband networks..

"According to a study conducted by the World Bank, every 10-percentage-point increase in broadband penetration provides a boost of 1.38 additional percentage points to GDP growth — higher than any other telecommunication service"[1]. Increased internet usage has a greater beneficial impact on GDP in developing nations than in developed nations because it allows them to catch up to developed nations in terms of physical infrastructure.

Honorable Prime Minister Shri Narendra Modi once quoted, "Cities were built on river banks in the past. Today they are built on highways. But in the future they will be built on the presence of fiber optic networks and next generation infrastructure. Our Prime Minister's vision of Digital India with high-speed broadband as basic infrastructure for every citizen; service delivery of government to citizens online and empowering citizens to give them a voice in governance forms a clear road map. Making this idea a reality requires focus and determination.

Broadband is the basic infrastructure needed to improve socio-economic status, to improve job creation, civic engagement, global competitiveness and economic inclusion, leading to a better quality of life. Broadband is a key driver of economic growth in low- and middle-income developing countries. Access to secure, reliable and affordable high-speed broadband services is a clear and urgent priority for every Indian citizen. The development of high-speed broadband across the country requires defibrillation and

[1] Broadband: A Platform for progress, A report by the Broadband Commission for Digital Development (kindly mention year also)

densification of networks. Investing in broadband expansion is increasingly important just to make sure they are all connected.

Under BharatNet project optical fiber connectivity is available up to Gram Panchayats (GPs)/ Schools but the actual users are falling in nearby areas therefore last mile is required to be extended by the TSP/ISP and therefore last mile connectivity is crucial in the BharatNet project due to various challenges like business viability in the Rural areas.

Last Mile Connectivity (LMC) is a critical concern to do away with digital divide in our country and thereby ensuring inclusive growth and social development. The inclusive character of digital connectivity is crucial to good governance through deeper, cheaper and faster transmission of information.

The study has explored and explained the issues related to last mile connectivity in the utilization of the BharatNet project. The study intends not only contributing to the exiting body of knowledge but also aims at unraveling nuances, strengths and weaknesses (NSW) in ensuring LMC under the said venture.

1.2 Broad-band /Internet status of India

India has shown remarkable growth in terms of broadband subscriber-base (wireless + wire line) during the last 5-6 years. There were approx 236 million subscribers in Dec-2016 and now, approximately 788.30 million internet subscribers as of March 2022. The growth of data consumption has also gone up and this year country has witnessed a growth of 31% in the data usage.

The statics of Internet/Broadband Subscribers in India, as per TRAI performance report QE 2022, is given in below:

Total Internet Connections	824.89 Million
Narrowband Connections	36.59 Million
Broadband Connections	788.30 Million
Wired Internet Connections	27.27 Million
Wireless Internet Connections	797.61 Million
Urban Internet Connections	493.08 Million
Rural Internet Connections	331.81 Million
Total Internet Connections per 100 population	60
Urban Internet Connections per 100 population	102.82
Rural Internet Connections per 100 population	37.06

Table 1: Status of Internet subscribers in the country as per TRAI performance report QE 2022

It is evident from the above table that there is perceivable gap between wired internet subscribers and wireless customers. Also, the rural population internet subscription is much less than the urban population. There is an urgent need to bridge the gap between wire lines and wireless internet users and also between urban and rural customers. This would be detrimental in sustainable and inclusive growth in the telecom sector as well as the country as a whole. The solution to these divides lies somewhere in the BharatNet. BharatNet is one of the world's largest optical fiber infrastructure projects which can potentially be utilized for providing broadband services to the institutions of rural India as well as local villagers.

1.3 BharatNet

The importance of broadband has been taken very prudently by the Government and envisages the need for the creation of robust optical infrastructure for broadband in its various telecom policies. For creation of a robust broadband infrastructure, TRAI had given the recommendations for the National Broadband Plan in the year 2010. In the year 2011, Department of Telecommunication approved the National Optical Fiber Network (NOFN) project for connecting all the 2,50,000 Gram Panchayats through the optical fiber.

The first project initiated by the Government of India was the National Fiber Optic Network (NOFN) to kick off a rural broadband revolution. NOFN was envisioned as an information superhighway by creating a robust middle-mile optical fibre infrastructure to the ISP and TSP to provide the broadband connections to the rural population at Gram Panchayat level.

The proposal of NOFN project was initiated on June 16, 2011. The proposal was having details of implementation strategies for creating NOFNs, institutional mechanisms for implementing NOFNs, and funding methods for their establishment and maintenance. The Telecommunication Commission reviewed the first concept note of the National Optical Fiber Network (NOFN), and finally approved the proposal on 25 October 2011.

The project was having the involvement of large number of stake holders / organizations of Central and State Governments as well as the private sector in development of NOFN infrastructure. The Executing Agency (EA)/SPV were proposed to be created in order to

look after and monitor the work of establishment, management and operation of the NOFN project.

Due to glacial progress in the project and various challenges thereto and thereof, the NOFN project got revamped in the year 2015 through bestowing wider scope and strategies.

The BharatNet project has been divided into two phases where-in phase-I approximately 1,25,000 GPs were planned to connect with optical fiber connectivity and in year 2017 the optical fiber connectivity's to these many GP's were completed . These GPs are now available to the TSP/ISP's to provide broadband services to the customers like Government institutions, private institutions and other users in the village territory. Under Phase-2, further 1, 25,000 GPs were targeted to complete with optical fiber connectivity by 2023. The scope of the project has been further increased to reach up to 600,000 villages with optical fiber connectivity and the villages will have at least 100 Mbps Broadband connectivity. This will revolutionize the whole country.

The BharatNet network has been so designed that it will be able to deliver up to 1 Gbps speed at GP level and bandwidth can be provisioned keeping in view the required demand. The BharatNet infrastructure will be made available to all the TSP/ISP on non-discriminatory basis which will save the CAPEX cost of all the TSP/ISP and these TSP/ISP will be able to facilitate affordable broadband proliferation in rural India. This will bridge the digital divide between urban and rural settings. It would ensure India to be digitally empowered.

The country has witnessed the importance of broadband during the Covid-19 pandemic. During pandemic, keeping the physical distance was the only panacea to prevent ourselves from the viral infection. Internet/ broadband enabled people to have virtual connections instead. The Internet plays a vital role in the economic activities of the country viz. education system or health system or its work from home or its home delivery of merchandise etc. During the entire two years of the pandemic, education could make possible breakthroughs using online platforms. The virtual meetings came in a big way, saving lots of travelling expenditure as well as time. The knowledge base has immensely got gigantic transactions across the globe.

The governance is also now in online plate form. Public service delivery systems are also now online. Now days, almost all departments, all institutions, and business entities are having websites that can be utilized by anyone to fetch information after coming on the internet. Internet is now touching every aspect of human life and there is huge growth in the IT industry, despite pandemic.

The urban people have lots of choices to get affordable and reliable internet through various TSP/ISP but rural India is still struggling with affordable and reliable broadband connectivity. BharatNet network can be one of the solutions for providing affordable internet connectivity to rural India by the TSP/ISP.

1.3.1 Implementation concept of the NOFN Project

The project was so designed that existing optical fiber of the three CPSUs - Bharat Sanchar Nigam Limited (BSNL), RailTel Corporation Limited (RailTel) and Power Grid Corporation of India Limited (PGCIL) would be utilized for connecting Block Headquarters (BHQs) to GPs. The fiber from existing fiber point of interconnection

(FPOI) up to GPs will be laid by the designated three agencies and this section of fiber will be known as incremental optical fiber of NOFN project. The ownership of this incremental OFC will be with the Government and the ownership of the existing fibre will be continued with the current owners. The concept diagram for the NOFN project is as under

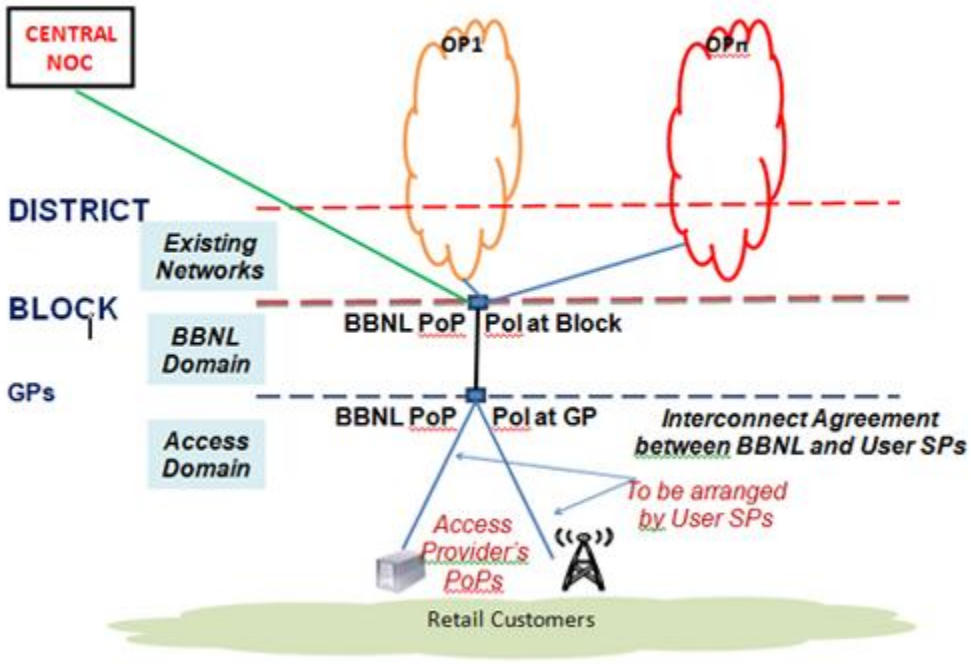

Fig.1 NOFN Concept Diagram

Under this concept, all GP's will be connected from the Block Level Point of Presence (POP). The optical fiber will be laid from the existing Fiber Point of Interconnection (FPOI) of the BSNL, PGCIL or Railtel. The Gigabit Passive Optical Network (GPON) technology will be utilized at Block and GP.

1.3.2 Challenges and Issues in NOFN

The physical progress of NOFN since January 2013 was very slow therefore government has constituted a committee to study the issue and challenges in the implementation of the NOFN project. The Committee held a detailed discussion with the executing agencies as well as BBNL to better comprehend the difficulties and challenges they encounter during implementation.

The committee found that the issues and challenged can be grouped in three broad categories i.e. NOFN technical and architectural problems, implementation plan problems, and problems with the deployment of broadband services using NOFN. (The details of issues in each categories is attached in Annexure-A)

Due to various challenges faced in implementation of the project under NOFN have affected its progress adversely. Therefore, committees take a note of the challenges and issues and consider changing the implementation strategies and this project has been re-envisaged as BharatNet in 2015 with different modalities of implantation.

1.3.3 Implementation modalities of BharatNet.

In order to smooth implementation, the complete project has been divided into different phases. The details under different modalities are as follows:

1.3.3.1 BharatNet Phase-I

In order to execute BharatNet Phase-I, BSNL's existing fiber network was used, and underground incremental optical fiber cables with Gigabit Passive Optical Network (GPON) technology were laid. Three Central Public Sector Undertakings (CPSUs)—Bharat Sanchar Nigam Limited (BSNL), RailTel Corporation of India Limited (RailTel), and Power Grid Corporation of India Limited—have been given the task of completing

Phase-I. (PGCIL). 1,00,000 GPs were connected to optical cable as part of BharatNet Phase I in December 2017. Additionally, the Phase-I work front was revised, and the Phase-I plan is currently being implemented by about 1.20 lakh GPs.

The connectivity status of BharatNet Phase-I as on 31.10.2021 as per Annual Report of BBNL is as under

CPSU	**GPs Planned in Phase-I**	**OFC Laid(Km)**	**Service Ready GPs**
BSNL	101780	250679	100838
RailTel	8002	26225	7744
PGCIL	10407	31627	10274
BBNL(diverted from BSNL)	125	46	14
Total	**120314**	**308577**	**118870**

Table 2: Status of BharatNet Phase-I as on 31.10.2021 (as per Annual report 2020-21 of BBNL)

1.3.3.2 BharatNet Phase-II

As envisaged in the NOFN Committee Report, on July 19, 2017, the Cabinet approved a revised strategy for BharatNet that incorporates the lessons learned from the implementation of Phase I of the project and aligns it with the Digital India vision. The revised strategy envisages an optimal media mix (OFC/radio/satellite) for connecting Gramm Panchayats (GPs), with each GP having up to 1 Gbps bandwidth (on wired media), laying of new fibre cables between GPs and blocks, and multiple implementation models - government model, private sector and CPSU model

As per the Annual Report 2020-21 of the BBNL the status of implementation of Phase-II is as under:

a. **State-led model:** in 8 states, this model is being implemented. Chhattisgarh, Gujarat, Jharkhand, Andhra Pradesh, Maharashtra, Odisha, and Telangana are at various stages of implementation. In Andhra Pradesh, work has not progressed for two years, as the state government has submitted a revised proposal for the implementation of BharatNet to change the technology from overhead to underground /PPP model. In Tamil Nadu, work for 2 out of 4 packages was awarded on 20/10/2021, while the remaining 2 packages were deferred due to litigation.

b. **BBNL led Private sector Model:** Two states, namely Punjab and Bihar, have been directly implemented by BBNL through the private sector model led by BBNL. In both states, the work is almost complete.

c. **CPSU led (BSNL):** Under this model, BSNL is conducting work in 4 states (UT). Madhya Pradesh, Uttar Pradesh and Sikkim are at various stages of implementation. For Jammu & Kashmir, BSNL has been requested to submit a revised phase II DPR for IP-MPLS with connectivity up to villages (including GPs).

d. **Satellite:** Under this model BSNL is implementing for 1408 GPs and BBNL is implementing for 4167 GPs (including 422 GPs proposed of Jammu & Kashmir) on satellite. As on 31st October 2021, a total of 4218 GPs have been made service ready on satellite media.

The status of BharatNet Phase-II as on 31.10.2021 is as under:

Implementation Model	GPs Planned in Phase-II	OFC Laid(Km)	Service Ready GPs
State Led Model	71411	156892	25542
CPSU led (BSNL)	27025	64312	10101
BBNL Led Private Sector Model	7382	22733	7357
Satellite	5575		4218
PPP	29625		
Newly Created GPs in State Led model	2844		
Total	**143862**	**243937**	**47218**

Table 3: Status of BharatNet Phase-II as on 31.10.2021(as per Annual report 2020-21 of BBNL)

1.3.3.3 Current Status of Implementation of the BharatNet

The Union Government has decided to merge BBNL with BSNL to facilitate wider use of BharatNet infrastructure. BharatNet infrastructure will continue to be a public asset available to all service providers on a non-discriminatory basis. BharatNet assets are owned by DoT and the project continues to be funded by DoT's USOF. The works under different phases are still continuing and the current status of the BharatNet as on 28.12.2022 is as under:

Item	Qty
GPs Planned Under Bharat Net Phase-I	**120314**
GPs Planned Under Bharat Net Phase-II	**143862**
Total GPs to be connected with BharatNet	**264176**
OFC Laid (Km) as on 28.12.2022 as per DOT Dash Board report	**6,00,898**
Gram Panchayat Connected - Cumulative (No.) as on 28.12.2022 as per DOT Dash Board report	**1,85,975**

Table 4: Status of BharatNet as on 28.12.2022 (as per DoT Dashboard)

1.3.4 Utilization of BharatNet

The infrastructure created by the BharatNet project is a public asset that can be accessed indiscriminately by service providers and can be used to provide broadband/internet services through Wi-Fi hotspots, Fiber to the Home (FTTH), fixed lines, dark fiber, and backhaul to the mobile network towers etc.

As per the report of DoT as on 30.06.22, there are 1830 ISP authorized under Unified License and 639 ISP authorized under UL-VNO in various license service areas of India. There is a total of 2469 ISPs that are authorized to provide internet services in our country.

The TRAI performance report on the growth of the top 10 ISPs (wire line) in 2020-21 revealed that only 3 Top 10 ISP are providing the services to rural India. However, there is huge potential in rural India.

As per network architecture of the BharatNet the optical fiber connectivity is available up to the GP's whereas the potential customers/ institutions are falling nearby of the GP at a certain distance therefore last mile connectivity would be one of the challenges to the ISP

as there would be the requirement of capital investment for extending the last mile connectivity and ISP might not finding the business case in such services.

To trigger the ecosystem and promote services on BharatNet USOF/ DoT, decided to award the work to the M/s CSC- SPV for the provision of 1 Wi-Fi Hotspot and 5 FTTH connections to Government agencies/ Institutions in 77,115 GPs in 31 States/UTs. The USOF/DoT also awarded the work to RISL, Rajasthan for the provision of 1 Wi-Fi & 5 FTTH Connections at 10,000 GPs in Rajasthan too.

As per the Utilization Report, it can be gauged that only 2.13 laks FTTH (Government + Non-Government institution) have been provisioned by the CSC & RIJL, whereas scope was available to provide 4.35 lakh FTTH to the Government institutions. This seems there is a huge gap in the scope and actual availability.

1.3.5 Operations and Maintenance of BharatNet

The BharatNet network is monitored through a centralized Network Operations Center (NOC) and its reports are monitored regularly. In addition, a mobile application was developed for real-time monitoring. CSC e-Governance Services India Limited (SPV under the Government of India) performed maintenance (i.e. initial maintenance of incremental OFC network O&M, equipment and support infrastructure) for approximately 1.20 million GP during the BharatNet phase-I. Currently, O&M has been given to BSNL.

For BharatNet Phase II, the respective implementing agencies are responsible for maintaining the network.

Bharat Broadband Network Limited (BBNL) annual report 20-21, revealed that only 58 % GP's are UP out of total service ready GP's as on 31.10.2021. The market demand for network up time is 99 % which is very hard to meet as the Service Level Agreement (SLA) of Bharat net is only 95%.

Chapter-2

Literature Review

2.1 Overview

This chapter will describe about the various publications, research papers, news articles which have been reviewed at initial level and also during the work of research in the topic.

2.2 Literature review & Research Gaps

At initial level literature review has been done the major research gaps identified for setting up the further research is as follows

Year	Author	Issue Discussed	Finding	Research Gap identified
2010	TRAI	TRAI recommendation (2010) on National Broadband Plan	TRAI gave recommendation for creation of robust broadband infrastructure in the country and authority also recommended that broadband target should be included in the	Recommendation was for creation infrastructure for the Broadband the aspect broadband proliferation was not covered

			upcoming national broadband policy	
2015	Srinivasan.N & Ilavarasan.P (2015),'White elephant or game changer? An analysis of National Optical fiber Network of India'. Economic and Politically Weekly, Vol. 50. No.42, PP 59-66,5	To study the cause of delay in the National Optical Fiber Network (NOFN) Project and lack of excitement on the part of private players	Authors suggested that absorptive capacity need to be developed and private plays require aggressive goading, but without ignoring the idea of social inclusion	The authors have done study on the delay in the implementation of NOFN and engagement of the private players in rolling out the NOFN project again the aspect of broadband proliferation through NOFN was not covered
2015	DoT Committee on NOFN	To re-examine the original architecture, capacity, reliability and design of NOFN. To give recommendations on the migration path	Committee gave recommendation holistically from strategic change to scope of the project. Project	The only gap which is noticeable in the committee report was that Operation Maintenance aspects and Last mile

		from NOFN (and its present status/commitments) to the revised architecture.	redisgnated as BharatNet. This covers all aspects of network architecture to implementation and to utilization.	connectivity. This might be because in 2015 these two aspects left for the market forces to decide
2017-2018	Kumar.R (2018),BharatNet : Implementation and utilization issues, 43rd APPPA, Dissertation	To identify the various issues pertain to Implementation and utilization of BharatNet	The research covers only the implementation issues and utilization issues in BharatNet.	The dissertation has not covered about the last mile connectivity in BharatNet and it seems very important aspect of utilization of BharatNet
2018	DoT	National Digital Communication Policy 2018	This Policy document clearly indicate the different mission and goals of India	Policy is silent about mechanism to achieve the set goals of policy

2019-2020	Panda. P, Dissertation on BharatNet : A study on socio socio-economic outreach	To study the implementation and social outreach part of the BharatNet	The research covers only the implementation and social outreach part of the BharatNet	The dissertation has not covered about the last mile connectivity in BharatNet and it seems very important aspect of utilization of BharatNet
2021	TRAI	TRAI recommendation on Roadmap to Promote Broadband Connectivity and Enhanced Broadband Speed, dated 31.08.2021	TRAI gave recommendation for Broadband Connectivity and Enhancement of Broadband Speed	Recommendation was for Broadband connectivity and speed of broadband .The aspect of Last mile connectivity not covered in the recommendations

2.3 Literature Review Summary

i. TRAI recommendation on National Broadband Plan, 2010 has been reviewed to get the relevant information in respect of National Broadband Plan for creation of robust broadband infrastructure in the country and authority recommended that broadband target should be included in the upcoming national broadband policy.

ii. 45th APPPA (2019-20) dissertation on BharatNet: A study on socio-economic outreach by Mr. Promod Kumar Panda has been reviewed and it has been

observed that research covers only the implementation and social outreach part of the BharatNet. Researcher has not covered the last mile connectivity in BharatNet which seems very important aspect of providing the broadband to the rural customers.

iii. 43rd APPPA (2017-2018) dissertation on 'BharatNet: Implementation and utilization issues by Mr. Rupender Kumar' has been reviewed and it has been observed that research covers only the implementation issues and utilization issues in BharatNet. Researcher has not covered about the last mile connectivity which in BharatNet seems very important aspect of utilization of BharatNet

iv. TRAI recommendation on Roadmap to Promote Broadband Connectivity and Enhanced Broadband Speed, dated 31.08.2021 have been reviewed to get the relevant information in respect of broadband status in the country and other aspects of broadband connectivity

v. DOT Annual Report 2021-22 has been reviewed to get the information on the internet subscription and growth of internet users in the country

vi. BBNL 9th Annual report 2020-21 has been reviewed to know about the status of BharatNet project.

vii. National Digital Communication Policy 2018 has been reviewed to know about the mission and goals in the broadband of the country.

viii. The Committee report on National Optical Fibre Network (NOFN), dated 31.03.2015 has been reviewed about to know change in scope and strategies from NOFN to BharatNet.

ix. Srinivasan.N & Ilavarasan.P (2015),'White elephant or game changer? An analysis of National Optical fiber Network of India'. Economic and Politically Weekly, Vol. 50. No.42, PP 59-66, 5 has also been reviewed. The study is only for NOFN project again there is no description on the LMC.

x. 9th International Conference on ICT and Digital economy, India telecom 2016 document on Broadband infrastructure for transforming India has also reviewed to find out about the LMC in Bharat net.

xi. The document released by the Broadband Commission for sustainable development by the ITU released on September 2021 on "**The State of Broadband : People Centered Approaches for Universal Broadband"** has been reviewed and it was emphasized in the report that Despite progress in internet use and adoption, Further efforts are needed to ensure tangible progress towards the 2030 global goals. Additional investments and inclusive and open partnerships can drive universal broadband adoption, which in turn will boost economic growth; help reduce poverty, will have an impact on social development and combat climate change[2]. This firm the research topic of Last Mile Connectivity for the Utilization of BharatNet in the context of India is much needed.

xii. The document released by the Broadband Commission for Digital development by the ITU released on June 2011 on "**A Broadband: A Plate form for the Progress"** has also been reviewed to get the use of broadband for the progress of the nation.

[2] State of Broadband Report 2021: Geneva: International Telecommunication Union and United Nations Educational, Scientific and Cultural Organization, 2021

xiii. The document on the last mile connectivity from KSEBL has also been reviewed to understand the various aspect of Digital Panchayat Last mile connectivity at Kerala. The document access through https://www.panchayat.gov.in/documents/20126/0/Digital+Panchayat_last+mile+connectivity_Kerala_101015.pdf/57eb8b0b-5649-ccf5-b30b-7e58dafdaa93?t=1554976234741 on dated 30.12.2022

Chapter-3

Setting of the work

3.1 Overview

The study was proposed intends to explain and explore the issues related to last mile connectivity in the utilization of the BharatNet project. In order to carry out the study statement of problem, Research objective, Research Design and methodology along with research questions and rationale of the research has been identified after extensive literature survey.

3.2 Statement of Problem

In 2018, the Ministry of Telecommunications released the National Digital Communications Policy 2018 (NDCP-2018). The policy emphasizes unleashing the transformative power of digital communication networks to achieve the goals of digital empowerment and improved welfare of the people of India. The policy is mainly concerned with broadband for all, so one of the missions of the policy is "Connecting India: Creating a Robust Digital Communication Infrastructure".

The goals of 2022 were set up under this Connect India and the goals are as under[3]:

"a) To provide Universal broadband connectivity at 50Mbps to every citizen."

"b) To provide 1 Gbps connectivity to all Gram Panchayats of India by 2020 and 10 Gbps by 2022."

[3] *National Digital Communication Policy 2018*(India*)*.

"c) To enable100 Mbps broadband on demand to all key development institutions Including all educational institutions."

"d) To enable fixed line broadband access to 50% of households."

"e) To achieve 'unique mobile subscriber density' of 55 by 2020 and 65 by 2022."

"f) To enable deployment of public Wi-Fi Hotspots; to reach 5 million by 2020 and 10 million by 2022."

"g) To ensure connectivity to all uncovered areas"

(Source: Page no. 4 Para no.1 of NDCP-2018 Policy of DoT)

BharatNet can full fill the goals of Connect India under NDCP 2018 by creating a robust digital communications Infrastructure. The phase-1 of the BharatNet was completed in the year 2017 and Bharat net phase-2 is in progress. As on 28.12.2022, BharatNet has connected 1,85,975GPs which indicate that approximately 70% development institution like Panchayat, educational institute (Primary schools, Secondary schools), PHC, etc. are now in the ambit of the BharatNet. The only bottleneck with the BharatNet is that this network is of the middle layer where TSP/ISP has to connect their own network at Block node at the block level and at GP level, TSP/ISP's need to extend the last mile connectivity to provide the internet services either through wire line or wireless technologies. The most prevailing technologies for last-mile access are Wi-Fi and FTTH.

As far as the demand for a broadband is concerned in the rural area, there are many government institutions like educational institutes, health institutions, Governance institutions, Panchayat offices, Police stations, etc., available in the rural areas which need reliable and affordable broadband services. All these institutions have already got

websites or portal and their day-to-day activities are being now feed to these portals from aforementioned institutions only via online mode. It implies that there is demand available in rural areas and as per the DoT report, ISPs are also available to serve to the demand but still there is a huge gap existing in terms of the availability of internet in the rural area. The constraints of the TSP/ISP for not utilizing the BharatNet for making available of reliable and affordable s internet in rural areas, needs to be studied.

Keeping in view the above facts and the goals of NDCP-2018, the key gaps identified and listed below need to be examined through the study.

I. In today's era service quality seems to be an important aspect and ISP's/TSP's are looking forward for the Service Level Agreement (SLA) of 99% (i.e. Network UP Time of the BharatNet) But due to network architecture of the BharatNet the desired SLA of ISP/TSP is a challenge.

II. In order to meet the demand of internet at rural institutions, ISP's/TSP's have to incur an investment in extending the last mile connectivity up to customer premises as BharatNet infrastructure / fiber is available at the GP's/School only and the business model might not be economically viable to the TSP/ISP.

III. Despite the USOF initiatives for awarding the work to the M/s CSC and M/S RISL to connect the Government Institutions through FTTH still Government Institutions like GP's, schools, Anganbadi kedra, Post offices, Police Thana, PDS, PHC are not utilizing the BharatNet connectivity.

3.3 Objectives

The broad gaps have been identified through literature review of various reports and recommendations of DoT, TRAI, BBNL, OECD, ITU reports and also previous year APPPA dissertation on Bharat net. As such, the proposed objectives of the study are as under:

i. To study the issues and challenges which are affecting the BharatNet Phase-I Network UP time and the intensity to which they are affecting the service level agreement (SLA) requirement of the ISP/ TSP in utilization of the BharatNet Phase-I Network.

ii. To identify the issues and challenges in providing the last mile connectivity (i.e. FTTH Connections) by the ISP/TSP in BharatNet Phase-I.

iii. To describe the issues and challenges in government institutions at GPs for not utilization of BharatNet connectivity.

iv. To suggest suitable Last mile connectivity for utilizing of BharatNet Phase-I by TSP/ISP and also suitable measures to improve the network up time of BharatNet Phase-I .

3.4 Research Strategy and Research Design

The research strategy would follow both the descriptive and exploratory research designs. A mixed research strategy will be employed to complete the study proposed. Both qualitative and quantitative data points would be garnered from primary and secondary sources. The cases studies / personal interviews would be used while collecting the

primary data points. In order to arrive at conclusive findings, the study would make use of both the data sources.

The research design will be a convergent research design where secondary data will be collected from the various departments like DOT, TRAI, BBNL, BSNL, CSC, ITU website, OECD website, NSSO and also through state government if required. The case study / best practices of M/s GFGNL at Gujarat and M/s T-fiber at Telangana on the last mile connectivity for providing broadband serviced through BharatNet will be studied. The personal interaction will also be carried out by these two organizations along with BSNL and DOT-USOF, BBNL, and BSNL officials.

The study of pilot project on the last mile connectivity in BharatNet given by the USOF to the BSNL has also carried out through consultation (PRA) with officers in USOF and BSNL. The primary data collected through focus group discussion consultation/interview of different stake holders like BSNL, BBNL HQ, and USOF division handling the policies on BharatNet utilization.

3.5 Rationale or Justification

In the recent past due to the COVID-19 pandemic, many vital services had been pushed online and rural India is still far behind in utilizing broadband,, the digital divide is still existing. The Government of India is rolling out the BharatNet project, which will connect 2.5 lakh Gram Panchayats (GPs) and all six lakh villages across the country with digital connectivity and high-speed broadband. Digital India is the GoI's flagship programme, with the goal of transforming India into a digitally enabled society and knowledge economy

One of the missions under National Digital communication policy 2018 is to Connect India: Creating Robust Digital Communications Infrastructure and the same are being carried out through BharatNet. The other important aspect of this policy is to provide "Broadband to all" which is aligning the Sustainable Development Goal (SDG) of the United Nations. As per ITU's ICT development index released in 2017, India ranked as 134 out of 175 nations. The NDCP 2018 aims to propel India into top 50 of ITU ICT Development Index. The dream can only be full filled once the BharatNet can be utilized to its full potential. In the growing age of information, reliable digital connectivity is of utmost importance. In recent pandemic time when all movement was stopped, only through digital connectivity most of the operations were running. The network UP time is the key to provide quality services to the citizens.

The dream of e-governance can only be true once citizens can get the best digital connectivity at an affordable rate. Despite so much growth in data consumption the ISP/TSP are not coming forwards in utilization of BharatNet. It is therefore felt that a study should be carried out to find the issues and challenges affecting network up time and Last mile connectivity. The study will help to bring out issues and challenges in the last mile connectivity (LMC) to provide broadband in rural areas at an affordable rate. This will be help full to the policy makers in making policy on last mile connectivity (LMC) for the BharatNet. The objective of broadband for all will also be full filled which will, in turn, reduces the digital divined and fulfill the dream of true Digital India

3.6 Research Questions (RQ)

During the research study following questions will be attempted:

RQ1. What are the factors affecting the network up time and Service level agreement (SLA) requirement of the ISP/TSP for the utilizations of BharatNet Phase-I ?

RQ2. What are the issue and challenges in providing the last mile connectivity under BharatNet project?

RQ3. Which are the responsive technologies available for the last mile connectivity for broadband services through optical fiber?

RQ4. What are the challenges in utilization of BharatNet connectivity in the Government institutions at GPs?

RQ5. What would be the best practices/ methodology to improve the Network UP time of Bharat net Phase-1 ?

3.7 Limitation /Delimitation

The BharatNet project is being implemented all across the country and stakeholders are present all across the country therefore keeping in mind the time constraints as well as geographical constraints the study is limited to two best-performing states i.e. Gujarat and Telangana with respect to LMC and one of the biggest state of the country i.e. Uttar Pradesh specially Uttar Pradesh east Telecom area comprises 48 Districts and 275 Blocks and approximate 18000 Gp's in Phase-I. I have already worked on BharatNet project therefore it will be easy to get the required data from the different stakeholders which will save time and a productive output can be derived.

3.8 Research Method to be applied and data sources

A mixed methodology has been used for this study. Broadly, secondary data and primary data based analysis has been carried out. The quantitative and qualitative database has been given due importance while working on the study.

The secondary data for network up time and utilization for the period 2019 to 2022 will be collected from secondary sources like DoT, BBNL, CSC, BSNL, etc.

The primary data will be based on focus group discussion consultation/interview of different stake holders like BSNL, BBNL HQ, and USOF division handling the policies on BharatNet utilization.

The personal interaction has been carried out by these two organizations along with BSNL and DOT-USOF, BBNL, and BSNL officials.

The study of pilot project on the last mile connectivity in BharatNet given by the USOF to the BSNL has also been carried out through consultation (PRA) with officers in USOF and BSNL.

In nutshell, interview schedule, observation and PRA exercises have constituted the major research methods besides using other need-based possible methods.

3.9 Chapterisation Scheme

Chapter 1: Introduction will give an overview about the telecom sector and the importance of broadband in the Indian economy's growth. The chapter will include the brief about the status of Broadband /internet status in India, brief about BharatNet and its utilization and operation and maintenance.

Chapter 2: The second chapter would be about the literature review of the work undertaken.

Chapter 3: The third chapter would be about the setting of the work (Research Methodology) this chapter includes the statement of problem, Research objective, Research Design and methodology along with research questions and rationale of the research.

Chapter 4: This chapter would be about the telecom policies in India for the Broadband. This chapter will give details of different telecom policies which enable the broadband proliferation in India and importance of Last Mile Connectivity for providing broadband services.

Chapter 5: This chapter would be about the Issues and Challenges in Bharat net Phase-I Network UP time.

Chapter 6: This chapter would be about the issue and challenges in the last mile connectivity for the utilization of BharatNet.

Chapter 7: Conclusion and recommendation will provide the suggestions for Last Mile Connectivity (LMC) and Network up time of BharatNet Phase-I.

Chapter-4

Telecom Policies in India for the Broadband Proliferation

4.1 Overview

In India telecom services like mobile telephony and internet services are being provided by the different Telecom Service Provider (TSP) and Internet Service Provider (ISP) across the country. The Department of Telecommunication (DoT) is the department under Ministry of Communication who provide the various licenses to all these operators to operate across the country. Before introduction of the private telecom operators in the sector DoT was the only operator who was providing telecom services across the country. After liberalization in year 1991, telecom sector was also opened up for the private telecom operators and year 1992 cellular mobile telephone was opened up for the private telecom operators in the 4 metro. Since then telecom sector has undergone through various transformation from Government Monopoly setup to competitive environment where various telecom operators were allowed to operate in the country and accordingly DoT has divided various licensing area in the country so TSP has choice to operate in any if the license area in which they wish to operate.

Worldwide internet was started way back in 1960's and India was witnessing the influence of internet in the development and growth therefore in 1986 the internet was used for the education and scientific research with the efforts of Department of Electronic (DOE) and United Nations Development Program (UNDP).

In 1995, Videsh Sanchar Nigam Ltd (VSNL) - now widely known as Tata Communications Ltd - first made cyberspace available to the citizens of India. At that time, the Internet was accessed over telephone lines through dial-up modems and data speeds were up to 9.6 kbps. The data speed was increased to 14.4kbps after introduction of new upgraded modems and by 1998 the data speed grown up to 28.8- and 33.4-kbps. Dial-up was eventually updated to allow analog line speeds of up to 56 kbps.

Over the past 25 years, the telecommunications sector has seen an extraordinary level of technological innovation. In the past, to connect to the Internet, one needed a dial-up connection over the telephone line at unbearably slow speeds to check email. Today, millions of citizens in India use touch screen phones to access the Internet at high frequency from any location. This change in the Internet landscape was only possible because of the government's active policy in this area. The various telecom policies related to broadband proliferation will be discussed in this chapter.

4.2. Broadband Policies in India

In order to achieve various technological advantages and at par with the developing countries Government of India first introduce the Broadband Policies in year 2004 and thereafter various policies has been issues by Government of India in order to achieve broadband proliferation in India to achieve the Sustainable Development Goals of UN.

4.2.1. Broadband Policy 2004

The Broadband Policy, 2004 (the "Policy") was formulated by the Government of India to harness the potential of broadband services. It aims to improve the quality of life by introducing distance education, telemedicine, e-government and entertainment, and to create jobs through rapid access to information and communication on the web.

Broadband demand is mainly driven by the ubiquity of the Internet and computers. It is well known that the country currently has low levels of internet and broadband access compared to many Asian countries. At the end of December 2003, the broadband, Internet and computer (PC) penetration rates were 0.02%, 0.4% and 8% respectively. High-speed Internet access is now defined as "broadband" at speeds up to 64 kbps, and always-on high-speed Internet access at 128 kbps is now considered "broadband". Different countries have different standards for broadband connections. The government expects growth in Internet and IT penetration to accelerate, as the success of broadband depends to a large extent on its deployment.

4.2.1.1 Broadband Connectivity

The Broadband connectivity defined as always on internet connection with the minimum download speed of 256 kbps. The other characteristics of broadband connectivity are as follows

a. Data connection is in always on mode
b. Interactive services including internet access can be supported
c. The minimum download speed should be 256 kilo bits per second.

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4.2.1.2 The estimated growth for Broadband and Internet subscribers

As per policy the target has been fixed for achievement of the growth for the broadband and internet subscriber in India.

The Estimated Growth For Broadband And Internet Subscribers		
Year Ending	**Internet Subscribers**	**Broadband Subscribers**
2005	6 million	3 million
2007	18 million	9 million
2010	40 million	20 million

4.2.1.3 Technology Options for Broadband Services

The various technology options to improve access to the internet and broadband services are as follows

a. Optical Fibre Technologies
b. Digital Subscriber Lines (DSL) on copper loop
c. Cable TV network
d. Satellite Media
e. Terrestrial Wireless and
f. Other emerging Technologies

The policy emphasizes the implementation of broadband services through existing telephone lines (i.e. copper loops). It has also mentioned that Mahanagar Telecom Nigam Limited (MTNL) and Bharat Sanchar Nigam Limited (BSNL) are actively using their existing telephony infrastructure to provide broadband services. It has also announced

that private ISPs will enter into commercial agreements with MTNL and BSNL to use their infrastructure to provide Internet services.

It has also been observed that cable networks reached more people than copper telephone lines, and therefore the policy allows cable networks to be used to provide broadband. The policy also mentioned the intention that in remote areas service provider can use Very Small Aperture Terminals (VSAT) and Direct-to-Home (DTH) to increase broadband penetration.

The policy also mentioned that the government de-licensed the 2.0-2.835 GHz spectrum for low-power indoor use (including Wi-Fi technologies based on the IEEE 802.11b and 802.11g standards)[4].

4.2.1.4 Quality of Service

The qualities of service parameters are of greater importance therefore policy have taken care of this and Telecom Regulatory Authority of India (TRAI) has been requested to prescribe quality of service parameters for broadband service.

4.2.1.5 Other Mandates of Policy

Policy also describe that the issues regarding cost of bandwidth for providing internet and broadband should be resolved by the Government and TRAI at the earliest.

The Department of Information Technology has been mandated to set up National Internet Exchange of India in order to ensure that internet traffic originating from and destined for India should be routed within India.

Role of Other Agencies: The growth of broadband and Internet services depends on personal computers and the content and applications available on the Internet. Therefore,

[4] Vikram Raghavan, Communications Laws in India (Legal Aspects of Telecom, Broadcasting and Cable Services), LexisNexis Butterworths, 2007, pp. 480-81

other departments such as state departments and the Ministry of Information Technology and other related departments should also contribute to the popularization of broadband services in rural areas.

Fiscal Issues: The policy places great importance on the local manufacture of broadband-related equipment. Government should aim to provide broadband and related equipment at low cost.

4.2.2 National Telecom Policy 2012

Telecommunications growth in rural areas has been slow, accounting for only 34% of total connections. There is an urgent need to bridge this digital and communication divide by providing better and more advanced telecommunication services in rural and remote areas. The current National Telecommunications Policy of 2012 also aims to create investor-friendly policies. It also seeks to create jobs in various telecommunications sectors through policy. One of the key features of the policy is on-demand access to broadband and telecommunications infrastructure, which in turn will enable businesses in urban and rural areas to participate in the network economy and trade for electronics for inclusive development

The policy's vision is "to accelerate inclusive socio-economic development by providing secure, reliable, affordable, and high-quality converged telecommunications services anytime, anywhere." The policy also seeks to recognize telecommunications as an infrastructure to realize the potential of ICT for development.

The main components of the policy are:

"a) Broadband Rural Telephony and Universal Service Obligation Fund"

"b) R&D, Manufacturing and Standardization of Telecommunication Equipment

"c) Licensing, Convergence and Value Added Services."

"d) Spectrum Management"

"e) Quality of Service and Protection of Consumer Interest"

"f) Security"

4.2.2.1 Strategy for Broadband Rural Telephony and Universal Service Obligation Fund

The policy provides robust and secure telecommunications services to rural and remote areas. To bridge the digital divide, the policy also calls for affordable and high-quality broadband connectivity and telecommunications services across the country. This will be achieved through a combination of technologies, i.e. Fiber optic, wireless, VSAT, etc. With USOF funding, the fiber optic network will be rolled out to village councils.

It also aims to achieve broadband access in all village councils by 2014 and in all villages and towns by 2020. It also plans to increase rural telephone density from 29 to 70 by 2012 and 100 by 2020. Deliver high-quality voice, data, media and broadcast services over converged networks. Expect to provide users with better service.

The policies formulated with respect to access to broadband are:

a. Developing the "broadband ecosystem" and working towards the realization of the "right to broadband". It also aims to recognize telecommunications and broadband services as basic necessities in education and health.

b. Affordable and reliable broadband on demand by 2015, 175 million broadband connections by 2017; 600 million by 2020, with a minimum download speed of 2 Mbps and higher throughput.

c. Revise existing broadband download speeds from 256 Kbps to 512 Kbps and 2 Mbps by 2015, and accelerate to at least 100 Mbps thereafter. The policy also encourages the use of FTTH (fiber-to-the-home) to create an "always connected" society.

d. Establish an organization to coordinate various government departments to efficiently lay optical cables across the country to facilitate the rapid expansion of high speed broadband services.

e. Implementation of e-government, e-village councils MNREGA, NKN, AADHAR, and AAKASH tablets using broadband with other government agencies. It will also help facilitate secure online financial transactions and broadband penetration

f. Stimulate interest in the use of broadband by promoting regional and local content, with the help of the Ministry of Information Technology. This will help drive investment in all Internet Protocol (IP) networks, including Next Generation Networks (NGN)

4.2.3 National Digital Communications Policy-2018

The NDCP-2018 aims to transform India into a digital economy and society by deploying ubiquitous, resilient and affordable digital communication infrastructure and services to meet the information and communication needs of citizens and businesses.

With the introduction of advanced technologies such as 5G, IOT, M2M, etc., the "customer-centric" and "application-driven" NDCP-2018 will bring new ideas and innovations.

The key objectives of the policy are:

"1) Broadband for all."

"2) Creating four million additional jobs in the Digital Communications sector."

"3) Enhancing the contribution of the Digital Communications sector to 8% of India's GDP from ~ 6% in 2017."

"4) Propelling India to the Top 50 Nations in the ICT Development Index of ITU from 134 in 2017"

"5) Enhancing India's contribution to Global Value Chains"

"6) Ensuring Digital Sovereignty."

The key mission of the policy is Connect India, Propel India and Secure India. The details under connect India is relevant for the research therefore the salient points under this head are as follows.

4.2.3.1 Connect India

Create a robust digital communications infrastructure

a. National Broadband Mission (Rashtriya Broadband Abhiyan) - 50 Mbps universal broadband connection for every citizen by 2022

b. "*BharatNet- Provide 1 Gbps connectivity to all Gram Panchayats of India by 2020 and 10 Gbps by 2022*."

c. "*GramNet – Connecting all key rural development institutions with 10 Mbps upgradeable to 100 Mbps*."

d. "*NagarNet – Establishing 1 Million public Wi-Fi Hotspots in urban areas."*

e. "JanWiFi – Establishing 2 Million Wi-Fi Hotspots in rural areas."

f. "*Enable 100 Mbps broadband on demand to all key development institutions including all educational institutions by 2022*."

g. "*Implementing a 'Fibre First Initiative' to take fibre to the home, to enterprises and to key development institutions in Tier I, II and III towns and to rural clusters*."

h. "*Establishment of a National Digital Grid by National Fibre Authority."*

i. Enhancement of SATCOM technology in India through revision of SATCOM policy, provision of new frequency bands, and simplification of administrative process of allocation and granting, permits and authorizations related to SATCOM systems, etc.

j. Ensure customer satisfaction, quality of service and effective grievance resolution through the establishment of a telecommunications ombudsman, develop comprehensive policies to encourage the adoption of environmental and safety standards and encourage the use of telecommunications technologies. Renewable energy in the telecommunications sector.

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4.2.3.2 National Broadband Mission (NBM)

The National Broadband Mission is the part of the National Digital Communications Policy-2018 **(NDCP-2018).** The mission was launched in year 2019 by the Ministry on Communication in order to realize the broad mission of "Broadband for All ".

The National Broadband Mission (NBM) envisaged providing equal access to digital communications for all segments and strata of society and enabling holistic measures to bridge the digital divide.

The National Broadband Mission (NBM) has strong emphasis on the three principals of Universality, affordability and Quality.

The major objectives of the mission under the said principles are as follows

a. "*Broadband access to all villages by 2022."*
b. *"Significantly improve quality of services for mobile and internet."*
c. *"Develop a Broadband Readiness Index (BRI) to measure the availability of digital communications infrastructure and conducive policy ecosystem within a State/UT."*
d. *"Creation of a digital fiber map of the Digital Communications network and infrastructure, including Optical Fiber Cables and Towers, across the country."*
e. *"Laying of incremental of Optical Fiber Cable and increase in tower density from 0.42 to 1.0 tower per thousand of population by 2024."*
f. *"The Centre will work with States and UTs for having consistent policies pertaining to expansion of digital infrastructure including for Right of Way (RoW) approvals required for laying of optical fibre cable*."

BharatNet is one the most important project which can realize the vision of the National Broadband Mission (NBM) as well as connectivity objective of NDCP-2018. The NBM document provides the policy intervention and support from different stakeholders to mitigate the challenges in driving the BharatNet project and achieving the objectives of the NDCP-2018.

Chapter-5

Issues and Challenges in Bharat net Phase-I Network UP time.

5.1 Overview

The objective of the BharatNet project was to provide optical fiber up to Gram Panchayat. In order to smooth implementation the project was divided in different phases like Phase-I, Phase-II etc. Under the Phase-I there were approximately 1,25,000 GP's were taken in consideration and project was executed by the three implementation agencies like BSNL, RailTel, PGCIL. These agencies were taken in consideration because these agencies were having existing optical fiber up to block level and therefore under Bharatnet project only the incremental fiber was mandated to be laid from block to GP's.

5.2. Concept of Implementation of the Bharatnet Phase-I.

Under this phase the scope of work was to lay the optical fiber cable from existing optical fiber point of interconnection till GP's therefore the Government of India decided to take BSNL, RailTel, PGCIL on board to utilize existing OFC infrastructure and faster implementation of the project. The Bharat Broadband Network Limited (BBNL) - SPV was also formed by the Government of India for the smooth implementation of the project. The asset created under this project will be owned by the Government of India and Ministry will provide the asset on non discriminatory basis to the all TSP's/ISP in order to realize the broad objectives of broadband proliferation and subsequent telecom policies in India.

Under this project the terminating point of the OFC was considered at the Panchayat Bhawan in the Gram Panchayat. The technology which was utilized under this project was Gigabit Passive Optical Network (GPON). The GPON technology was developed indigenously by the Center for Development of Technology (C-DoT). In GPON technology there are two major components one is Optical line Terminal (OLT) and other is Optical Network Terminal (ONT). The OLT was installed in the BSNL telephone exchanges at Block HQ and ONT's were installed in the GP's locations.

5.3 Bharatnet Phase-I Network

The network of BharatNet Phase-I is based on the exiting optical fiber and incremental fiber and OLT & ONT's. The line diagram /ABD diagram shows the complete overview of the network in the block of implementation

5.3.1 Bharatnet Phase-I Network Elements

The network elements of BBNL GPON is given below where various elements deployment has been given

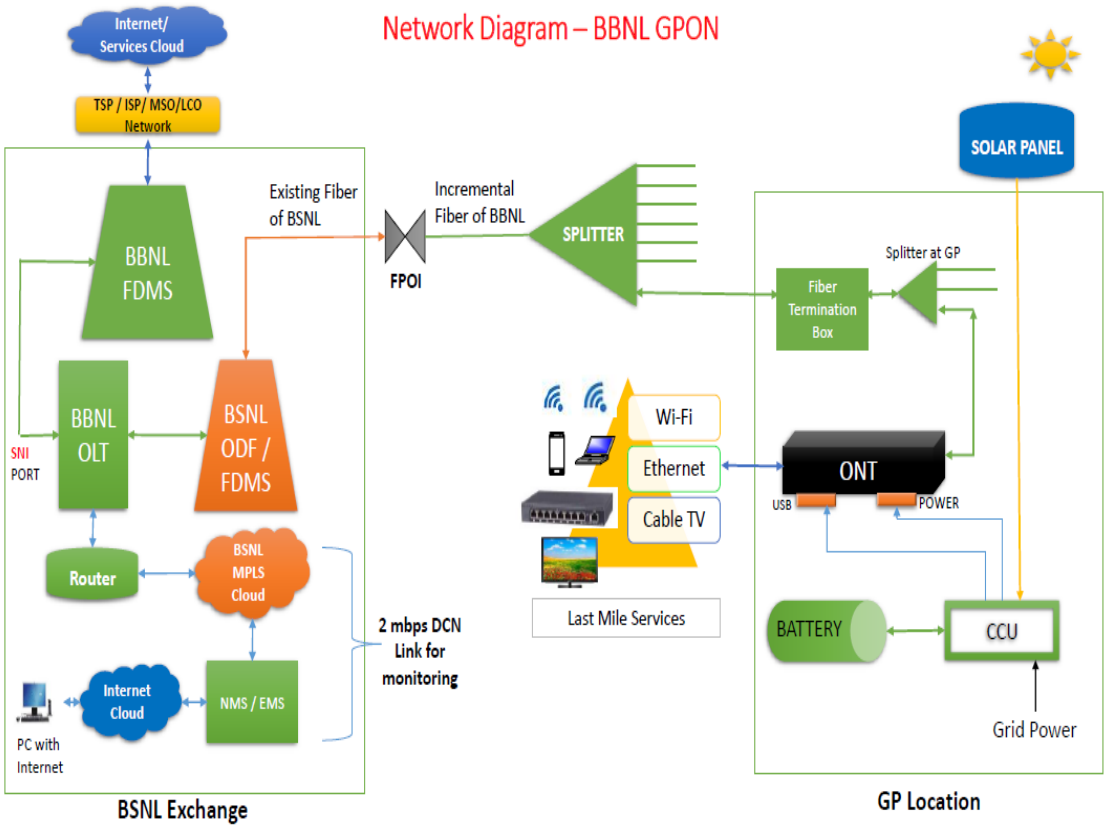

Fig 5.1. Network Diagram- BBNL GPON

a) **Optical Line Terminal (OLT):** The OLT was indigenously developed by the C-DoT and was installed at the BSNL exchange at Block HQ. The OLT is the GPON network equipment where all the ONT's from all the GP's are aggregated and other end of the OLT integrated with the BSNL /TSP/ISP internet network. The OLT provide different feeds of services like internet, voice, multimedia at GP's

b) **Existing Fiber:** The existing fiber from OLT till FPOI is utilized for the extension of incremental fiber till Panchayat Bhawan at GP's.

c) **Splitters:** There are various types of splitters are being utilized in order to aggregate the various GP's in one of the existing fiber. These splitters are of 1:2,

1:4 and 1:8. These splitters can spilt one existing fiber in various numbers of fiber like 2 ,4 or 8 by utilizing appropriate splitters in the route of block to GP's

d) **Optical Network Terminal (ONT)**: This device is customer premises equipment which is being installed at the Panchayat Bhawan and the various services like internet , voice, Wi-fi, multimedia etc can accessed at the GP location trough this device.

e) **CCU, Battery, Solar Panels :** These devices are being installed at the GP location in order to feed power supply to the ONT's

The images of ONT's, CCU, Battery and Solar Panel are in the Fig2 & 3

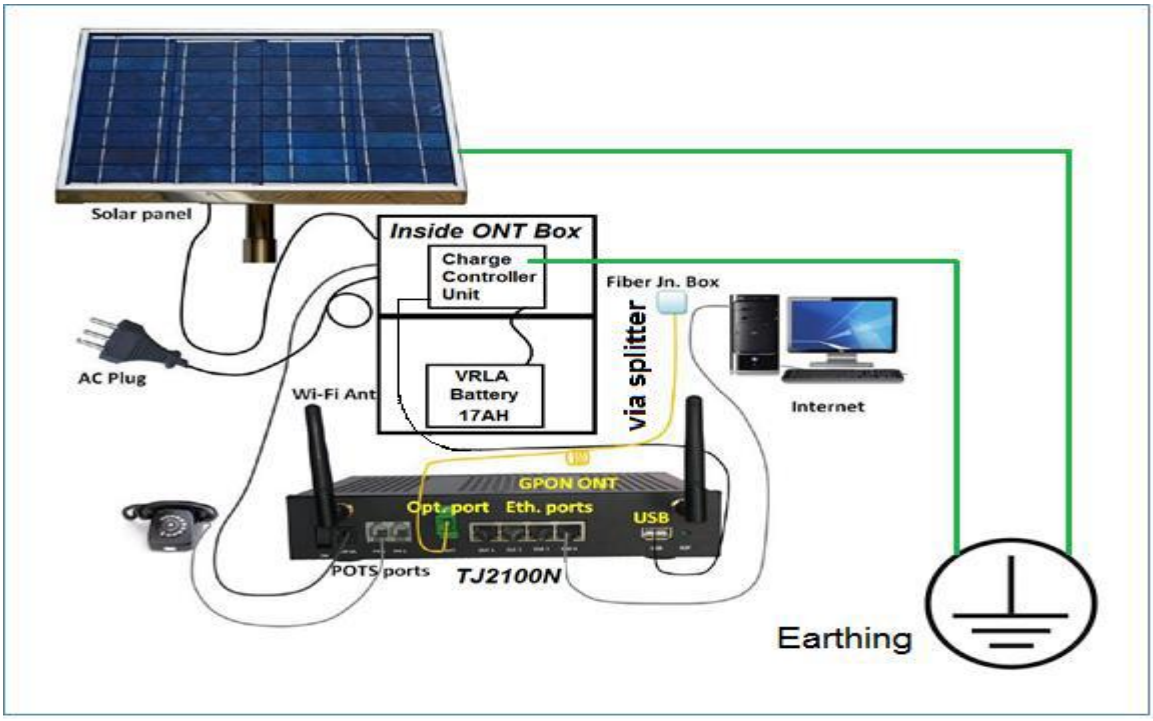

Fig 5.2 Image of the ONT, CCU, Battery and Solar Panel

Fig 5.3. Image of ONT, CCU, Battery installed at Gram Panchayat

5.4 BharatNet Phase-I Newtrok Diagram

During planning and implementation a L-14 & OLT Port diagram has been prepared in order to get the glips of the network and also for future reference. The sample l-14 digarm is in fig 5.4

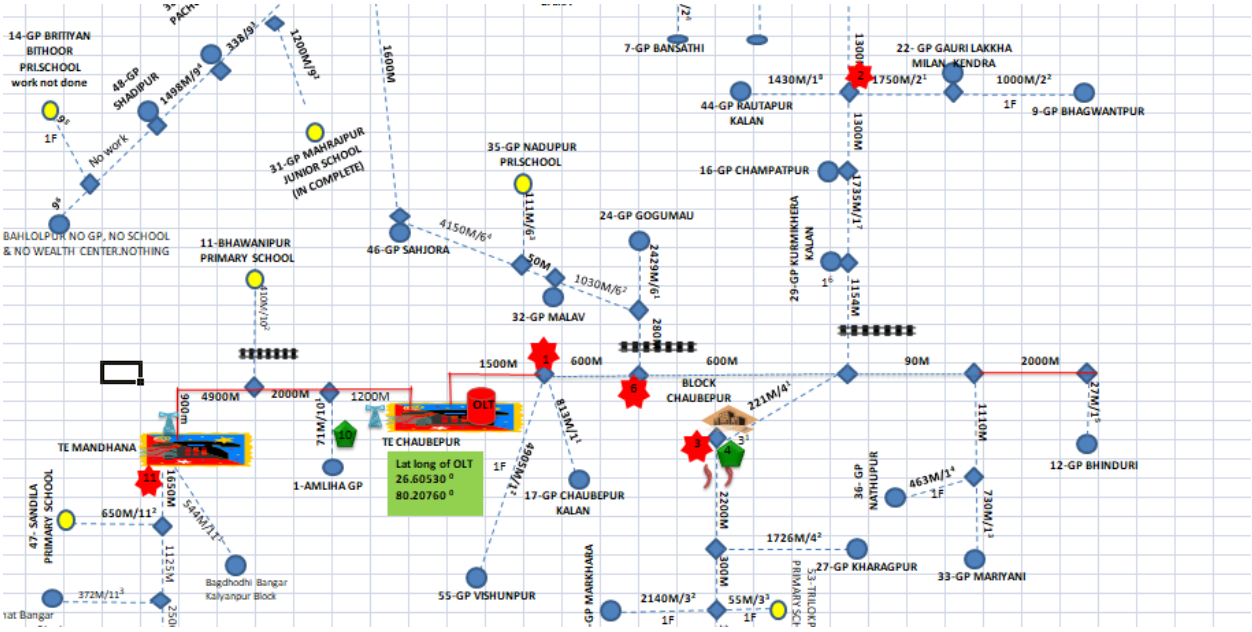

Fig 5.4 L-14 Diagram of the Block in BharatNet Phase-I

In this digaram it has been shown that how the increemntal cable has been laid from the existing optical fiber of the BSNL. The OLT has been shown at BSNL exchange and the ONT's are being installed either at GP Pnachayat Bhawan/Primary School/ Aganwadi kendra or any other suitable Government buildings. The incremental cables are being laid along the raods and some time some railway crossings are also being crossed in order to through the GP connectvity with the block i.e OLT.

The power supply at the OLT locations are being feed through existing BSNL power sources i.e Battery and power plants whereas at GP location the power of ONTs are being

fed through the Solar pannels installed at GP location and where ever possible alternative power supply is being provided through the availble A.C power supply / electricty supply at GP locations.

5.5 BharatNet Phase-I Network Status

The BharatNet Phase-1 was completed in year 2017 and as per BBNL annual report 2020-21 the status of the project as on 31.10.2021 is as under.

S. No.	Phase	GPs planned	OFC laid (km)	Service Ready GPs
1.	Phase-I	120314	308577	118870

Table 5.1

Further the GP's which are being service ready also being monitored through the centralized Network Operation Center (NOC). The data of GP available in the NMS from 2019 to 2022 has been collected from the BBNL NOC and a summary has been prepared which is shown in the table below

Year	Month	GPs visible in NMS
2022	Jan	120480
2022	Feb	120527
2022	Mar	120700
2022	April	120742
2022	May	120717
2022	June	120955
2022	July	120795
2022	Aug	121024

Table 5.2 GP Status in Year 2022 in NMS

Year	Month	GPs visible in NMS
2021	Jan	117374
2021	Feb	118122
2021	March	118911
2021	April	119546
2021	May	119783
2021	June	119731
2021	July	119858
2021	Aug	119999
2021	Sep	120055
2021	OCT	118233
2021	Nov	120147
2021	Dec	120279

Table 5.3 GP Status in Year 2021 in NMS

Year	Month	GPs visible in NMS
2020	Jan	104065
2020	Feb	110929
2020	March	113340
2020	Slept	115545
2020	Oct	115851
2020	Nov	116383
2020	Dec	116914

Table 5.4 GP Status in Year 2020 in NMS

Year	Month	GPs visible in NMS
2019	August	103857
2019	Sept	106360
2019	Oct	102198
2019	Nov	101118
2019	Dec	101164

Table 5.5 GP Status in Year 2019 in NMS

5.5.1 Operation and Maintenance of the BharatNet Phase-I

The project execution of the BharatNet phase-I was under the BSNL, Railtel & PGCIL and the maintenance of the OFC network was under the executing agencies therefore executing agencies was responsible for the operations and maintenance of the Bharatnet Phase-I network.

BharatNet phase-I network is having the existing fiber and incremental fiber therefore the maintenance of the both kind of the fiber was with the executing agencies. The year wise operational data has been collected from the BBNL NMS. The operational status of the GP's from 2019 to 2022 is as under

Year	Month	GPs visible in NMS	Total Up		Total Down	
			UP GP	UP but inaccessible due to OLT unreachability	Unknown Previously Down	Down
2019	August	103857	25632		18423	59802
2019	Sept	106360	26381		14960	65019
2019	Oct	102198	25178		15310	61710
2019	Nov	101118	25568		15133	60417
2019	Dec	101164	31768		13852	55544

Table 5.6 GP Operational Status in Year 2019 in NMS

Year	Month	GPs visible in NMS	Total Up		Total Down	
			UP GP	UP but inaccessible due to OLT unreachability	Unknown Previously Down	Down
2020	Jan	104065	35972		10856	57237

2020	Feb	110929	45223		11868	53838
2020	March	113340	48229	2620	7284	55207
2020	sept	115545	58565		9713	47267
2020	Oct	115851	59736	3928	6851	45336
2020	Nov	116383	64457	3294	5434	43198
2020	Dec	116914	62491	4074	6956	43393

Table 5.7 GP Operational Status in Year 2020 in NMS

Year	**Month**	**GPs visible in NMS**	**Total Up**		**Total Down**	
			UP GP	**UP but inaccessible due to OLT unreachability**	**Unknown Previously Down**	**Down**
2021	Jan	117374	66040	4284	5202	41848
2021	Feb	118122	71118	3192	4421	39391
2021	March	118911	69827	4468	5707	38909
2021	April	119546	72166	4682	5718	36980
2021	May	119783	68293	4385	6618	40487
2021	June	119731	67979	4924	7328	39500
2021	July	119858	67607	5584	7772	38895
2021	Aug	119999	67050	3657	6998	42294
2021	Sep	120055	68458	4087	6772	40738
2021	OCT	118233	69149	4024	6838	38222
2021	Nov	120147	72993	3628	5584	37942
2021	Dec	120279	73142	4469	5575	37093

Table 5.8 GP Operational Status in Year 2021 in NMS

Year	Month	GPs visible in NMS	Total Up		Total Down	
			UP GP	UP but inaccessible due to OLT unreachability	Unknown Previously Down	Down
2022	Jan	120480	67449	4488	7499	41044
2022	Feb	120527	69747	3652	5817	41311
2022	Mar	120700	65496	3614	6544	45046
2022	April	120742	53495	3078	9806	54363
2022	May	120717	49776	2674	9917	58350
2022	June	120955	43833	3551	12712	60859
2022	July	120795	34463	2353	14066	69913
2022	Aug	121024	32069	1671	11518	75766

Table 5.9 GP Operational Status in Year 2022 in NMS

Since operational data has not been made available contagious months in the year and operational status data is also statistical therefore for study purpose the year wise operational data has been considered from the month where highest GP was UP. Further the reasons for down of the GP's will also be taken for further exploration of the study in order to identify the issues and challenges in the network up time of the BharatNet phase-I. The year wise operational statics of the GP's are as follows.

Year	Month	GPs visible in NMS	Total UP		Total Down		UP %	Down %
			UP GP	UP but inaccessible due to OLT unreachability	Unknown Previously Down	Down		
Year 19	Dec	101164	31768		13852	55544	31.40	68.60
Year 20	Nov	116383	64457	3294	5434	43198	58.21	41.79
Year 21	Dec	120279	73142	4469	5575	37093	64.53	35.47
Year 22	Feb	120527	69747	3652	5817	41311	60.90	39.10

Table 5.10 Year wise GP Operational Status

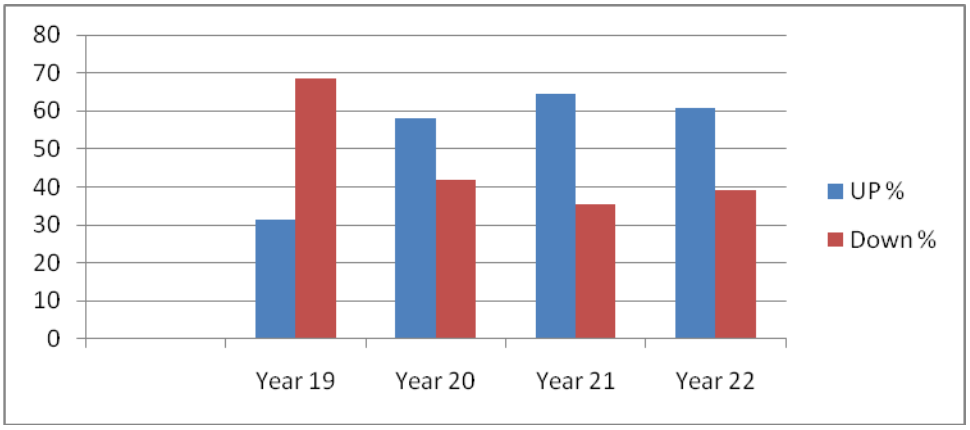

Fig 5.5

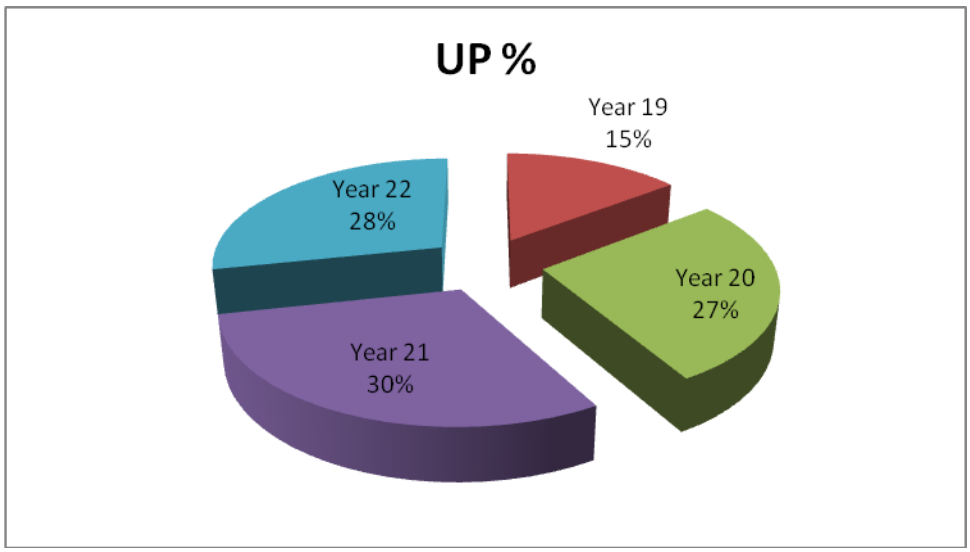

Fig 5.6

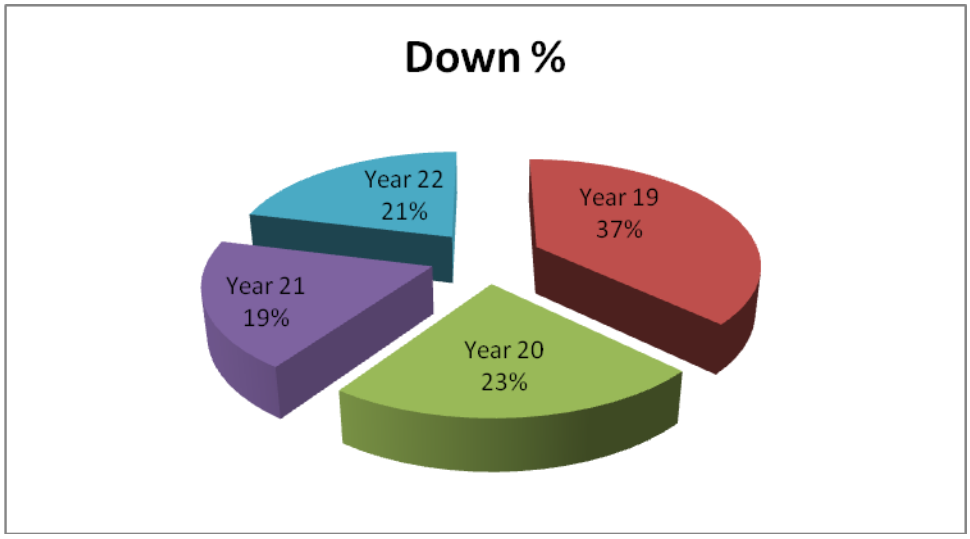

Fig 5.7

From the above figures it can be seen that in year 2022 there were almost 22% GP were down and the reasons recorded from the NMS has also been collected and the year wise reasons of down of the GP's are listed as below in the table 5.11

Year	Down GP's	BBNL FIBER	LEASED FIBER	NO ALARMS	ONT GPON	ONT INFRA	OTHERS	POWER/SWITCHOFF
Y22	41311	21173	5683	2104		3476	511	8364
Y21	37093	16619	5925	1586	3	5182	344	7434
Y20	43198	20362	4671	2860	713		637	13955
Y19	55544	30136		7322	962	746	9002	7376

Table 5.11 Year wise GP down Reasons

The percentage contribution for the different reasons of down is shown in table 5.12

Year	BBNL FIBER (%)	LEASED FIBER (%)	NO ALARMS (%)	ONT GPON (%)	ONT INFRA (%)	OTHERS (%)	POWER/SWITCH OFF (%)
Y22	51.25	13.76	5.09	0.00	8.41	1.24	20.25
Y21	44.80	15.97	4.28	0.01	13.97	0.93	20.04
Y20	47.14	10.81	6.62	1.65	0.00	1.47	32.30
Y19	54.26	0.00	13.18	1.73	1.34	16.21	13.28

Table 5.12 Year wise GP Down % Reasons

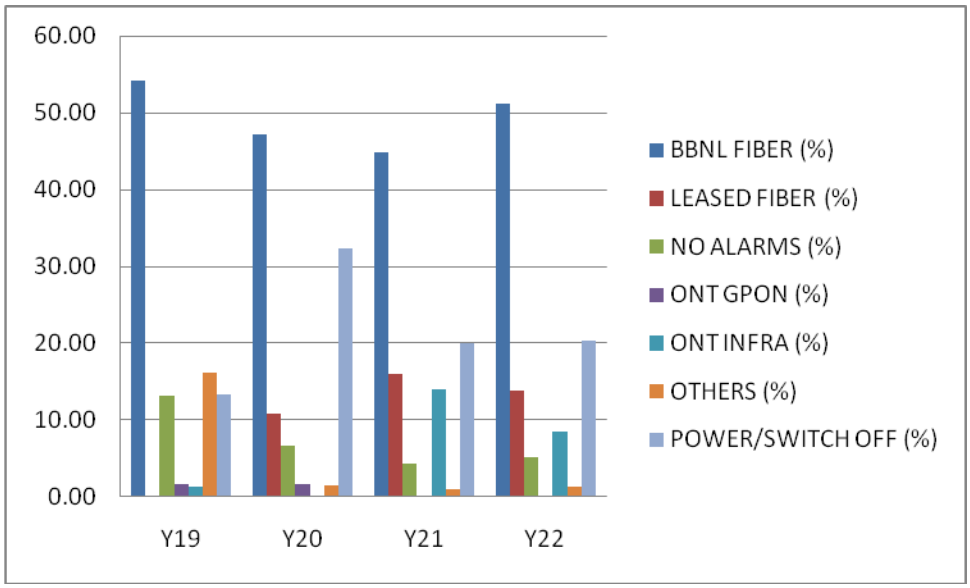
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Y19
Y20
Y21
Y22
BBNL FIBER (%)
LEASED FIBER (%)
NO ALARMS (%)
ONT GPON (%)
ONT INFRA (%)
OTHERS (%)
POWER/SWITCH OFF (%)

Fig 5.8

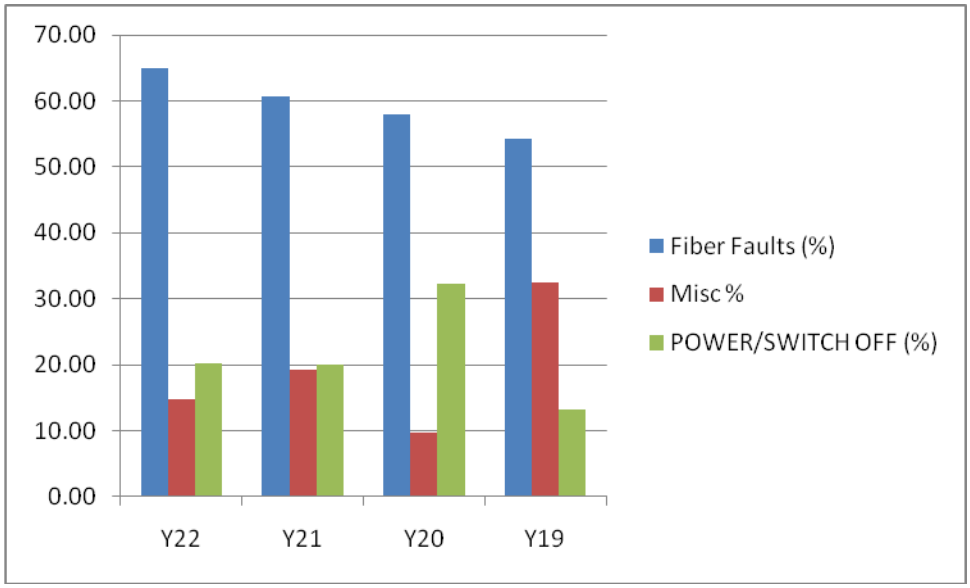
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Y22
Y21
Y20
Y19
Fiber Faults (%)
Misc %
POWER/SWITCH OFF (%)

Fig 5.9

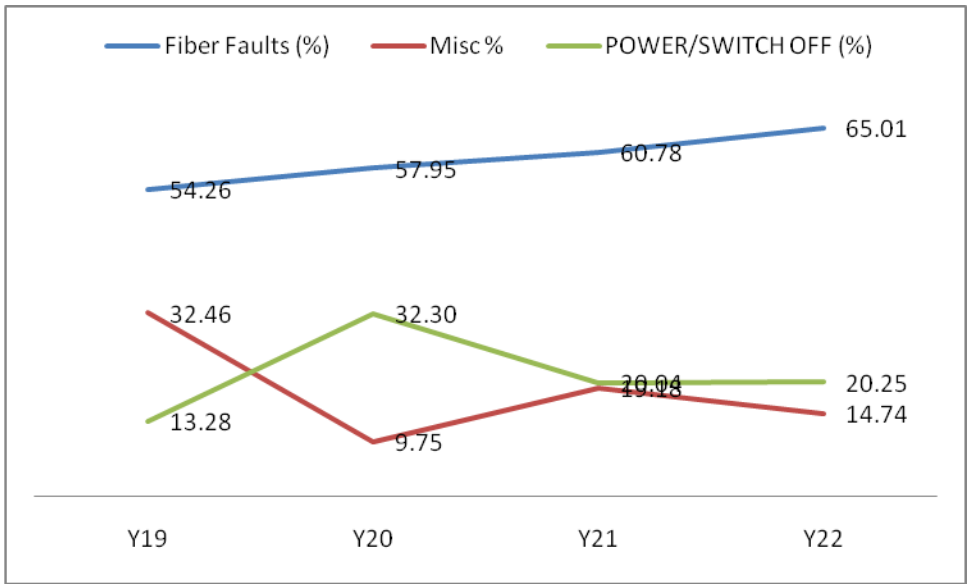

Fig 5.10

From the above graph it is evident that there majority of GP's are down due to Fiber faults and Power/Switch off other misc reasons are very less. Further the graph also indicates that fiber faults are increasing from 2019 to 2022 where as power and other reasons are almost at par this indicates the poor maintenance of fibers by the maintenance agencies.

5.5.2 Operation and Maintenance Modalities

A) First Line Maintenance of the GPON equipment

In BharatNet Phase-I there were 3 Major equipment vendors (i.e. M/s Tejas, M/s L&T, M/s ITI) were providing the GPON equipment for installation at BSNL telephone exchange and GP locations. The equipments were installed by these vendors and the responsibilities for repair and maintenance was under these vendors. The first line maintenance of the equipment was also with these vendors.

B) Optical Fiber Maintenance

The operations and maintenance was carried out by the executing agencies i.e. BSNL, Rail Tel, PGCIL till 30.06.2019. Most of operations and maintenance was carried by the BSNL under the BharatNet Phase-I. The fiber maintenance was carried out by the transmission teams of BSNL at the District/SSA level. This transmission team was responsible for the fiber maintenance of the existing BSNL fiber as well as BBNL incremental fiber. This team was also responsible for the maintenance of the existing BSNL network where BSNL other services like Landline, Broadband, Mobile BTS tower was running. The existing BSNL transmission team was having only 1 Junior telecom officer and 2 Phone Mechanics (PM)/ Regular Majdoor (RM) along with 2 labours. This team may have approximately 200-300 RKM for the maintenance.

The area of responsibility for this team was to locate the fiber faults and repair of fiber faults. In a district there were approximately 10-12 Blocks which are geographically 30-40 KM away from the District HQ where the transmission team was situated. The movement of the team was based on the trouble tickets generated by the NMS.

From above table 5.10 it is evident that the number of UP GP's was very less and in July 2019 department of telecom has taken decision to modify the operation and maintenance and the fiber maintenance was handed over to Ms CSC and CSC was asked to depute the Fault Repair Team at each of the Block level. The FRT consist of the one cable fault locator and jointer and 2 labour for assistance.

C) BharatNet Network Monitoring

The network was monitored through the centralized Network Operation Centers (NOC) at New Delhi & Bangalore. The NOC have one C-DoT NMS where all the status of the GP from all the vendors are being captured based on the alarm by the GPON system. Based on the Alarm the trouble tickets are being created and forwarded to the concern in charge of the FRT.

The Project monitoring units (PMU) are also available at the commissionaire level that are responsible for the project execution as well as monitoring of the NMS as well as coordination with operation and maintenance agencies in their respective areas.

5.6 Issues and Challenges in O&M and Newtrok UP time

As per the NMS reports of the previous year the mjority of the GP's are down due to fiber faults or the power swith off. After discussion with all stake holders like PMU, BSNL, CSC, NOC it has been noted there are various issues and challnages in the maintenance of the Bharatnet phase-I. the major issues and challenges which has been identifid are as follows

A) Issue of lack of coordination among different stake holders for fiber mainteance

i. The incremental fiber is terminated at the panchayat Bhawan/Schools/ other government institution where custodianship of the equipment has not been clearly owned by the functionaries of these institutions although tripart agreement clearly indicate that the custionaship lies to these functionaries.

ii. The BharatNet Phase-I network having existing fiber as well as incremental fibers therefore there is always dispute on the fuber faukts between BSNL & BBNL Fibers.

iii. There is huge development activities are being carried out across the country like developments of roads, highways, railways, cannels, water pipe line layings and there is lack of coordination among the different agencies therefore there are huge cable cuts which affect the network up time.

iv. Local bodies area lso carrying out the development activities like roads khadanja, Nali etc. wich affect the optical fiber.

v. There are GP's Location which are far flenge from the village and there is issue of security at GP locations.

vi. The GP's are also not having proper electricity and secirity which is also the cause of down of the GP's and as per NMS data approximately 20% GP's are down due to the power/ switch off condition.

vii. The mainteanace agencies are not being deploying the skilled manpower in FRT. Some time in many bolcks FRT are not existing.

viii. The mainteanace agencies are also rectifying the faults in temporary basis by hanging the optical fiber on the tree due to development activities.

ix. O&M of the fiber sholuld be SLA based as such no strict SLA exists

B) Issue and Challanges with GPON Vendors

i. There is huge delay in rectification in faulty GPON equipment

ii. The Battery provided by the vendors has been life expired but not replacing due to various reasons

iii. Vendors are not Opening of repair centre in the state due to various reasons

iv. First Line Maintence activities are not eing carried out vendors

C) Issues and Challenges with BSNL

i. Non availability of OLT due to poor infra condition at BSNL telephone exchange at Block HQ.

ii. Non rectification of existing fiber faults due to shortage of FRT teams

iii. Issues in replacing the existing BSNL fiber

iv. Non Submission of the final ABD/L-14 Diagaram for tracing the optical fiber

D) Issues and Challanges in PMU of BBNL

I. The Staff strength is very less in PMU as per the area alloted to the PMU

II. No regukar staff avaialable for the verification and coordination work.

III. PMU is not able to coordinate for the preventive mainenance due non presense at the block level

Chapter-6

Issues and Challenges in the Last Mile Connectivity for the utilization of BharatNet.

6.1 Overview

The infrastructure created under the BharatNet project is a national asset and is accessible to service providers on a non-discriminatory basis, and can also be used to provide broadband/internet services through Wi-Fi hotspots, fiber to the home (FTTH), leased lines, dark fiber, backhaul to cell towers, etc.

The BharatNet network has been so designed that it will be able to deliver up to 1 Gbps speed at GP level and bandwidth can be provisioned on a demand basis. The BharatNet infrastructure will be made available to all the TSP/ISP on non-discriminatory basis which will save the CAPEX cost of all the TSP/ISP and this TSP/ISP will be able to facilitate affordable broadband proliferation in rural India. This will bridge the digital divide between urban and rural India and true digital India will be realized.

As per network architecture of the BharatNet the optical fiber connectivity is available up to the GP's whereas the potential customers/ institutions are falling nearby of the GP at a certain distance therefore last mile connectivity would be one of the challenges to the ISP.

Last Mile Connectivity (LMC) is a critical concern to do away with digital divide in our country and thereby ensuring inclusive growth and social development. The inclusive character of digital connectivity is crucial to good governance through deeper, cheaper and faster transmission of information.

6.2 Broadband Access Technologies

There are several technologies available to provide the broadband access to the retail customers or small business entities. The various technologies for broadband access are as follows

a) Optical Fiber technology (i.e FTTH, FTTHx)

b) Copper Technologies (DSL, ADSL)

c) Wireless Broadband (RF, Wi-Fi, AWS)

d) VSAT

In addition to existing access technologies, new technologies that have the potential to provide innovative means of broadband access to rural and remote areas are being developed and tested. Some key emerging technologies with great potential are wireless broadband near power lines using "surface waves", Li-Fi with LEDs, micro-satellites, drones, millimeter waves, using many types of data nodes. Access in wireless networks. heterogeneous network. The Network components globally used for supporting broadband technologies are in fig 6.1

	← Optimal connectivity to support data/bandwidth demand →				
Technology	Access	Backhaul	Domestic transmission	National long distance	International long distance
LTE/4G	IP Microwave (eNode B)	IP Microwave/Fiber (FTTT)*	Fiber	Fiber	Fiber
3G	IP Microwave (Node B)	IP Microwave/Fiber (FTTT)	Fiber	Fiber	Fiber
AWS/5G	IP Microwave	IP Microwave/Fiber (FTTT)	Fiber	Fiber	Fiber
DSL	Copper	Fiber/Copper	Fiber	Fiber	Fiber
FTTx	Fiber	Fiber	Fiber	Fiber	Fiber
Wi-Fi	IP Microwave (UBR)	Fiber/Copper	Fiber	Fiber	Fiber
VSAT	Satellite	Satellite	Satellite	Satellite	Satellite

Fig 6.1 Network components globally used for supporting broadband technologies

(Source: - 9th International Conferences on ICT and Digital economy, India telecom 2016)

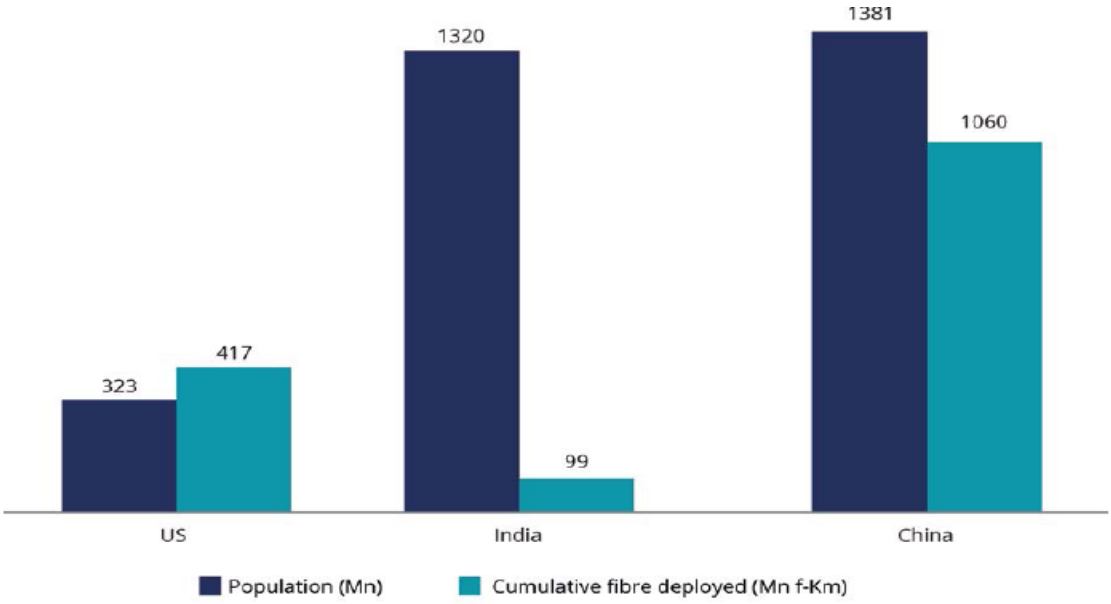

Fig 6.2 Comparative analysis (Population vs. Cumulative fiber deployment)

(Source: - 9th International Conferences on ICT and Digital economy, India telecom 2016)

6.2.1 Technology choice of the Broadband for Last Mile Connectivity

The various technologies consideration of the broadband for the list mile connectivity are given in Fig 6.3

Fixed Solution	Throughput (DL)	Protocol	Robustness	CAPEX	Scalability	Maintenance
FTTx (GPON)	> 1 Gbps	IP	🟢	🔴	🟢	🟡
xDSL (vDSL2)	< 300 Mbps	ATM/IP	🟡	🟢 (1)	🟡	🟢
HFC (DOCSIS 3.0)	< 400 Mbps	IP	🟡	🟡 (1)	🟡	🟡
BPL	< 500 Mbps	IP	🔴	🟢 (1)	🔴	🟡
Wireless Solution	**Throughput (DL)**	**Bandwidth**	**Range**	**CAPEX**	**Robustness**	**Interoperability**
LTE/LTE – A	< 100/300 Mbps	1,4 – 20 Mhz	5 – 100 km	🟢	🟢	🟢
Satellite	< 24 Mbps	1 – 40 MHz	100 – 6000 km	🟡 (1)	🔴	🔴
WiFi	< 433 Mbps[3]	20 – 160 MHz	35 – 115 m (indoor)	🟢	🟡	🟡
DC-HSDPA +	< 84 Mbps	5 – 20 MHz	< 50 km	🟡	🟡	🟢

Legend

🟢 **Better**

🟡 **Average**

🔴 **Worst**

Fig 6.3 (*Source: - 9th International Conferences on ICT and Digital economy, India telecom 2016)*

As per the comparative technologies the best fit technologies are as under

a) FTTx(GPON)- Extreme reliability, high throughput, future proof technology

b) xDSL (vDSL2): Proven, cheaper to adopt and maintain technology

c) LTE: High throughput, good legacy interoperability, high mobility technology

d) Satellite: Global coverage, severe conditions appropriate technology

The choices of technology for delivering the services are also influenced by the demand of the clusters. The demand cluster can be divided in three different categories i.e. Urban, Semi Urban and Rural. The technologies mapping based on the demand cluster is depicted at fig 6.4

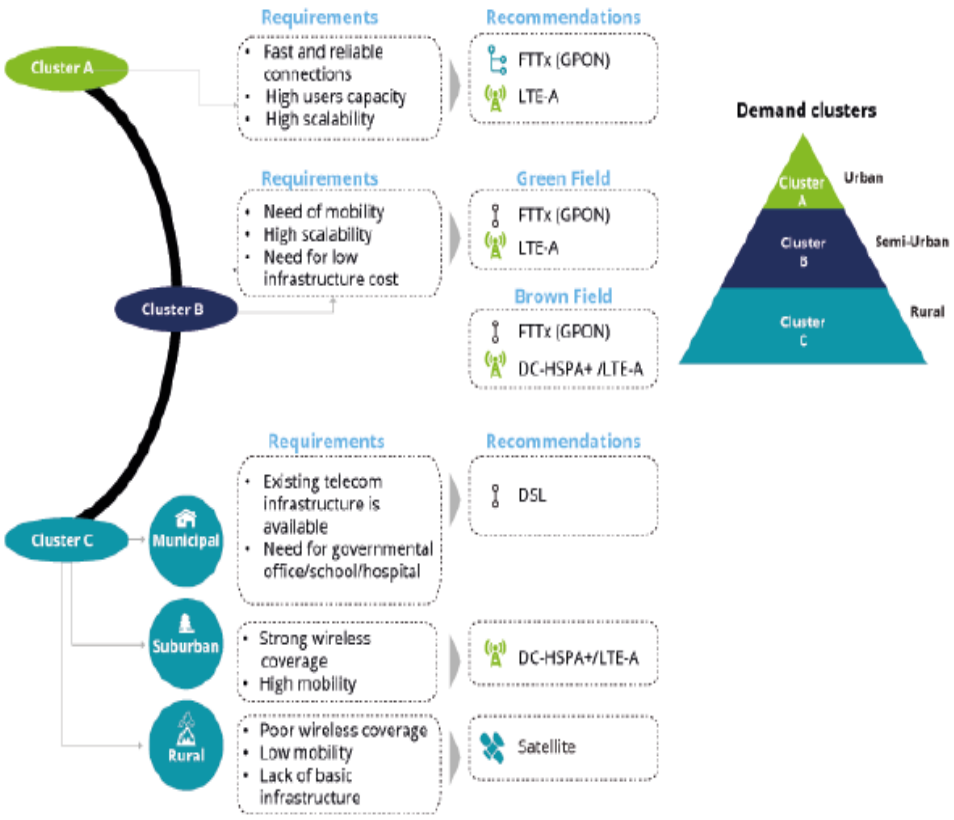

Fig 6.4 (*Source: - 9th International Conferences on ICT and Digital economy, India telecom 2016)*

As per the current trend multi play services are being utilized by the citizen. Internet is no more for the instrument of the education but also for the multiple bandwidth hungry services like OTT, entertainment & Gaming etc are also running. In order to run such a bandwidth hungry services a robust and extremely scalable network is required therefore FTTx (GPON) is now becoming obvious choice not only in urban clusters but also in rural clusters also therefore the choice for the last mile connectivity apart from the Wi-Fi is becoming FTTx (GPON). The GPON technologies based on fiber has low maintenance and very much scalable also.

6.3 BharatNet Utilization

The BharatNet network created from Block to GP's has following mission

a) Provide high speed digital connectivity to rural areas of India at affordable prices.

b) Provide B2B services in a non-discriminatory manner.

c) Promote the spread of broadband services in rural areas for socio-economic development in line with the vision of the "Digital India" initiative launched by the Government of India to transform India into a "digital society and economy". Knowledge"

BharatNet is middle level optical fiber network from block to Gram Panchayats (GPs) which provides connectivity to service providers like TSPs, ISPs. MSOs, LCOs and Government agencies for extending their services from Block to GPs. It offers following services to the service providers and government institutions:

1. **Bandwidth:** ISP can opt for the bandwidth directly from one point to another point and also can opt for point to multi-point (P2MP) from block to GPs using GPON technology.
2. **Dark Fiber :-** BharatNet offer the dark fiber in leased basis to the TSP/ISP on incremental cable laid by BBNL between Fiber Point of Interconnect (FPOI) and GPs

6.3.1 Status of Digital Connectivity

As per the report of TRAI for the July-Sep 2022 published on 3.2.2023 the Internet/Broadband subscriber in India is as below

Internet/Broadband Subscribers	
Total Internet Subscribers	850.95 Million
% change over previous quarter	1.68%
Narrowband subscribers	35.01 Million
Broadband subscribers	815.93 Million
Wired Internet Subscribers	30.82 Million
Wireless Internet Subscribers	820.13 Million
Urban Internet Subscribers	507.13 Million
Rural Internet Subscribers	343.82 Million
Total Internet Subscribers per 100 population	61.62
Urban Internet Subscribers per 100 population	104.77
Rural Internet Subscribers per 100 population	38.33
No. of Public Wi-Fi Hotspots	1,76,989
Aggregate Data Consumed (GB)	1,66,21,376

As per report it is evident that there is huge disparity of internet at urban and rural population. The status of rural and urban divide is in fig 6.5

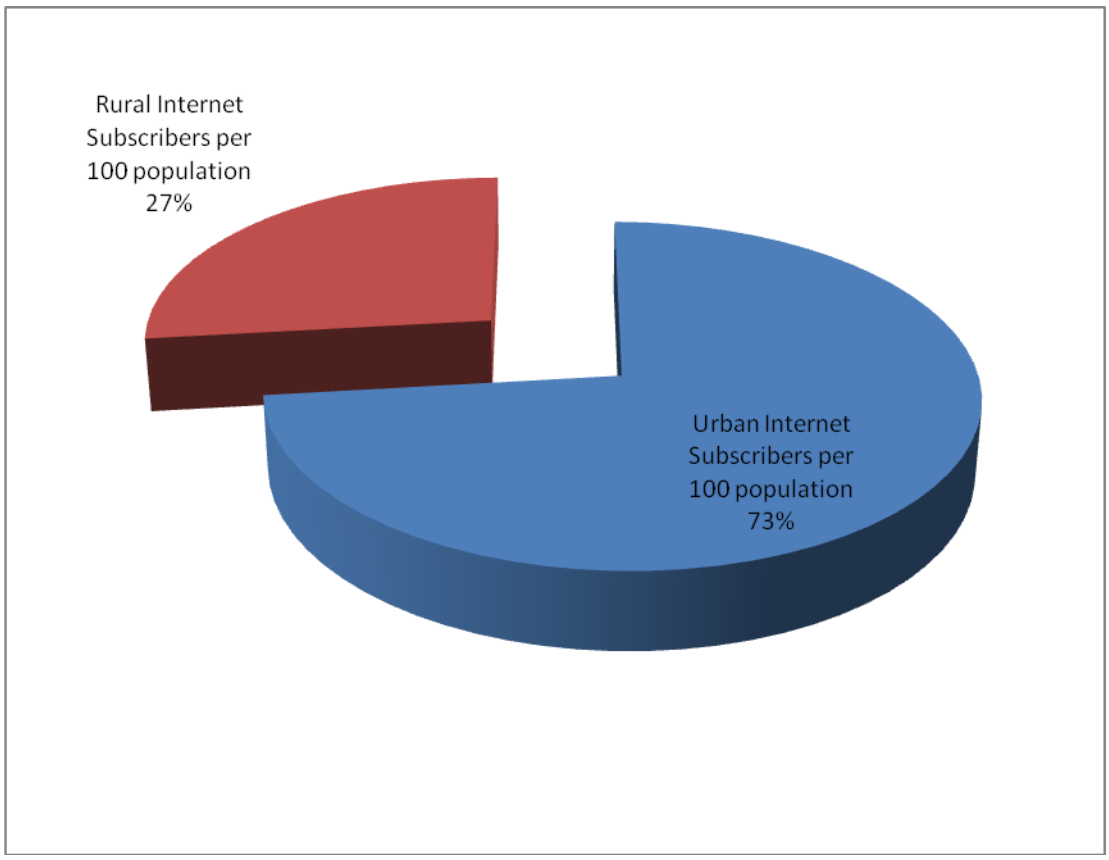

Fig 6.5

6.3.2 BharatNet utilization Initiatives

BBNL was responsible for leasing the Bandwidth and dark fiber to the ISP/TSP for further expansion of broadband services at the rural area in order to bride the digital divide. Initially BBNL has MoU with BSNL for providing the FTTH at rural area and later M/s CSC has been put on board with BBNL for utilization BharatNet in order to provide the broadband services at the rural areas around the Grampanchayat.

BBNL has also put the efforts to tie up with Local ISP/ LCO/MCO to utilize the BharatNet and provide the internet at rural areas

The status of utilization as per the annual report 2020-21 of BBNL is as follows:

A) Works Awarded to CSC-SPV & RISL

a. CSC has been awarded the work of setting up Wi-Fi Hotspots with 2 Access Points in 32,595 GPs for setting up Last Mile Connectivity. Later USOF/ DoT, has taken a decision that CSC- SPV will provide 1 Wi-Fi Hotspot and 5 FTTH connections to Government agencies/ Institutions in 77,115 GPs in 31 States/UTs.

b. USOF/DoT awarded the work to CSC-SPV for providing 1 Wi-Fi and 5 FTTH connections to 2,692 GPs in Bihar and 5 FTTH connections to 4,802 GPs in Punjab.

c. USOF/DoT awarded the work to RISL, Rajasthan for setting up of 1 Wi-Fi & 5 FTTH Connections at 10,000 GPs in Rajasthan.

d. USOF/DoT awarded the work to CSC-SPV for setting up 1 Wi-Fi Hotspot and 5 FTTH connections in 36,744 Villages in Bihar.

B) Utilization Status of FTTH & Wi-Fi:

a. A total of 328923 FTTH connections (Active + Plan expired) (BSNL- 17,076 ISPs- 14,468, & CSC-SPV- 2, 97,379) has been provide by the BSNL / CSC-SPV / ISPs together in rural areas using BharatNet connectivity in 27 States/ UTs.

b. M/s CSC-SPV has installed the Wi-Fi Hotspots at 94,268 GPs out of which Wi-Fi Hotspots are active at 58,247GPs.

c. RISL has installed Wi-Fi Hotspots at 8,034 GPs out of which Wi-Fi Hotspots are active at 5,206 GPs.

d. BSNL has also provided the Wi-Fi services using BharatNet at 678 GPs in the States of Kerala and Uttar Pradesh out of which Wi-Fi Hotspots are active at 658 GPs.

e. Other TSP has also installed Wi-Fi hotspot in 62 GPs out of which Wi-Fi hotspots are active in 21 GPs.

f. M/s CSC-SPV has installed FTTH & Wi-Fi in 2,977 Villages in Bihar. Total 12,221 Villages have been connected with FTTH and 1,941 villages have been connected with Wi-Fi only.

C) Provision of Bandwidth:

About 42,10,825 Mbps bandwidth have been utilized by BSNL, CSC SPV, ISPs, and TSPs, including 33,21,650 Mbps at 66,433 GPs @ 50 Mbps for CSC SPV.

A) Provision of Dark Fibre:

About 30,932 Fibre Kms of the dark fiber have been utilized by BSNL/TSPs/ISPs in the various States for FTTH connections, BTS Connectivity, and Cable TV etc.

B) SWAN Integration:

A total of 16,284 SWAN Connections have been provided using BharatNet (72 GPs in Kerala, 258 GPs in Karnataka, 03 GPs in Puducherry, 214 GPs in Uttarakhand and 11 GPs in Chandigarh, 13 GPs in West Bengal, 7733 GPs in Gujarat Phase-II, & 7980 GPs in Rajasthan).

In addition, other Service Providers, on their own, are also utilizing BharatNet network for providing Last Mile connectivity. However, it is observed that the utilization of the network is not commensurate with the number of GPs made Service Ready GPs (about 1.75 lakh) so far, as about 2.29 lakh FTTH connections have been provided and Wi-Fi Access Point have been installed at 1.04 lakh GPs. Therefore, there appears to be a need to take new measures for increasing the utilization.

6.3.3 Model of Last Mile Connectivity in BharatNet

The BharatNet Fiber is available till the GP after that actual service provider will lay the fiber till customer premises. The preferred technologies for Last Mile Connectivity are Wi-Fi & FTTH. The FTTH technology has the following features:

a) FTTH is an effective broadband technology access.

b) Last mile connectivity through Wi-Fi as a public access medium has a limited range around the mast and can only be used as a shared medium around the site.

c) The FTTH network can be rolled as an effective network for providing multiple connectivity in an expanding network providing broadband services including cable TV, voice, telemedicine, tele education and other content-based services appealing to rural masses.

d) May spur the utilization of BharatNet quickly.

e) Has the potential to provide connectivity to Millions of Rural Subscribers

f) Potential for providing employment opportunities to rural Youth

For the estimation and business viability of the Last Mile connectivity model is shown in fig 6.6 and the cost calculation is shown in the table 6.1

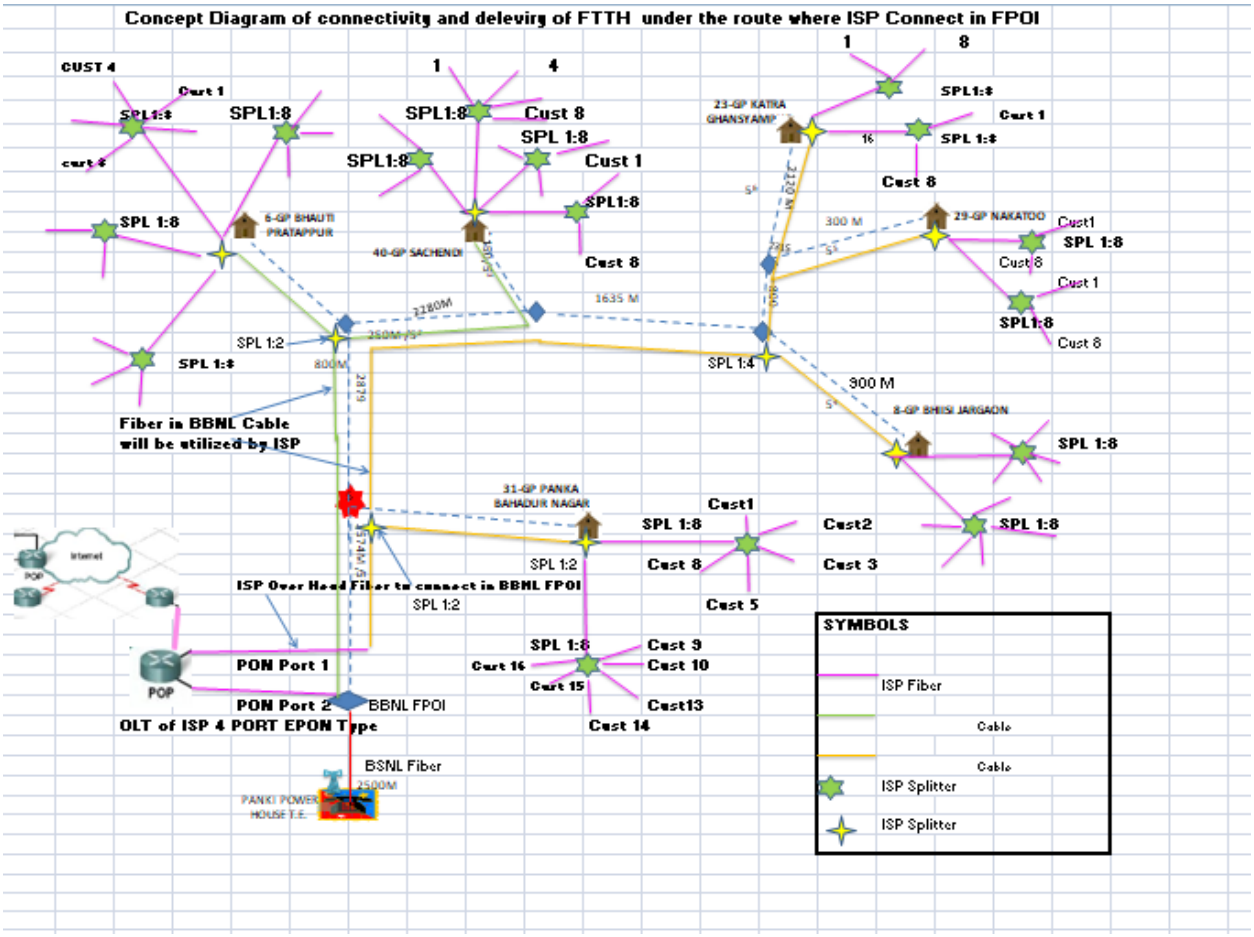

Fig 6.6

A) Line Item Requirement for Making the Network of FTTH Delivery (5 Year Model)

GP Name	GP No along the route	BBNL Incremental Distance from FPOI To GP for leasing of Fiber	BBNL Incremental fiber Fiber	Local lead Distribution Fiber	Splitter (1:2 & 1:4: 1:8)	FTB	Patch Card @ 2 M	ONU	OLT EPON 4 Port	OLT TO FPOI Fiber	Inter Net Leased Line (MB) on OLT
Cost @ RS of Each item		**2250**		**10**	**100**	**80**	**50**	**1500**	**54000**	**20**	**8**
GP1	1	2500	1	9000	13	65	52	52			
GP2	2	5000	1	9000	13	65	52	52	1	2000	3200
GP3	3	7500	1	9000	13	65	52	52			

GP4	4	10000	1	8700	13	63	50	50			
GP5	5	12500	1	8700	13	63	50	50			
total of item		**37500**	**5**	**44400**	**65**	**321**	**256**	**256**	**1**	**2000**	**3200**
Expenditure on Each Line item in Rs		**84375**		**444000**	**6500**	**25680**	**12800**	**384000**	**54000**	**40000**	**307200**

B) Cost Calculation

Expenditure Heads	**Item**	**Expenditure for the Period**
Capital Expenditure (One Time) assuming that network will be in technology for 5 Years	OLT EPON 4 Port	54000
	Local lead Distribution Fiber	444000
	Splitter (1:2 & 1:4: &1:8)	6500
	FTB	25680
	OLT TO FPOI Fiber	40000
	ONU Charges	187500

Sum of Capital Expenditure		**757680**
O&M Charges For Last Mile Network @ 6%		**45460.8**
Recurring Expenditure Per Year	BBNL Leased Fiber Payment	84375
	OLT Space Rent	72000
	Power /Infra Charge	48000
	Deployment of FRT Team	240000
	Internet Leased Line Expenditure	307200
Sum of Recurring Expenditure Per Year		**751575**
Total Expenditure For 1 Year (Capital expenditure/5 + O&M Charges+ Recurring Expenditure)		**948571.80**
Amount to be recovered from business model @ 20 % On capital investment		**151536.00**
Average Revenue Required to make Business case		**8800.86**

C) Customer Projection and Revenue Earnings in Business model

Item	Plan	Customers Probability 1 (No's)	Revenue Per Month for Probability 1 (In Rs)	Customers Probability 2 (No's)	Revenue Per Month for Probability 2 (In Rs)
Customer Distribution to earn the average Revenue	857	0	0	1	857
	757	0	0	1	757
	657	0	0	2	1314
	557	0	0	5	2785
	457	4	1828	5	2285
	357	15	5355	15	5355
	257	20	5140	15	3855
	157	25	3925	20	3140
Total		**64**	**16248.00**	**64**	**20348.00**
Average Revenue per Customer In Rs			253.88		317.94
Recoverable Amount on Average Revenue in a Year In Rs			380812.5		976704
Required Revenue Recovery from			1100107.80		1100107.80

Business model In Rs					
Deficit in Revenue In Rs			-719295.30		-123403.80
Per Connection Subsidy required for Business Viability			5754.36		
If ONU Charges Recoverable from Customer In Rs			187500		123403.80
% Recovery of ONU From Customer			100%		56%
Discount/ Subsidy to be given on the BBNL Leased Line In Rs			-531795.30		0
% Discount Required on the BBNL Leased Fiber			32%		0

6.4 Stake Holder Consultation for Last Mile Connectivity in Utilization of BharatNet

As per the report of DoT there are 2064 ISP authorized under Unified License and 593 ISP authorized under UL-VNO in various license service areas of India. There is a total of 2657 service providers are authorized to provide internet services in our country. As per license category these service providers are operating in their license area. The operational area under different license category is given in table 6.2 and the number of service provides are in table 6.3. The percentage distribution is ISP and VNO is in Fig 6.7 & 6.8 respectively

LICENSE TYPE	COUNT
A	NATIONAL AREA
B	22 States/ UTs
C	229 SSAs

Table 6.2

LICENSE TYPE	COUNT
ISP A	155
ISP B	735
ISP C	1174
VNO (ISP) A	67
VNO (ISP) B	411
VNO (ISP) C	115
TOTAL	2657

Table 6.3

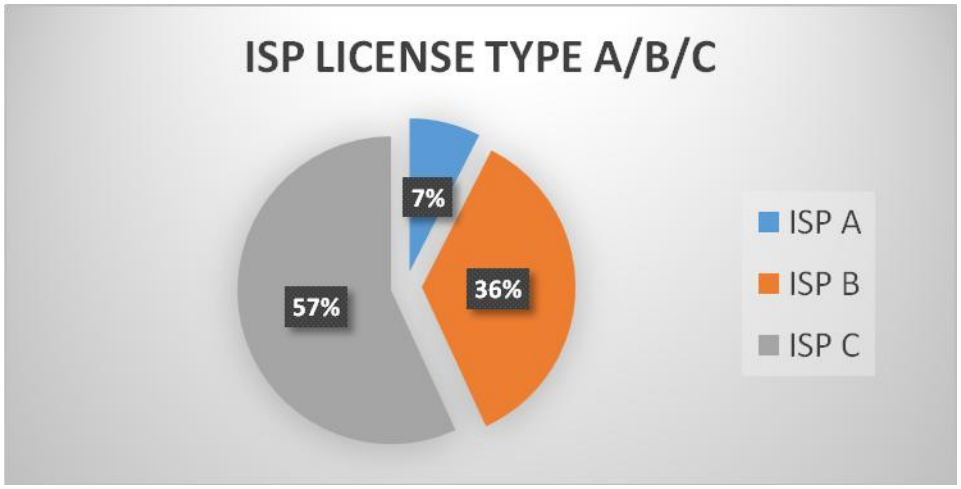

Fig 6.7

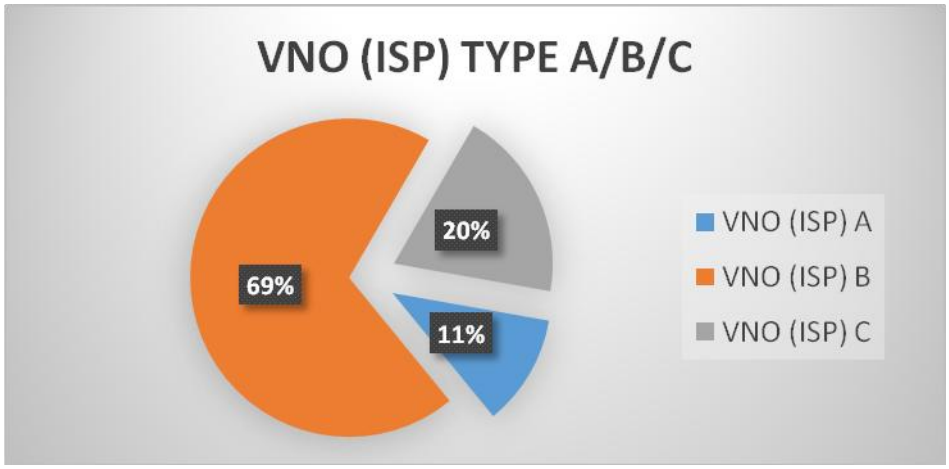

Fig 6.8

A focus group discussion was conducted with major ISP/TSP in order to find out the issues and challenges in utilization of BharatNet. Following major stake holders has been discussed on the matter

a. Bharat Sanchar Nigam Limited

b. Gujarat Fibre Grid Network Limited (GFGNL)

c. Andhra Pradesh State Fibernet Limited (APFSL)

d. RailTel

e. Doorsanchar STS Telecom Services Pvt. Ltd.

f. RG Technosolutions Pvt. Ltd.

g. NetPlus

h. Reliance JIO

i. AirTel

j. CSC e-Goveranance

After Focus Group Discussion (FGD) following issue and challenges has been emerged

i. Higher capital cost to set up infrastructure

ii. Network UP time of the BharatNet is the major concern to all the stake holders. QoS is main concern to the customers. Most ISP/TSP required Service Level Agreement (SLA)

iii. Field level issues like Right of Way Issues (RoW), permissions, coordination, at local level is also concern to the LCO/ISP/TSP. Most the TSP/ ISP/LCO lay the last mile fiber overhead through electric poles or street furniture.

iv. The Last mile connectivity will be started from the GP Panchayat Bhawan and Electricity, Infrastructure condition and security are major concerns

v. Affordability Issues (high cost for rural customers). The customers at rural can afford higher plans for the FTTH

vi. Demand side issues like lower customer demand & awareness

Supports highlighted by the TSP/ISP during the Focus Group Discussion are as follows

i. Majority of the respondents believe that subsidy support for **capital** will help them greatly to extend last mile connectivity in rural areas

ii. Respondents have requested subsidy in **operations and maintenance** to assist them in providing connectivity to rural regions

iii. Respondents said that **ILL subsidy** will enable them to offer last mile connectivity in rural areas with ease while achieving viability

iv. Respondents are of the opinion that other subsidies such as **direct subsidy to customer** will be beneficial

The Subsidy proposed by various TSPs/ ISPs is given in the table 6.4

S No.	TSP/ ISP	Proposal
1	RailTel	Rs. 19750 as CAPEX and Rs. 300/ month as OPEX. CAPEX include RailTel PoP to Block connectivity. No time limit for OPEX
2	BSNL	Rs. 8800 as CAPEX and Rs. 100/month per customer upto 4 years depending on type of village
3	Reliance JIO	Rs. 19000 as CAPEX and OPEX: 8 % to 10 % of CAPEX
4	GFGNL	Rs. 6000/ FTTH Connection
5	APSFL	CAPEX of Rs. 75/ month for 5 years and OPEX of Rs. 50/ month

6	DSTS	Rs. 6775 as CAPEX and Rs. 140/ customer as OPEX for 1 year.
7	Net Plus	Rs. 6000 as CAPEX
8	RG Techno Soln.	Rs. 5000 as CAPEX and Rs. 150 as OPEX for 12 months.

Table 6.4

6.4.1 New initiative of Department of Telecommunication for enhancing utilisation of BharatNet.

DoT has taken the new initiatives for the Last Mile Connectivity in order to enhancing the utilization in BharatNet. Some the initiatives are as follows

i. DoT has taken one major step where BBNL has been merged with the BSNL in order to better operation and maintenance and utilization. The BSNL is the government enterprises under the ministry of telecommunication and also have PAN India presence for delivering the services in all nook and corner of the country. As per the network design the BharatNet Phase-I is the extension of BSNL network up to the GP. The FTTH delivery at rural area will be faster.

ii. DOT has also awarded the Pilot Project to the BSNL for delivery 100,000 FTTH at rural area. Under this pilot project DoT has been given subsidy to BSNL for proliferation of FTTH.

iii. DoT is providing the Special Assistance to the states for the capital investment in the utilization of the BharatNet.

iv. BharaNet Udyami Scheme for the utilization of BharatNet.

6.5 BSNL's Pilot for One Lakh FTTH Connections

- A pilot proposal of BSNL for rolling out of One Lakh FTTH connections using BhartNet within the six months through BharatNet Udyamies (BNUs) has been approved by the USOF with financial subsidy of Rs. 67 Crore from USOF for both ILL and capital incentives.

- The USOF subsidy includes capital incentive of Rs. 4500/- per FTTH, which is to be passed on to the BNU and Rs. 2 Lakh per mini-OLT per 100 Mbps ILL subsidy for one year. However, BSNL has requested to revise ILL cost to Rs. 4 Lakh.

- BNUs work as revenue share partner with BSNL for providing FTTH connections using BharatNet. For provisioning of FTTH connections, BNUs procure, install & maintain Mini-OLT, OFC, ONT, other accessories, etc. BSNL has the following Revenue Share Arrangement with BNUs as below:

Model Name	**Revenue Share**		**Responsibility**			
	BSNL	**BNU**	**OLT**	**ONT**	**Splitter**	**OFC**
BNU	50%	50%	BNU	BNU	BNU	BNU

- BSNL has developed Franchisee Management System (FMS) for on boarding the franchisees and revenue share partners of BSNL. As on 15.12.2022, about 1,240 BNUs have been on boarded as revenue share partner with BSNL under the Pilot

- Under the pilot, 04 Blocks namely Agaion (Bihar), Bhuna (Haryana), Sagar (Karnatka) and Sahapur (Madhya Pradesh) were selected as pilot Blocks with a target to saturate FTTH connections (5% home pass i.e. equivalent to 4128 FTTH) in these Blocks and overall 40,000 in the various villages across country, within 02 months i.e. from 01.10. 2022 to 30.11.2022. As on 30.11.2022, a total of 4,100+ FTTHs are provided within 04 Pilot Blocks and around 41,311 FTHH connections in various villages across country.

As on 15.12.2022, around 1,804 OLTs have been tagged under BNU model and around 57,137 FTTH connections have been provided under the Pilot across country.

It has been experienced from the Pilot funded under USOF that there is a demand in the rural areas for the FTTH connections with lower tariff plan (i.e. around Rs. 299 per month with free to air TV channels) and 'Nil' upfront charges, due to lower paying capacity of rural customers. BNUs are also willing to work as revenue share partner with BSNL since they are getting Capital incentives for Last Mile Connectivity.

6.6 BharatNet Connectivity in Government Institutions

DOT has been taken greater steps for proliferation of internet through BharatNet. DoT has awarded the work to the M/s CSC to provide FTTH connections in the 5 Government institution at GP's. The status of connection under the scheme is given in table as follows

No's of GP allotted to the CSC for 5 FTTH in GP's	Scope of FTTH	No of GPs where FTTH Installed in Govt. Institutions	No. of FTTH Connections Provided in Govt. Institutions
77,115	**385,575**	**42128**	**101629**

Table 5.5 (Source: - USOF)

The major government institutions in the GP's are Panchayat Bhawan and Schools and the internet connectivity has been extracted from these institutions from the GP's. The proliferations are not as expected. The scope was around 3,85,575 and the achievement is only 1,01,629 which only 26.35 %. The computer availability in the panchayat bawan as per the report Generated through e-GramSwaraj (http://egramswaraj.gov.in) on Sat, Feb 04, 2023 16:33:59 PM is only 2546. (The state wise report is annexure 6.1)

The status of the school infra structure has been taken from the Report on UNIFIED DISTRICT INFORMATION SYSTEM FOR EDUCATION PLUS (UDISE+) 21-22. The status of infrastructure is in fig 6.8. The state wise report is in annexure 6.2)

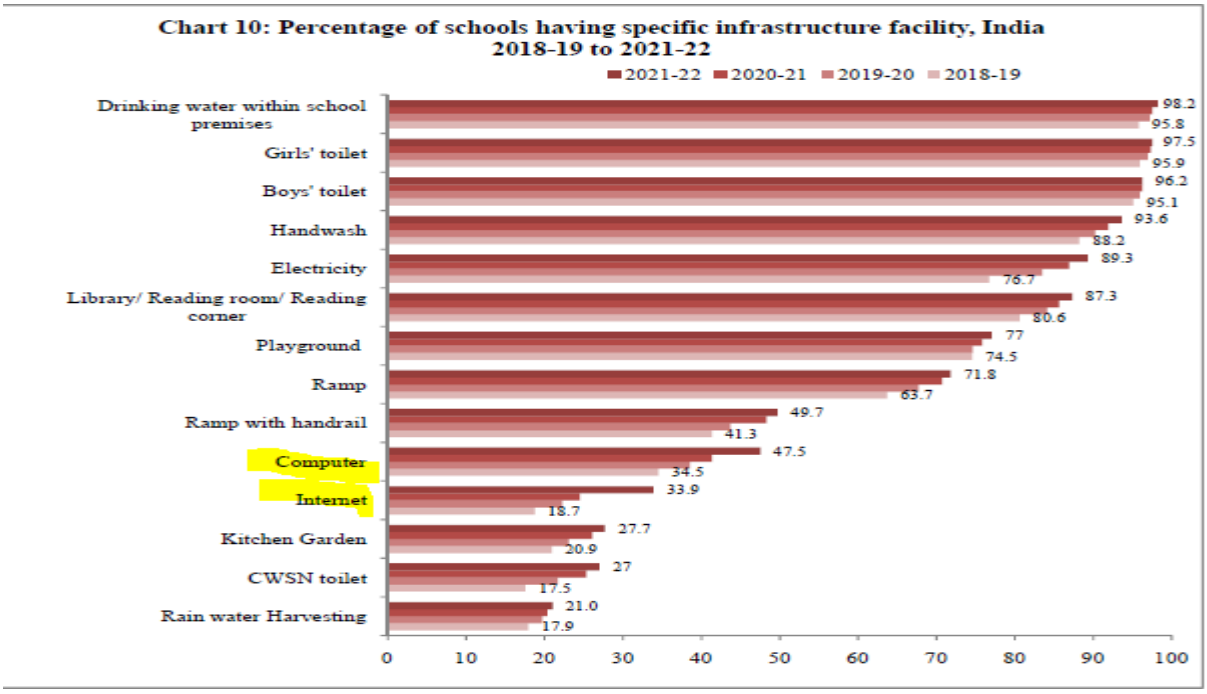

Fig 6.8 (Source report of UDISE+ on 21-22)

The stake holders have also been consulted about the issue and challenges in the government institution and the major issues and challenges have been highlighted are as follows

i) Availability of the electricity

ii) Security issues

iii) BharatNet Network UP time

iv) Non Availability of the IT Infrastructure

v) No Skilled manpower to use the IT infrastructure

Chapter-7

Conclusion and Recommendations

7.1 Conclusion

Broadband in particular, along with ICT, is a very effective tool for inclusive growth. A larger population that was previously unconnected will become a prospective client as internet connectivity improves. The poor sector of society provides an industry with limitless growth potential if properly planned and implemented. The best living example of it is South Korea. South Korea had a 1% broadband penetration rate in 2000. The South Korean government established an IT programme called "Cyber Korea 21[5]" to provide excluded populations with affordable IT education. This programme was supported by a robust broadband plan introduced in 1995. Korea currently has the most developed broadband market in the world, well outpacing the US, China, and all but one European nation[6].

If broadband reaches the last mile and all electronic services are available, society will find it useful and likely to stimulate many economic activities and perhaps even stop urban migration to some extent. Migration to cities is mainly due to better access to markets, information, banking, education, health, water and sanitation in addition to job opportunities. With the launch of e-tailers, shopping has become much easier in almost all sectors. Even an industry like banking has gone through major changes. Mobile phone companies got a banking license. Instead of a regular bank branch, the bank is run by a

[5] ITU Broadband Korea: Internet case study March 2003

[6] http://www.itu.int/net4/ITU-D/idi/2017/index.html

mobile retailer. Education has also moved outside the classroom. National and international colleges and universities offer many online courses. Entertainment has also moved from traditional television and movie theaters to personal viewing. Even the use of many public services no longer requires physical movement from one place to another. There is no field where ICT does not disrupt the traditional way of doing things. The availability of online resources makes traveling unnecessary. So, ICT not only saves time, ease of doing things, but it has increased productivity and besides, a person can do many other functions with extra use.

The spread of broadband will certainly revolutionize rural economic activities and create local jobs in addition to the availability of goods and services that a villager may not get without broadband

The NDCP 2018 & NBM have already envisaged the commitment of the government towards broadband proliferation. Despite of various issues and challenges BharatNet program is moving ahead in transforming the rural India.

The new initiatives of DOT for the last mile connectivity will defiantly give wings to the BharaNet program and true potential of the Bharatnet will be realized. The initiative like BharatNet Udyami for the LMC will give opportunity to the rural youth for skill development and self employment. In spite of many initiatives there is urgent need to involve all the stake holders in the project and adopt a holistic approach to develop an ecosystem for the LMC.

7.2 Recommendations

Broadband is an infrastructure that needs a strong ecosystem to take off. The Indian ecosystem is characterized by the linguistic, cultural, geographical and digital literacy diversity of its visionaries apart from the affordability factor. This would mean that all stakeholders (Central/State Governments, Service Providers, ISPs, Content Providers, etc.) would participate in driving and synergizing individual efforts to develop a complementary ecosystem.

A) Organizational Structure

The asset created under the BharatNet will be owned by the Government and asset will be given to the all TSP/ISP on non discriminatory basis. At present the BBNL has been merged with the BSNL than there is chance of conflict of interest. BBNL was SPV so there was no conflict of interest but now in present scenario the conflict of interest is present. Government should establish such kind of organization structure where the vision remains intact. In present setup monitoring of the performance at field level is also seems an issue. Government must think for better performance monitoring mechanism.

B) BharatNet Network UP time

The BharatNet Network UP time is the major concern of all the TSP/ISP for the utilization of the BharatNet. The Network UP time is dependent on the various factors like ONT location infrastructure, ONT security, Unmanned ONT locations etc. Use of BSNL fiber for extending the network up to GP's, Fiber faults due to various development agencies. The following are recommendation to improve the network UP time

a) In order to overcome issue of ONT location infrastructure the location of the ONT can be shifted at any villager and can me engaged as the BharatNet Udayami.
b) The O&M of existing fiber and incremental fiber should be given to the same agency in order to better coordination for maintain end to end fiber faults.
c) The O&M should be SLA based.
d) There should be provision of the patrolling teams who patrol the OFC route in order to prevent the OFC damage from the development work in the route. If any case the OFC damage through the development work than there should be provision to immediate repair through the damaging agencies otherwise damage claims should be initiated.
e) The existing optical fiber should be replaced by the new optical fiber.
f) The power infrastructure at the Block Node location should be made separate from the BSNL
g) Blanket Right of Way should be made available to the O&M agencies so that fiber maintenance agencies could not get trouble in repair and maintenance.
h) There should be provision of using the electric poles and other street furniture for the over head fiber wherever underground fiber laying is not possible.
i) One Fault Response Team (FRT) team in each block should be deployed by the O&M agencies. O&M agencies must be encouraged to engage the local BharatNet Udyami for the FRT work.

j) There should be a robust structure for the BharatNet vertical that will be responsible for monitoring of BharatNet work.

C) Last Mile Connectivity in the BharatNet

The last mile connectivity is a concern for the utilization of the BharatNet as this network is available up to the GP and the actual customers are residing far from this GP location therefore extending last mile connectivity by the TSP/ISP is non economical. The following are the recommendation to enhance the Last Mile Connectivity

a) Since BBNL was not the full fledge ISP and other TSP/ISP was hesitant enough to extant the last mile connectivity due to various reasons of economics. The steps of merging the BBNL with BSNL can be seen as welcome move as BSNL has already an established service provider in rural area and BSNL network is naturally alliance with the BBNL network therefore the FTTH delivery will be easier and less capital extensive. The capital subsidy for compensation of the viability is welcome move of the DoT and the result of pilot project is encouraging. This capital subsidy should be extended to the other TSP/ISP/LCO also so that proliferation can improve.

b) The Scheme of BharatNet Udyami should not be restricted up to BSNL but it should be equality applicable to the other TSP/ISP who so ever utilizes the BharatNet network for the Last Mile Connectivity.

c) DoT should also make available the Mudra loans to these BharatNet Udyami or any other skilled villager who wanted to setup the Common service centre while using the BharatNet.

d) PM Wani Wi-Fi Public Data Office (PDA) should be providing the subsidy to utilize the BharatNet.

e) It has been observed that Government institution are not fully utilizing the BharatNet due to non availability of skilled manpower and IT infrastructure. The central government can ask State Government and Ministries to make available the IT infrastructure in all the Government institutions.

f) Field level issues like Right of Way Issues (RoW), permissions, coordination, at local level is also concern to the LCO/ISP/TSP. Most the TSP/ ISP/LCO lay the last mile fiber overhead through electric poles or street furniture. Government should ask State authority to provide in block RoW permission for using the electric poles or street furniture.

g) Department of Expenditure has announced the Special Assistance Scheme for the capital investment where Central Government approves the soft loans to the state. DoT may encourage the state government for taking such assistance for improving the broadband infrastructure at the government institution including the LMC through BharatNet.

h) Government should not dependent on the subsidy scheme but DoT has to develop a complete ecosystem where TSP/ISP found the business viability in operating at the rural. Government should work for reducing the cost of internet lease lines, PLI schemes for manufacturing the low cost customer premised equipment. Wavier in the license fee to the ISP/LCO for providing the FTTH at Rural area through BharatNet. This will help in developing the self sustainable model of the utilization of BharatNet and proliferation of the Broadband in rural areas.

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APPENDIX

Annexure-A

The details of issues listed by the NOFN committee report

C) The issues in the design of NOFN and technology choice identified by the Committee through the consultations process are as under:

a. "The existing design is based on linear topology from Block to GP which may not be able to provide the reliability acceptable to service providers and users of bandwidth."

b. "NOFN is based on fibre connectivity to all GPs irrespective of geographic conditions, population density, length of incremental fibre laid etc. Laying of fibre to some GPs may be extremely expensive and it may be possible to provide broadband reach through other technological means."

c. "24 fibre optical cable under NOFN is connected to a single fibre of BSNL at the Point of Interconnect (PoI), thereby 23 fibre strands would remain unutilized. Further, a single cut of the fibre between Block and PoI would disconnect services to number of GPs".

d. "The health of BSNL fibre from Block to the Point of Interconnect (PoI) with NOFN fibre is uncertain. Thereby, the attenuation loss may hinder reliable service provision."

e. "NOFN was envisaged as an incremental network to the existing backhaul fibre, and only minimal incremental fibre was required to be laid. However, during implementation it has been observed that the backhaul fibre infrastructure may be degraded or missing in parts resulting in patchy quality of service."

f. “Delays have been reported by some implementing CPSUs due to traceability of existing fibre and then ascertaining its availability and quality.”

g. “Too many points of interconnections at block level are a hindrance for effective utilization of the network.”

h. “The framework for integration of NOFN with other Government networks like NIC/NKN/SWAN etc for effecting service delivery has not been provided.”

i. “Non-involvement of States, an important collaborator in the project, in the planning and implementation of NOFN has led to a distancing of the State from ownership of the project and resulted in slow progress besides the risk of the infrastructure not being utilised. Strong involvement and robust participation of the States in planning, implementation, maintenance and utilization of NOFN was missing affecting the project at all stages.”

D) “The issues in the implementation strategy identified by the Committee were as follows:”

a. “Lack of accountability, financial or otherwise, in project implementation.”

b. “Lack of ownership of the project by the CPSUs and inability of BBNL in ensuring timely project implementation.”

c. “Fragmented nature of project implementation design both in terms of geographical spread while phasing implementation and in assignment of responsibilities for project components leading to inter-agency co-

ordination problems that have arisen and also anticipated to arise in future."

d. "In Phase I, the Blocks to be connected were selected based on the least length of incremental optical fibre to be laid. While this was intended to speed up implementation, it has meant non-contiguous coverage on ground which is likely to render service layer integration difficult, besides making alternative options of implementation an important issue to be addressed"

e. "Excessive emphasis on cost controls leading to lack of empowerment of implementing agencies."

f. "Absence of competitive price discovery for project management."

g. "Network rollout on a nationwide scale through limited agencies."

h. "The procurement process for PLB duct and tendering process for trenching and laying have been delayed due to BBNL's rigidity in decision-making along with the CPSU's trepidation of taking decisions that could be questioned later."

i. "Inadequate human resource and technological tools available within BBNL to monitor and manage the project."

j. "Lack of adequate advance planning in BBNL to various elements of NOFN – service provision, bandwidth utilization, operations, repairs & maintenance etc. Lack of adequate empowerment of BBNL has affected expeditious decision-making impacting project timelines."

k. "The near absence of any inter-linkage with the providers of content and services is sure to lead to a situation where even if the network were

established, its utilization would be extremely low, hindering the vision of Digital India."

E) "The issues in the maintenance and utilization of bandwidth were identified by the Committee were as follows:"

a. "With the design architecture of linear topology for optical fibre, the incremental fibre approach connecting with a single fibre at PoI and uncertainties about the health of BSNL fibre, the reliability and redundant provisioning of a network of this nature stands compromised. It would be impossible to achieve high levels of SLA (around 99.9%) which is essential for reliability in service provisioning. Thereby, the possibilities of gainful utilization of bandwidth for non-Government purposes have substantially reduced."

b. "Planning for services provision using the network is missing. Although a separate proposal for a Government User Network (GUN) overlay over NOFN has been considered, approvals for the services layer is awaited. Therefore, the network cannot be utilized immediately on its commissioning."

c. "The lock-in for service provisioning with one service provider i.e. BSNL, the high cost of bandwidth between Block and District charged for using the BSNL network and lack of appropriate interconnect arrangements at Block/ District levels inhibit competitive and reliable provisioning that would eventually affect broadband penetration in rural areas."

d. “The lack of skilled manpower at the GP-level and inadequate planning in BBNL for repair and maintenance of assets at the GP raises issues of reliability and quality of network availability.”

e. “Provision of space for housing equipment at the GP, reliable electricity supply in GPs and security of equipment are unaddressed issues that have the possibility of affecting utilization of bandwidth.”

(Source: DOT.(2015,March).*Report of the Committee on National Optical Fibre Network (NOFN))*

Annexure 6.1

Table 7.11 Number of schools by management and availability of internet facility, 2021-22

India/ State/ UT	Total Schools					Schools with internet facility available					Percentage of Schools with internet facility available				
	All management	Government	Government aided	Pvt. unaided	Others	All management	Government	Government aided	Pvt. unaided	Others	All management	Government	Government aided	Pvt. unaided	Others
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
India	1489115	1022386	82480	335844	48405	504989	247000	43795	200274	13920	33.9	24.2	53.1	59.6	28.8
Andaman and Nicobar Islands	416	342	2	72	0	187	133	2	52	0	45	38.9	100	72.2	0
Andhra Pradesh	61948	45137	1542	15058	211	34744	20313	756	13560	115	56.1	45	49	90.1	54.5
Arunachal Pradesh	3603	2985	68	503	47	794	458	38	284	14	22	15.3	55.9	56.5	29.8
Assam	60859	45490	3841	5852	5676	7126	4680	265	1945	236	11.7	10.3	6.9	33.2	4.2
Bihar	93165	75558	742	8097	8768	10381	4421	65	3493	2402	11.1	5.9	8.8	43.1	27.4
Chandigarh	233	123	7	76	27	230	123	7	76	24	98.7	100	100	100	88.9
Chhattisgarh	56512	48743	417	7063	289	20735	16469	153	4066	47	36.7	33.8	36.7	57.6	16.3
Dadra and Nagar Haveli and Daman and Diu	460	388	8	63	1	264	194	8	61	1	57.4	50	100	96.8	100
Delhi	5619	2762	247	2610	0	5619	2762	247	2610	0	100	100	100	100	0
Goa	1510	814	557	139	0	879	299	459	121	0	58.2	36.7	82.4	87.1	0
Gujarat	53851	34699	5590	13559	3	49522	32681	4685	12153	3	92	94.2	83.8	89.6	100
Haryana	23726	14562	16	8261	887	12158	4345	14	7160	639	51.2	29.8	87.5	86.7	72
Himachal Pradesh	18028	15380	0	2646	2	6215	4175	0	2040	0	34.5	27.2	0	77.1	0
Jammu and Kashmir	28805	23173	1	5526	105	8566	5169	1	3345	51	29.7	22.3	100	60.5	48.6
Jharkhand	44855	35840	1175	1559	6281	16726	12052	390	1153	3131	37.3	33.6	33.2	74	49.9
Karnataka	76450	49679	7110	19650	11	22590	5308	3133	14145	4	29.6	10.7	44.1	72	36.4
Kerala	16240	5010	7183	3164	883	15459	4738	6938	3010	773	95.2	94.6	96.6	95.1	87.5
Ladakh	978	838	28	112	0	418	342	13	63	0	42.7	40.8	46.4	56.3	0
Lakshadweep	38	38	0	0	0	37	37	0	0	0	97.4	97.4	0	0	0
Madhya Pradesh	125582	92695	740	30345	1802	34562	16469	254	17339	500	27.5	17.8	34.3	57.1	27.8
Maharashtra	109605	65639	24037	19268	661	52553	18540	16985	16542	486	48	28.3	70.7	85.9	73.5
Manipur	4617	2889	583	1010	135	1065	340	64	617	44	23.1	11.8	11	61.1	32.6
Meghalaya	14600	7783	4172	2120	525	2460	1111	782	488	79	16.9	14.3	18.7	23	15.1
Mizoram	3911	2563	230	1034	84	307	153	31	114	9	7.9	6	13.5	11	10.7
Nagaland	2718	1960	0	757	1	1383	850	0	532	1	50.9	43.4	0	70.3	100
Odisha	62291	49072	5807	6104	1308	9284	3970	1012	3717	585	14.9	8.1	17.4	60.9	44.7
Puducherry	736	422	33	281	0	724	422	31	271	0	98.4	100	93.9	96.4	0
Punjab	27701	19259	450	7978	14	16429	9013	386	7026	4	59.3	46.8	85.8	88.1	28.6
Rajasthan	106373	68948	0	34826	2599	63674	36889	0	26170	615	59.9	53.5	0	75.2	23.7
Sikkim	1259	864	19	376	0	434	231	8	195	0	34.5	26.7	42.1	51.9	0
Tamil Nadu	58801	37636	8323	12396	446	22086	9292	3207	9323	264	37.6	24.7	38.5	75.2	59.2
Telangana	43083	30023	700	12193	167	9887	2772	188	6917	10	23	9.2	26.9	56.7	6
Tripura	4929	4262	43	363	261	896	682	14	175	25	18.2	16	32.6	48.2	9.6
Uttar Pradesh	258054	137024	8113	97808	15109	54554	12074	3366	35701	3413	21.1	8.8	41.5	36.5	22.6
Uttarakhand	22815	16484	608	5225	498	6245	2575	246	3245	179	27.4	15.6	40.5	62.1	35.9
West Bengal	94744	83302	88	9750	1604	15796	12918	47	2565	266	16.7	15.5	53.4	26.3	16.6

Source: UDISE+ 2021-22

Annexure 6.2

S.No.	State Code	State Name	Computers Available
1	35	ANDAMAN AND NICOBAR ISLANDS	0
2	28	ANDHRA PRADESH	271
3	12	ARUNACHAL PRADESH	0
4	18	ASSAM	131
5	10	BIHAR	27
6	4	CHANDIGARH	0
7	22	CHHATTISGARH	79
8	7	DELHI	0
9	30	GOA	0
10	24	GUJARAT	216
11	6	HARYANA	20
12	2	HIMACHAL PRADESH	56
13	1	JAMMU AND KASHMIR	2
14	20	JHARKHAND	81
15	29	KARNATAKA	64
16	32	KERALA	152
17	37	LADAKH	0
18	31	LAKSHADWEEP	0
19	23	MADHYA PRADESH	214
20	27	MAHARASHTRA	184
21	14	MANIPUR	0
22	17	MEGHALAYA	0
23	15	MIZORAM	0
24	13	NAGALAND	0
25	21	ODISHA	115
26	34	PUDUCHERRY	0
27	3	PUNJAB	29
28	8	RAJASTHAN	153
29	11	SIKKIM	0
30	33	TAMIL NADU	187
31	36	TELANGANA	269
32	38	THE DADRA AND NAGAR HAVELI AND DAMAN AND DIU	0
33	16	TRIPURA	29
34	5	UTTARAKHAND	44
35	9	UTTAR PRADESH	97
36	19	WEST BENGAL	126
Total			**2546**
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