

# **NOFN Project- Shaping India into a Digitally Empowered Nation**

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## **Abstract**

*NOFN (National Optical Fibre Network )Project is the World's largest rural broadband connectivity project through optical fiber. All 250K Gram Panchayats in India to be connected with a minimum bandwidth of 100 Mbps on optical fiber by this project. Hence, NOFN is opening a new avenue for large rural population coverage (about 900 Millions) for Telecom Services. Through NOFN, non discriminatory access infrastructure for all Service Providers will be provided. Under this project, Approx. 6 lakh Kms of new incremental optical fiber cable to be laid. Indigenous equipment design by C-DOT and manufacturing under "Make in India" is one of the bright feature of the project. It has a High capacity Network Management System and Network Operation Centre. Hence NOFN has potential to transform many aspects of rural lives by providing internet, video, data and telephony services and enabling education, business, health, e-governance, entertainment etc. to every household.*

## **The Need:**

Digital India is an exciting and visionary program to bridge the various divides between rich and poor, city and village, literate and illiterate. On the other hand India is considered as one of the world's fastest growing economy and aims to be the second largest economy by 2021. However, in view of tele density and broadband penetration the picture is not so good. With a 72.2% rural population, we have only 52.43% tele density and only 5.4% broadband users in Rural India. The poor connectivity in rural area is the major hurdle in implementation of Govt. schemes designed for upliftment of Rural India and hence for Indian economy as Indian economy is heavily dependent (approx. 30%) and rural economy (approx. 90%) upon agriculture. On the other hand, Government by it's nature has to create the necessary infrastructure for the growth and development of the society .

Hence to bridge the digital divide between urban and rural population, to stimulate the rural economy and for effective implementation of Government Schemes to improve healthcare and education services for rural India, the NOFN Project as a part of Digital India was designed. Many Information and communication (ICT) application such as e-commerce, e-banking, e-governance, e- education and tele-medicine require high speed internet connectivity. Hence NOFN is an ambitious initiative to trigger a broadband revolution in rural areas and truly transform India.

Today, i-ways are the new highways, the information ways that help move ideas, services, economic transactions and social interactions and these have become carriers and catalysts of development. We can imagine an example, a young student in a remote village being able to hear, see the interact with the best teacher, the learning enhanced by animation, slow-imagination or real life video footage. We can think of a super-specialist doctor studying, online, a villager's health parameters and providing advice to the patient locater in a remote corner of the country. Or a farmer getting up-to-date information on crop prices and weather and agriculture advice in real time. Or skill trainings being provided to youth anywhere in country, or rural craftspeople being able to sell their creations to customers anywhere in the globe through their website and e-commerce platforms. These dreams, and much more, can become reality with the aid of a nationwide broadband network National Optical Fiber Network.

As of now, the 1.2 Million Km existing fiber in India caters only 28% population majorly in urban area. The planned 0.6 Million Km new fiber under NOFN project, targets to cater 72% population which is largely rural population.

### **The announcement :**

Earlier President of India, Smt. Pratibha Patil emphasized the importance of providing broadband connectivity up to Panchayats in the first speech of New Government in June 2009. In her address to the nation, she emphasized that Panchayats are the constitutionally mandated 3<sup>rd</sup> tier of government and key institutions for local self governance. Village Panchayat is the lowest level of governance in rural India. Coverage of Panchayats with Broadband internet

connectivity has a great potential for empowering rural masses by giving them access to information, public services including those of education, health and financial inclusion.

The concept note for NOFN was first considered by Telecom Commission on June, 2011. Government of India approved the proposal on 25-10-2011 for the setting up of National Optical Fiber Network (NOFN) to provide connectivity to 2.5 lakh Gram Panchayats of the country using optical fiber, which would ensure broadband connectivity with adequate bandwidth. The Gram Panchayats (GPs) are to be connected to Block Headquarters (BHQs) by utilizing the existing optical fiber of three CPSUs – BSNL, RailTel & PGCIL and extending it to the Gram Panchayats by laying incremental fiber. The incremental OFC so laid shall be owned by the Government . This was to be done by utilizing Universal Service Obligation Funds (USOF) and creating an institutional mechanism for management and operation of NOFN. The initial cost of the Project was estimated as Approx Rs 20,000 Cr.

#### **Institutional Mechanism :**

The role and responsibilities of various agencies in the project are as under :

- **DOT :** The monitoring and Administrative agency for the project is the Department of Telecommunications.
- **HLC :** A High Level Committee (HLC) formed on 25-April-11 to guide the project. This committee was formed under the Chairman of Sh. Sam Pitroda, Advisor to Prime Minister, Co-Chairman Sh Nandan Nilekani, Chairman UIDAI, Secretaries- DoT, DIT, Member Finance DoT, CMD BSNL, CDOT, Secretaries- DoT, DIT, Planning Commission, Health, Rural Development, Panchayati Raj, DG NIC , USOF.
- **TAC:** Technical Advisory Committee under the chairmanship of Advisor to the Principal Advisor Scientific Advisor to PM, CDOT, BSNL, Railtel, Powergrid, USOF, NIC, TCIL.
- **BBNL :** For establishment, management and operations of NOFN project, a Special Purpose Vehicle (SPV), Bharat Broadband Network Limited (BBNL), a PSU of Govt. of India was registered under The Companies Act 1956 on Feb 25, 2012. BBNL shall work as Operator of operators (Carrier of Carriers). Bandwidth Provider to TSPs/ISPs/Cable

Operators, to enable them to launch various access services B2B. BBNL shall provide Non-discriminatory access to all licensed operators

- **Executing Agencies (EA) :** Three CPSUs Bharat Sanchar Nigam Limited (BSNL), RailTel Corporation Limited (RailTel) and Power Grid Corporation of India Limited (PGCIL). These are the Executing Arms for OFC Laying. Whole project will be executed on behalf of BBNL.
- **C-DOT :** Is designated for Technology and NMS Development for the project.
- **NIC :** Has been assigned the work of GIS Support and e-Gov Content and is major user of the project.
- **USOF:** The Funding Agency via Ministry of Finance under Planned schemes.

### **The Mapping :**

GIS mapping of all CPSUs OFC routes along with BSNL POPs was completed and validated once by NIC during 2011-12. This is available at [www.gis.nic.in/telecom](http://www.gis.nic.in/telecom) . User-ID and passwords provided to all Circles. In this mapping the Long Distance and Circle OFC has been shown in separate layers. The GIS also shows the layers of Railtel and PGCIL routes.

The Layer of Roads, District boundary, Blocks and Gram Panchayat names have been given. CDOT has prepared a tool for simulated planning of the equipment as per availability of OFC routes and GPON link margin

### **The Pilot Projects :**

Before expediting nation-wide implementation, it was decided in March, 2012 to carry out pilot projects at different geographical locations. The three Pilot Blocks were planned to cover 59 GPs in three different states- Arain in Ajmer District of Rajasthan for execution by BSNL, Parvada in Vishakhapatnam District of Andhra Pradesh for execution by Powergrid and Panisagar in North Tripura District of Tripura for execution by RailTel. The Pilot Projects were completed on October 15, 2012. Further this connectivity to the Gram Panchayats was distributed horizontally to other Government bodies (Schools, Health Centres, Thana, Post Office etc.) via Wi-Fi links by installing Base BBWTs at GP location and Client BBWTs at distant locations. This experiment of further distribution of bandwidth through Wi-Fi links remained quite successful.

**The award of work to PSUs :**

The HLC decided that the three CPSUs BSNL, RailTel and PGCIL may be entrusted with the physical implementation of the NOFN Project on behalf of BBNL. Circle wise work allocation to the three PSUs is as under:-

<b>Name of CPSU</b>	<b>Incremental RKMs to be laid by CPSU</b>	<b>No. Of GPs</b>	<b>Telecom Circes to be covered</b>
<b>BSNL</b>	1,73,910 (70%)	3864 (59%)	(18 Circles) Andaman & Nicobar, Assam, Bihar, Chandigarh, Chhattisgarh, Haryana, Jammu And Kashmir, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Sikkim, Uttar Pradesh, Uttarakhand, West Bengal
<b>RailTel</b>	36,047 (15%)	966 (15%)	(11 Circles) Arunachal Pradesh, Dadra & Nagar H., Daman and Diu, Gujarat, Manipur, Meghalaya, Mizoram, Nagaland, Pondicherry, Tamil Nadu, Tripura
<b>Power Grid</b>	35,791 (15%)	1769 (26%)	(4 Circles) Andhra Pradesh, Himachal Pradesh, Jharkhand, Orissa

**The Surveys :**

Before commencing implementation of the project, the three Executing Agencies (EAs) conducted comprehensive surveys for connectivity to all the GPs allocated to them, under the guidelines of BBNL. For initial planning, the GIS was to be referred. To minimize the incremental OFC laying the existing OFC routes of BSNL, Powergrid, Railtel OFC route were also taken in plan for use. Detailed survey were conducted by respective Circle/SSAs as per the prescribed guidelines issued by BBNL. Panchayat names and codes were followed as per directory available at [www.panchayat.gov.in](http://www.panchayat.gov.in) . L-14 diagrams were prepared for each OLT. On

examination of detailed survey reports and after necessary corrections by CPSUs as desired by BBNL Project Monitoring Units (PMUs), the Technical Sanction for each block was issued by the respective BBNL PMUs. The execution of the project has to be done as per TS. Estimates were prepared by the respective PSUs on the basis of quantity mentioned in TS and sanctioned by respective PSUs.

### **The roadmap of project :**

- In this project total Approx 6 lakh Km new incremental OFC is required to be laid whereas approx 4 to 5 lakh km of dark fiber from existing OFCs of BSNL/Railtel/Powergrid is required on long term basis for providing backhaul connectivity. For the purpose of trenching and laying of OFC, the SoR (Schedule of Rates) followed by BSNL/PSUs on a reference date be taken as applicable SoR by BBNL. Considering the scale of project, 100000 GPs have been planned to be connected in Phase-I. Existing rural telecom infrastructure of EAs has to be leveraged for installing OLTs to provide connectivity to the ONTs at GPs. Accordingly the Govt. Agencies - BSNL, Railtel, Powergrid have offered their telecom infrastructure for usage on commercial terms and nearly 700,000 Route Km existing OFC has been made available for NOFN. The execution of the work is decentralized.
- By using the existing infrastructure there is approx. Rs.20,000 Cr Capex saving and 4 Years lead time gain in project implementation. Approx. 60,000 OFC PoP ready to connect Village Panchayats and additional 40,000 OFC PoP to connect Village Panchayats may be made available where as incremental OFC requirements will be about 600,000 Route Km.
- Due to this, project excavation of about 1200K Km by major Telecom Service Providers (TSPs) to expand business in Rural has been saved and hence there is saving of Road infrastructure by laying of quality Incremental Fiber from in-route existing OFC to the GPs.

- The jointing location of Existing and Incremental Cable, so created, will be called the Fiber Point of Interconnect (FPOI). As per initial planning the Fiber from the Block to the FPOI (in existing Cable) will be on leased basis to BBNL. However, as per latest understandings, BSNL shall provide commercial Fiber to the Home (FTTH) connections using this network and shall get major revenue share from BBNL.
- Space and power at Block/locations for GPON OLT will be provided by BSNL on lease basis to BBNL. Charges are under finalization. Backhaul connectivity to the GPON OLTs at BHQs or at other locations in a block will be provided from Multi-play network through Tier-1/Tier-2/OCLAN switch of BSNL for Broadband connectivity. Same Backhaul connectivity will be used for other services as well as Backhaul to the Other operators on request basis.
- In addition to the GPs, all Block Headquarters will also be provided the same connectivity and all District Headquarters will be provided the connectivity of 1 GE.
- OFC laying tender to be called on behalf of BBNL as per existing Schedule of Rates of BSNL. Work Order are supposed to be given to multiple contractors to complete the work in a targeted timeframe.
- Strategy to procure OFC, Pipe, Accessories and GPON is under consideration in BBNL. 24F OFC and GPON Equipment is to be procured by BBNL where as PLB & DWC duct has to be procured by respective PSUs on tender basis or from the Telecom Factories of BSNL.
- In general, 24 Fiber Cable is to be laid under ground as per existing BSNL norms for OFC laying, however for difficult terrains option of Armoured Cable and overhead cable is also open with suitable justification.
- Dark fiber from / to Railtel, PGCIL has to be arranged by Coordination among BSNL, Powergrid and Railtel for survey of their OFC routes and Identification of spare fiber in OFC for the required lengths.

### **Right of Way:**

To resolve the right-of-way for laying of fiber, Tripartite MOUs were signed between Central Government, State Government (Except Tamil Nadu) and EA (the PSUS BBNL/Powergrid/

RailTel). These MOUs envisage that no right-of-way charges including reinstatement charges will be levied by the State Government, their local bodies, companies or agencies on the grounds that the information highway so created is primarily for the benefit of the local communities, Panchayats and State Governments. The Reinstatement will be done by Execution Agency. The space & power for equipment at Gram Panchayat office will be provided free of cost by State Government – as part of MOU. For this purpose, suitable order along with MOU have been issued by respective state Govnment.

### **The Technology :**

#### **PON Technology: The Unique solution under circumstances**

In the situations like the availability of less power supply in rural areas in general, availability of less space in GPs, lack of skilled manpower to maintain advanced technology equipment in GPs and availability of less fibers, passive electronics i.e. Passive Optical Network (PON) is recommended for connectivity. Hence for NOFN Network, Gigabit Passive Optical Network (GPON) is the technology choice. GPON is open standard Open Access equipment which drives up to the distances of 60Km. In this technology, the subscriber end terminal the Optical Network Terminal (ONT/ONU) are low power, Low cost, Scalable upto 1Gbps, Upgradable 10G PON. This technology is a point-to-multipoint scheme that enables a single optical fiber to serve multiple premises. This technology can work on redundancy mode, i.e. connectivity to the GPs can be made on ring topology. The connectivity from Optical Line Terminal (OLT) at BHQ is the best technologies available in world. To ensure availability of multiple fibers from available fibers, splitters makes passive nature of en-route multi-directional OFC connectivity. Hence, this technology reduces incremental OFC requirement and Project cost.

### **NMS by CDOT :**

To create an integrated Network Operations Center (NOC), an Network Management System (NMS) has been designed by C-DOT. To monitor the overall health of connected OLTs and ONTs, a monitoring bandwidth of 2 Mbps has been provisioned from Block OLTs to NOC. The NOC is situated at Hyderabad. The NOC caters Multi technology/ multivendor/ Multi service/ Multi operator, Millions of Network Elements. There is provision across vendors using EMS/



NMSs/NEs of Telecom service providers and provision of monitoring faults on provisioning path to monitor service status. This system has been designed to ensure end-to-end management of network and services of NOFN network to provide services to Gram Panchayats/municipals/villages. Facility of Service Provisioning, Service Creation, Service Deletion, Service modification i.e. Service Monitoring (QoS/SLA) and Providing inputs to billing systems at NOC.

The users of NOC and field persons responsible for providing uninterrupted services at GPs have been provided user id and passwords so that they can monitor system and network health and take corrective action.

### **Real Time Monitoring through Mobile App. :**

One Mobile Application Platform has been created by NOC for Real time monitoring of execution of the project. Using this application one can monitor daily cable laying progress on a route and progress of GPs connected from remote locations. Real time progress with onsite visuals can be seen by this application.

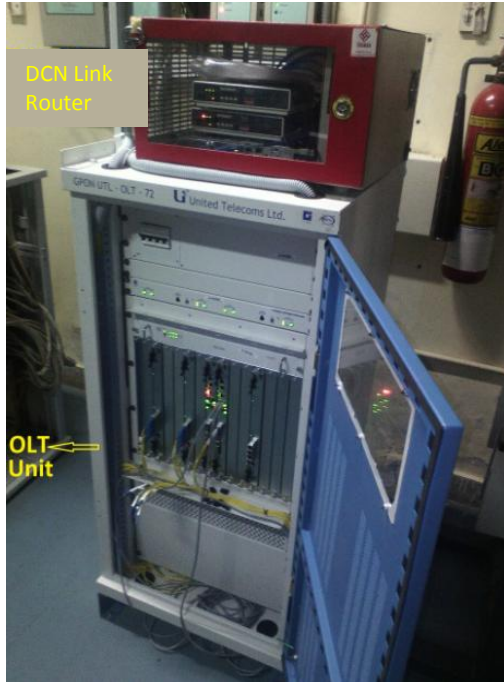
### **The Status of Project :**

#### **CPSUs Phase-1 target & Actual Completion by 19<sup>th</sup> Feb, 2017 (No. of GPs)**

<b>CPSU</b>	<b>Target (GPs)</b>	<b>Pipe Laid (GPs)</b>	<b>Cable Laid (GPs)</b>	<b>GPs Lit</b>
BSNL	84232	79898	66582	15166
RailTel	8727	6528	4516	563
PGCIL	7196	5971	5721	915
<b>Total</b>	<b>100155</b>	<b>92397(92%)</b>	76819	16644

### **The GPON Equipment (Site Images) :**

The actual site photograph to understand layout of GPON equipment at OLT and ONT locations are given as under :-

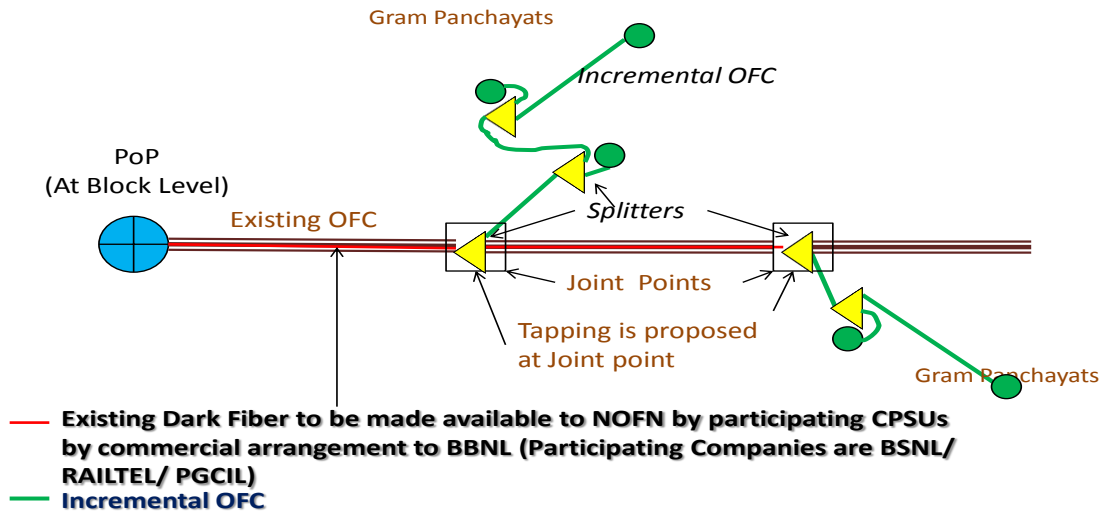


**The OLT Location**

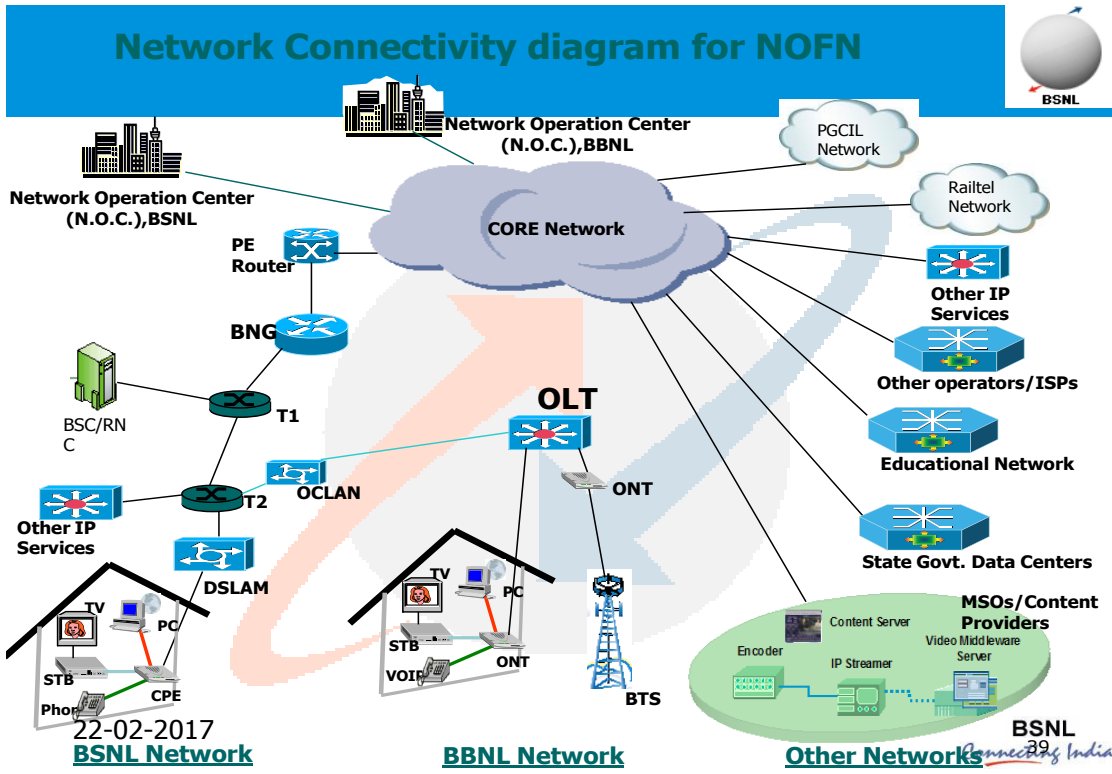


**The ONT Location**

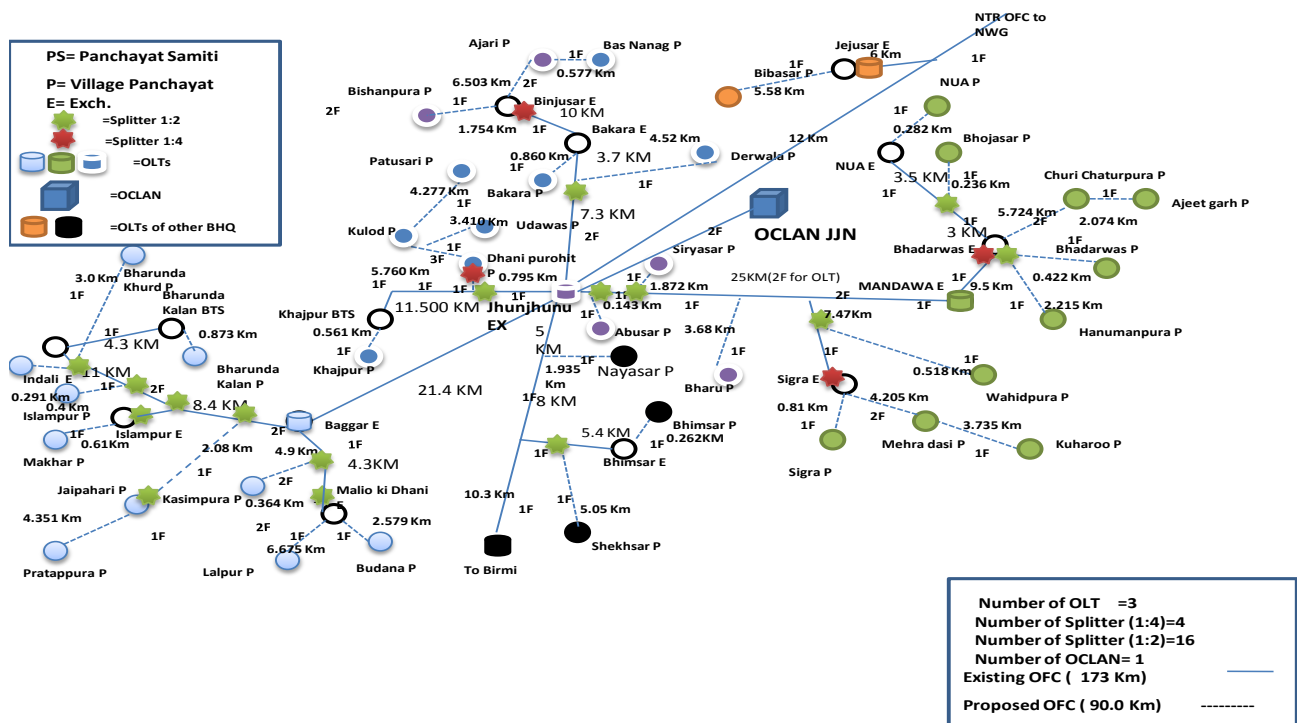
**The Connectivity Diagram of existing and incremental OFC:**



**Network Connectivity diagram for NOFN**



Typical L-14 Diagram of a Block (Jhunjhunu)



### Key Highlights NOFN Project :

This is the World’s largest rural broadband connectivity project through optical fiber. All 250K Gram Panchayats in India to be connected with a minimum bandwidth of 100 Mbps on optical fiber by this project. Hence, NOFN is opening a new avenue for large rural population coverage (about 900 Millions) for Telecom Services. Through NOFN, non discriminatory access infrastructure for all Service Providers will be provided. Under this project, Approx. 6 lakh Kms of new incremental optical fiber cable to be laid. Indigenous equipment design by C-DOT and manufacturing under “Make in India” is one of the bright feature of the project. It has a High capacity Network Management System and Network Operation Centre. Hence NOFN has potential to transform many aspects of rural lives by providing internet, video, data and telephony services and enabling education, business, health, e-governance, entertainment etc. to every household.

### The beneficiaries from the project :

1. The Public :

- Being benefited through e-governance services of Government.
- Another e-services (Education, Medical, Ecommerce etc. ) may be operated by private agencies also.
- The broadband services provided by TSPs

## 2. **Banking Sector and Private Companies :**

- **e-commerce :**

Rural banking through online transactions and ATMs

Online purchases and transactions for bill payments, tickets etc.

- **Employment Generation :**

Large scale employment generation through operation and maintenance activities, BPO services, rural entrepreneurship etc.

- **Public Internet Access :**

Availability of Internet services to villages

Delivery of Internet by Common Service Centres

## 3. **The operators (TSPs/ISPs/MSOs/Cable TV Operators):**

- Broadband and other telecom/cable services to the public using the bandwidth at GPs. Services like B2B, P2P, B2C etc. can be assessed by common man through NOFN.

## 4. **Governments :** As a part of Digital India Programme, the Government of Center or States are primarily and essentially the User of NOFN Project. Following may be the aspects of using the network

- **e-governance :**

Land Records

Birth/Death Certificates

UID based services

NAREGA

- **e-healthcare :**

Online medical consultations

Medical records

Pan India exchange of patient information

- **e-education :**

Quality education delivery

Digital literacy programmes

- **Cash-less India**

**5. BSNL :**

The Government's only PSU providing telecom services and fulfilling government social responsibility regarding telecom services may earn revenue from the project as under :-

- As executing agency for implementation of project.
- For operation and maintenance of the network so created.
- Revenue share By providing FTTH connection at GPs.
- Revenue share By providing FTTH connections to other public and private agencies and households.
- Leasing of power and space to OLT.
- BSNL may provide bandwidth to TSPs/ISPs/MSOs/OSPs on non discriminatory basis on its commercial tariff.
- Revenue share by Providing access for termination of OFC of any service provider as authorized by BBNL on BBNL FDF.
- Use of incremental fiber for strengthening it's network or providing lease circuits etc.
- Spare fibers of NOFN may be marketed by BSNL on behalf of BBNL for which BBNL will share earned revenue to BSNL.

**Key challenges of NOFN implementation:**

The issues in implementation of NOFN project may be categorized in 3 aspects :-

**1. Issues in technology & architecture of NOFN :**

- (i) The existing linear topology from Block to GP may not be able to provide reliable services to users.
- (ii) Laying fibers to some GPs which are very remote may be extremely expensive and time taking.
- (iii) 24F OFC under NOFN is connected to a single fiber of BSNL at the point of interconnection. There by 23 fibers would remain unutilized. Further, a single cut of the fiber between Block and POI would disconnect services to a number of GPs.
- (iv) During implementation it has been observed that the backhaul fiber infrastructure may be degraded or missing in parts resulting in patchy quality of services.
- (v) Delays are being reported by some implementing CPSUs due to traceability of existing fiber.
- (vi) Non involvement of States, in the planning and implementation of project has led to a distancing of the State from ownership of the project and resulted in slow progress besides the risk of infrastructure not being utilized.

## **2. The issues in implementation strategy :**

- (i) Lack of ownership of the project by the CPSUs and inability of BBNL in ensuring timely project implementation.
- (ii) Excessive emphasis on cost controls leading to lack of empowerment of implementing agencies.
- (iii) Network rollout on a nationwide scale through limited agencies.
- (iv) Inadequate human resources and technological tools available with BBNL to monitor the project.
- (v) Lack of adequate empowerment of executing agencies and BBNL has affected expeditious decision making impacting project timeline.

## **3. The issues in maintenance and utilization of bandwidth :**

- (i) With linear topology design of the network and dependency of network on existing BSNL fiber which is quite old at some places, the reliability and redundant

- provisioning of a network stands compromised. Thereby, the possibility of utilization of bandwidth for non government purposes has substantially reduced.
- (ii) Planning for services provision using the network is missing. Therefore, the network can not be utilized immediately on its commissioning.
  - (iii) Non supply of GPON equipment at most of the places where OFC laying has been completed has become a major issue in effective maintenance of the network by BSNL. Because of non availability of connectivity the OFC cuts in the network are very difficult to get into notice in time, hence the network so created is being damaged badly.
  - (iv) The lack of skilled manpower at the GP level and inadequate planning for repair and maintenance of assets at the GPs raises issues of network reliability.
  - (v) Provisioning 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.

### **Vision of BharatNet:**

As per the report of March, 2015 of a High Level committee formed to review the progress of NOFN Project, the committee strongly felt that it is absolutely essential to review the constraints felt during implementation of NOFN Project and suggest corrective ideas to raise the inspirational level to match that of Digital India.

The committee recommended that the project may be renamed as BharatNet to reflect the national aspiration through the vision that “BharatNet shall be a project of national importance to establish, a highly scalable network infrastructure accessible on a non-discriminatory basis, to provide on demand, affordable broadband connectivity of 2 Mbps to 20 Mbps on demand for all households and to all institutions, to realize the vision of Digital India, in partnership with States and the private sector.

### **References:**

- BSNL & BBNL website, TRAI Report 17.01.2017