

National Optical Fibre Network (NOFN)

Beyond the Fibre

Draft Recommendations



Department of Electronics & Information Technology (DeitY)

Ministry of Communications & Information Technology

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Executive Summary

The ambitious National Optical Fibre Network (NOFN) promises to bring broadband connectivity to each Gram Panchayat in the country, providing rural citizens the opportunity to reap the benefits of accessing ICT enabled services- public, private and social- ensuring inclusive economic and social growth. The Department of Electronics and Information Technology (DeitY) and the Departments of Telecommunications (DoT) have partnered to evolve an integrated approach to ensure successful broadband adoption in rural India by addressing the supply of bandwidth and the aggregation of demand, ensuring availability of services, addressing technology implementation as well as evolving a sustainable business and implementation model, as NOFN is rolled out nationwide.

Based on a Pilot undertaken by the Departments of Electronics and Information Technology in 3 blocks, three multi-stakeholder Committees on Portfolio of Services, Technology as well as Business Model & Implementation have provided recommendations for the national rollout of NOFN. This report- **NOFN: Beyond the Fibre** - is based on the recommendations which have been derived from the early lessons of the Pilot and best practices from around the world.

The Committee on Portfolio of Services has recommended a framework for various departments to identify portfolio of services that are affordable, accessible and relevant for citizens to ensure early adoption. This includes identification of anchor departments for leveraging NOFN, along with an implementation checklist for Central Ministries and concerned State Departments to identify and develop services, and augmentation of services being provided or envisaged under various Mission Mode Projects. The committee has also recommended identification of applications enabling machine automation and piloting them for data collection.

The Technology Committee has recommended establishing a unified broadband infrastructure entity to bring together and manage the complete fibre infrastructure in the country. Further, it has recommended that an assessment of the backhaul requirements of bandwidth at district and block level should be undertaken, to ensure that a complete network exists between district and panchayat. Emphasis is laid on evolving a comprehensive ecosystem supported by cloud

infrastructure and localization. In order to strengthen the last mile reach, it has proposed that a dedicated 'eGov' band may be created by allocating the required spectrum.

The Business Model and Implementation Committee has proposed an integrated approach that ensures and enables non-discriminatory and affordable access to connectivity, end-user devices and services. It has recommended a two pronged implementation strategy that includes establishment of a Government User Network (GUN), by DoT/ BBNL, to provide last mile connectivity through DeGS as the ISP to various public institutions, along with enabling private ISPs, TSPs and cable operators to offer services to individuals and business users. DoT may issue guidelines to enable the same. The Committee has proposed establishing a State Broadband Taskforce to monitor the implementation at the last mile. The need for a Bandwidth Aggregator as a separate licensed entity, to provide backhaul connectivity to DeGS has been highlighted. It is proposed that the Common Services Centers (CSC) network may be expanded, to provide shared assisted access to citizens, in each Gram Panchayat. Innovative financial models have been proposed that include bundling of connectivity with end-user devices and pay-per-usage models vs. bandwidth consumption. The creation of a Digital Inclusion Fund at the national level, to provide seed funding for last mile connectivity and service adoption at the village level, has also been recommended.

A summary of the recommendations is as follows:

- 1) Assisting Service and Content Providers for identifying and developing affordable, accessible and relevant services for citizens, to ensure early adoption, by both government and private providers, as per the framework recommended by the Portfolio of Services Committee;
- 2) Identification of anchor departments, and enabling them to identify and develop services, including those envisaged under various MMPs;
- 3) Identifying and piloting applications that enable machine automation for data collection and business intelligence;
- 4) Establishing a Unified Broadband Infrastructure Entity to bring together and manage the complete fibre infrastructure in the country;
- 5) Assessment of the backhaul requirements of bandwidth at district and block level to be undertaken, to ensure that the complete network exists between districts and panchayats;

- 6) Evolving a comprehensive ecosystem supported by cloud infrastructure and localization.
- 7) Dedicated 'eGov' band to be created by allocating the required spectrum;
- 8) An integrated approach that ensures and enables non-discriminatory and affordable access to connectivity, end-user devices and services;
- 9) Establishing a Government User Network (GUN), by DoT/ BBNL, to provide last mile connectivity through DeGS as the ISP to various public institutions;
- 10) Private ISPs, TSPs and cable operators to offer services to individual and business users.
- 11) Establishment of a State Broadband Taskforce to monitor the implementation of the last mile connectivity and service enablement, under the aegis of the State Apex Committee for NeGP;
- 12) Issuing policy guidelines for enabling Bandwidth Aggregators as licensed entities to provide backhaul connectivity to local service providers including DeGS;
- 13) Common Services Centers Network to be expanded to provide shared assisted access to citizens;
- 14) Digital Inclusion Fund to be created at the national level, to provide seed funding for last mile connectivity, promote localization, and service adoption at the village level;
- 15) Free Right of Way may be provided for service providers providing connectivity in Gram Panchayat and villages. Right of Way must be allowed for provisioning of connectivity at end-user locations, including through electricity ports, access to terraces for placement of antennas, etc.

Table of Contents

1 Background	6
1.1 DeitY's NOFN Pilot	7
1.2 Beyond the NOFN Pilot Project.....	8
2 Portfolio of Services Committee.....	9
2.1 Understanding the Users	10
2.2 Understanding the Applications.....	10
2.3 Identifying Services	12
2.4 Service Adoption	13
2.5 Other Implementation Requirements	14
2.6 Consolidated Recommendations.....	16
3 Technology Committee.....	18
3.1 Creation of Unified Broadband Infrastructure	18
3.2 Create Ecosystem of services.....	19
3.3 Last mile connectivity.....	19
3.4 Consolidated Recommendations.....	20
4 Business Model and Implementation Committee	22
4.1 Detailed Recommendations	23
4.2 Consolidated Recommendations.....	30
Annexure A.....	32

1 Background

In October 2011, Government of India approved setting up of the National Optical Fibre Network (NOFN) to provide gigabit connectivity in each of the 2,50,000 Gram Panchayats (GPs) in the country. This network is expected to extend existing dark optical fibre to Gram Panchayats. The vision of NOFN is to:

- Provide 100 Mbps broadband connectivity to all the Gram Panchayats
- Provide B2B services in a non-discriminatory manner
- Facilitate proliferation of G2C, B2C and P2P broadband services in rural areas
- Catalyze broadband penetration in rural areas so as to foster overall socio-economic development

NOFN is a multi-stakeholder project, with a number of organizations including the Department of Telecommunications, the Department of Electronics and Information Technology, BBNL, BSNL, RailTel, PGCIL, C-DOT, TCIL and NIC collaborating to ensure that broadband connectivity reaches every Gram Panchayat, enabling adoption by the public and private institutional users as well as the citizens.

The ability to access broadband enabled services provides opportunities to empower digitally marginalized rural citizens; changing the way they learn, communicate, manage their livelihoods and access health, financial and government services. However, mere access to broadband and ICT infrastructure is not enough to ensure adoption by the digitally marginalized. Affordability and provisioning of appropriate bouquet of services are equally important elements governing the adoption process. Therefore, it is essential to evolve an integrated approach addressing supply of bandwidth and the aggregation of demand by ensuring availability of an adequate portfolio of services that can jumpstart usage.

1.1 DeitY's NOFN Pilot

Department of Electronics and Information Technology (DeitY) has implemented a pilot project in 3 (three) blocks-

- i. Arain Block (Ajmer District- Rajasthan)
- ii. Parwada Block (Vishakapatnam District- Andhra Pradesh)
- iii. Panisagar Block (North Tripura District- Tripura)

The Pilot covered all 59 (Fifty Nine) Gram Panchayats in the three blocks, where NOFN connectivity had been established, to explore how services for citizens and public institutional users can leverage NOFN. During the pilot, the State Governments were approached to identify the portfolio of services to be provisioned through NOFN connectivity and the infrastructure to be deployed at various public institutions. All 59 gram panchayats in the Pilot have been provided 100 Mbps vertical connectivity by BBNL and 195 public institutions have been provided 10 Mbps horizontal wireless connectivity by BSNL. These institutions have also been provided gap ICT infrastructure to ensure availability of end-user devices at institutions.

DeitY has liaised with Ministry of Rural Development, Ministry of Health & Family Welfare, Ministry of Human Resource Development and Ministry of Panchayati Raj Institutions for on-boarding various G2G, G2C & B2C services. One Primary Health Centre has been identified in each pilot block to provide telemedicine services. The identified PHC and the corresponding referral hospitals have been equipped with the required telemedicine equipment as well as the e-Sanjeevani software, and healthcare workers have been given training to use these solutions.

21 Digital Knowledge Centers (DKCs) have been established as hubs for dissemination of digital literacy courses and vocational skills training to the rural population. DeitY has collaborated with various agencies like NASSCOM, Azim Premji Foundation, IL&FS, Amrita University Skills Development, etc. to make e-learning content available to end users.

1.2 Beyond the NOFN Pilot Project

As the NOFN Pilot matures, a number of best practices have been identified that can be incorporated during the national rollout of NOFN. Accordingly, DeitY has constituted three committees to recommend requirements for the successful national rollout of NOFN.

- a) **Portfolio of Services Committee:** To recommend portfolio of G2C and B2C services leveraging NOFN connectivity.
- b) **Technology Committee:** To recommend technical architecture for scaling up service delivery on NOFN.
- c) **Business Model and Implementation:** To design a sustainable nation-wide business model to ensure adoption of service delivery over NOFN.

2 Portfolio of Services Committee

While significant progress has been made during the Pilot, to operationalize and deliver various G2G, G2C and B2C services to citizens by leveraging NOFN connectivity, adoption has been slow. The following factors are important to enable adoption:

- Strong ownership from line departments to ensure delivery of broadband enabled services
- Local level handholding for institutional users to ensure delivery of e-services
- Collaborative service enablement and monitoring teams at the local level
- User awareness and capacity building
- Augment online services with video and multimedia to leverage the high bandwidth availability

Successful adoption requires rollout of services to meet the needs of identified users through a well-targeted strategy and implementation framework. It is expected that citizens and businesses will avail of NOFN connectivity through services provided by TSPs / ISPs, who will be responsible for ensuring availability of value added services. Further, cable TV operators are expected to ramp up bandwidth off-take enabling them to offer both entertainment and internet to customers.

It is anticipated that public institutions will become anchor tenants of the NOFN network to provide various government services. It is proposed that initially key anchor departments that offer a large number of direct citizen services should be brought onboard to avail the NOFN connectivity. These include, but are not limited to, School Education, Higher Education, Technical Education, Health & Family Welfare, Food and Civil Supplies, Social Welfare, SC/ST/ OBC/Minority Welfare, Rural Development, Panchayati Raj and the National Skill Development Mission. It is expected that these departments will develop various services and relevant content for service delivery. Capacity building of department employees and the awareness generation amongst citizens must accompany the development of services.

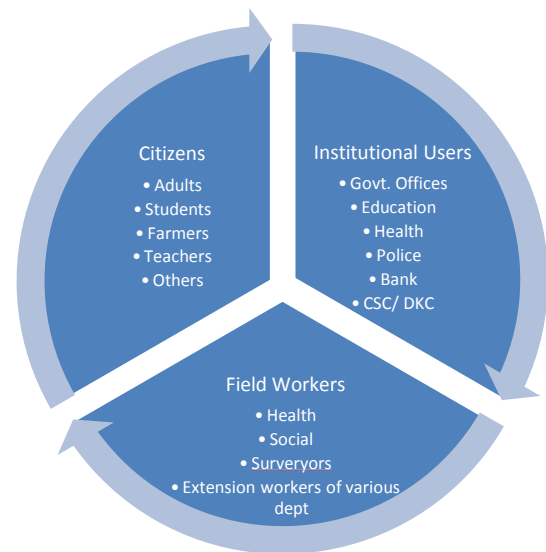
A focused drive to augment the current text / data based e-services with video and multimedia elements is needed to leverage the high bandwidth availability available through NOFN. The onus of developing these services is with the relevant Department along with their partner content providers.

All services must be made available in both individual and shared / assisted access modes. Service delivery should be compatible with mobile devices and through public kiosks such as Common Services Centres.

The Committee's recommendations are as follows:

2.1 Understanding the Users

BBNL is a wholesaler of bandwidth and its primary customers/ users are expected to be telecom service providers, cable operators and internet service providers. However, in order to ascertain the true demand for bandwidth, it is important to evaluate the needs of the end-users and the various services that can be leveraged by the end customers, which include citizens, the institutional users and the field workers.



While most institutional users require fixed access, a large number of field workers will also require mobile access to enable real-time data updation from handheld devices in the field.

2.2 Understanding the Applications

While the range of broadband enabled services that can be deployed for various institutional and individual users is potentially huge, most users would avail of the following types of applications:

2.2.1 Communications

These include applications that enable unified communication services (voice, conferencing facilities, instant messaging, fax, email, etc), network and data centre management, VPN and other network security services. These types of applications are generally availed by institutional and business users for improved productivity and reduced costs. However, in some instances home users may also leverage these

services, particularly for triple play- telephony, television and internet access. These applications, for the most part, enable person to person communication.

2.2.2 Machine Automation

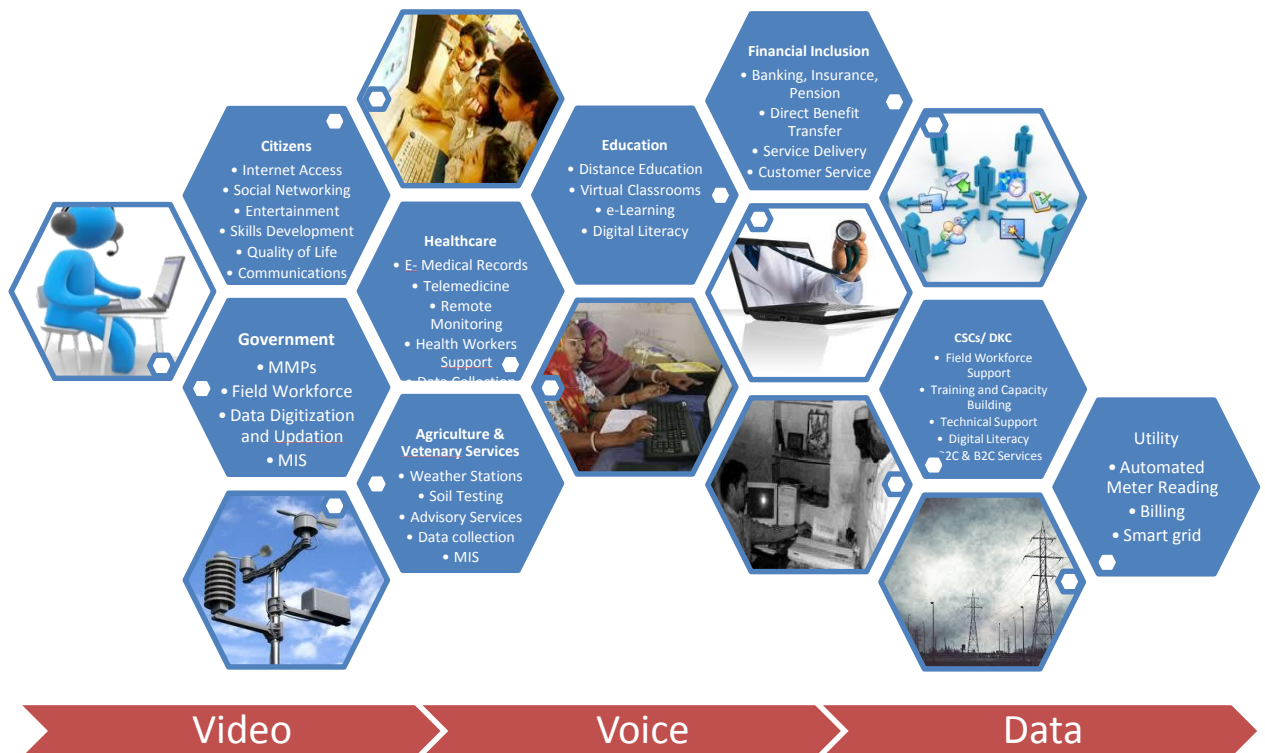
Installed on machines like utility meters and weather stations, these applications enable automated data collection on a regular basis. These types of applications are generally available by utility companies for automated meter reading and billing, surveyors to collect data from the field, etc. Other services include video surveillance for public safety and institutional security, toll monitoring and highway security, automated weather stations, and biometric attendance at schools and offices. These applications send data over a broadband network at regular intervals, reducing human intervention for data collection. Enablement of such applications requires installation of external devices on the machine like a camera or wireless device, which collects data that is sent over the broadband network (often wireless) to a pre-determined database. Business intelligence applications are often used to further analyze the collected data.

2.2.3 User Applications

These user specific applications leverage voice, video and data platforms and are designed for specific purposes that can apply to different types of industries and consumers. Generally, they are designed by various service and content providers and can enable government, business or social services. The responsibility of the application development and content creation lies with the service provider. Examples of such applications include tele-medicine, e-learning, online certificates, virtual classrooms, etc. These applications are designed and developed for specific user groups by various service providers. The technology platform along with relevant content and user awareness are critical for such applications.

2.3 Identifying Services

The figure below maps the broadband enabled services, leveraging communication, machine automation and user applications, across various institutional and individual users. These services are often voice and video enabled, with integrated data needs. Annexure 1 provides an indicative list of domains where government departments and agencies can effectively use online services to enhance the process outcomes. It also provides a template that can be used by them to identify services that can be offered to the stakeholders using NOFN connectivity. It is important to note that it is expected that these services will be developed and offered by both government and private entities.



2.4 Service Adoption

The principle of “build it and they will come” may not work when new broadband enabled services are made available to the first time users. While ensuring access to broadband connectivity and end-user devices is critical, to encourage adoption by rural users, it is important for the services to meet the following criteria:

2.4.1 Applicability/ Relevance

Any service that is enabled must have a clear value proposition not only for the service provider implementing the service, but also for the user who is expected to avail the service. The user must be made aware of this value proposition- a comprehensive awareness strategy should be designed and implemented to increase awareness among the service providers and end users. Before any service is developed, the service provider must undertake need assessment, and if possible, involve users in the service design process.

2.4.2 Awareness and ability

While the service may be relevant to the users, unless they are aware and have the ability to use the service, adoption may not be possible. This pre-supposes that the users are digitally literate and have access to end-user devices. Further, service interfaces must be user friendly, available in local languages and address needs of differently-abled users. Intuitive user interfaces leveraging images and audio/ video are often more successful with first time users having lower levels of digital literacy. Also, all functionaries involved in service delivery, must be provided with the required training and support services to successfully render the service.

2.4.3 Affordability

Users must be able to afford the service. In addition to the service costs, costs of accessing through end-user devices and bandwidth usage must also be taken into consideration. Innovative pricing models are needed to ensure adoption. Subsidized

access to government and public services may be considered depending on the business case and sustainability model.

2.5 Other Implementation Requirements

2.5.1 Aggregation of Service Delivery

Currently, penetration of broadband enabled end-user devices in rural India, though growing at a rapid pace, is still limited. Thus, there is need to aggregate service delivery through an institutional mechanism that provides non-discriminatory public access to services. Tele-centres like the Common Services Centers (CSCs) and other public access points like schools and gram panchayat offices can ensure access to services. Such public service aggregation points lower the cost of access, while providing assisted access to encourage usage.

2.5.2 Integrated Delivery of Services through Multiple Channels

As the ownership of mobile phones and tablets is growing rapidly in rural areas, they are likely to emerge as the preferred modes of access in the coming years. Hence, there is a need for integrated delivery of electronic services through these devices. This would help tremendously in widening the access to these services in rural areas. Services in domains such as government services, health, education, financial inclusion, etc. can be effectively delivered through mobile devices.

2.5.3 Delivery of Integrated Services

Integration of services of multiple departments and agencies and delivering them electronically through multiple channels will provide a big boost to the demand for these services. For example, there is considerable scope for integrating various services under the e-District project which will help in increasing the demand for these services in rural areas. The Directorates for Electronic Service Delivery, being

set up by states, may ensure availability of services through the network. Further, opportunities also exist for private service and content providers to develop services that are relevant for rural customers, which may be delivered through partnerships with TSPs, ISPs and cable operators.

2.5.4 Enforcing Quality of Service and Service Level Agreements

Optimizing quality of service delivery and enforcing service levels for the service provider increases customer satisfaction. For example, just making an application for a G2C certificate available online is not enough. It is important that the application is processed within expected timelines and the user is kept abreast of the progress of the application. Services that are able to successfully engage the user, have higher uptake and lead to repeat customers.

2.5.5 Augmenting existing business processes

A large number of services are already available online. However, due to limited bandwidth availability, these are primarily basic data based services. There is a need to rethink existing services, and upgrade them to leverage higher bandwidth which will be made available through NOFN. For example, currently available offline e-learning modules can be enhanced through online virtual classrooms; email based grievance redressal systems may be upgraded to use a video based complaint system; placements for skills programs can be enhanced through video conferencing based interview processes, etc.

2.5.6 Appropriate Business Models

It is important that appropriate business models are designed and implemented for various services to make them sustainable in the long run. Appropriate pricing mechanisms and business models are also required to be put in place for last mile connectivity for government institutions, businesses and citizens.

2.5.7 Regulatory Issues

A supportive regulatory environment must be established to enable meaningful and value added delivery of various services. For example, regulations may need to be suitably modified to enable business correspondents (BC) to deliver a range of financial inclusion services. Online authentication, privacy and security issues also need to be suitably addressed as the range of online services would expand greatly and the number of users and entities accessing online information and services would multiply manifold.

2.6 Consolidated Recommendations

Based on the above deliberations, the specific recommendations of the Committee on Portfolio of Services are as follows:

2.6.1 DoT to issue guidelines enabling cable TV operators to connect to NOFN and obtain bandwidth for distribution of entertainment and internet

2.6.2 Identification of anchor departments and services by NeGP Apex Committee by March, 2014, with the following activities to be taken up immediately by Central Ministries (including concerned State Departments):

2.6.2.1 Preparing a list of all services offered by the Department

2.6.2.2 Development of end-to-end services that leverage voice, video and data, by the Departments, using the draft template covering:

- i. User identification
- ii. Relevance / applicability
- iii. User needs analysis
- iv. Business Process Reengineering
- v. Application requirements

- vi. Connectivity requirements
- vii. Policy environment
- viii. Business model

- 2.6.2.3 Strengthening delivery of MMPs by development of rich content, including voice and video, for service delivery
- 2.6.3 Development of anchor services by anchor departments, by September, 2014
- 2.6.4 Rollout of anchor services between October 2014 - March 2016
 - 2.6.4.3 Emphasis on enabling service delivery for individual access (including through mobile devices) and assisted shared access (Common Services Centres) in addition to delivery through public institutions.
 - 2.6.4.4 Capacity Building of all Departmental employees for e-service delivery
 - 2.6.4.5 Awareness generation programs for citizens to be coordinated by DeitY under the National e-Governance Plan, under guidance of the NeGP Apex Committee. It is recommended that Ministries / Departments of Schools Education, Higher Education, Technical Education, Health & Family Welfare, Food and Civil Supplies, Social Welfare, SC/ST/ OBC/Minority Welfare, Rural Development and Panchayati Raj and the National Skill Development Mission may lead these activities.
- 2.6.5 Identification of 3-5 machine automation applications, to be taken up on Pilot basis for data collection and business intelligence by leveraging NOFN connectivity. These could include power, traffic management and toll collections, collection of water resources data from dams and reservoirs, etc.

3 Technology Committee

The Deliberations of the Technology Committee are as below

3.1 Creation of Unified Broadband Infrastructure Entity

- 3.1.1 Unified broadband infrastructure encompassing all infrastructures under one entity should be created. It will provide non-discriminatory and non-profit based access to everyone as per their bandwidth requirements.
- 3.1.2 Serious efforts are recommended to create Unified bulk broadband network through policy mechanism.
- 3.1.3 There is a need to create 'Network' between District and Panchayat. It needs to be a common infrastructure which will be leveraged by both Government and Private sector.
- 3.1.4 As a short term measure to accelerate demand and usage of broadband at last mile, the project planned with Rural Development Ministry for providing CUG should be taken up. This will not only facilitate service delivery in the rural areas but also create awareness and demand for bandwidth in the region and facilitate digital inclusiveness.
- 3.1.5 Fiber sharing should be done for usage and cost optimization in longer run.
- 3.1.6 Backhaul requirements to be considered/taken into account while designing the architecture to meet demands during future rollout of advance networks like 4G/LTE.
- 3.1.7 Network architecture should be compatible to quality of services (QoS) requirements and the types of services planned to be rolled out. Thus quality and capacity will be the consideration of architecture.
- 3.1.8 It's suggested to provide assured bandwidth, quality and service.
- 3.1.9 As only incremental fiber is laid by BBNL, there will be thick and thin elements where bandwidth at upper section is insignificant to cumulative bandwidth at lower links. The incremental fiber is on multi core whereas fiber from block to BBNL PoP is on single core which limits the scalability. This gap needs to be overcome essentially.

3.1.10 Laying aerial optical fibre will significantly reduce time and cost of the project in comparison to underground cable. There are no significant security or maintenance issues.

3.1.11 Indigenization should be ensured by policy initiatives/providing sufficient investments. It will be cost effective in long run and promote self reliance.

3.2 Create Ecosystem of services

There will be optimal utilization of infrastructure. It will create demand for bandwidth along with utilizing scale offered by fiber.

3.2.1 Cloud related policies, framework and regulatory mechanism to be strengthened to give a push to its adoption. In a shorter run government cloud needs to be taken forward and subsequently conducive environment to be created for public cloud infrastructure by private entities while ensuring their interoperability.

3.2.2 Public clouds will create a spurt in demand by tapping the last mile businesses.

3.2.3 Localization should be given thrust to meet the expectation in terms of services offered as well as network utilization.

3.2.4 Cloud committee and Localization committee reports need to be incorporated / considered in this report once these are released.

3.3 Last mile connectivity

Options are to be explored extensively and various models to be explored, Pilot run are to be done for checking feasibility and challenges in each.

3.3.1 Create Cost effective last mile connectivity so as to keep it affordable in line with entertainment services offered by cable operator. Initiating and experimenting with pilot run for Cable operator network through Coax and Fiber optic cable. Also Wifi mesh

structure need to be explored via pilot run. This needs to be completed within 6 months to explore the feasibility and comparative evaluation of each.

3.3.2 eGov band should be reserved upto 20 Mhz in the range of 800/900 MHz band.

3.3.3 Other mediums like FTTH, 4G, 3G, Wifi, Wimax etc needs to be explored in parallel to cable operator network for all connectivity like backhaul, last mile, etc.

3.3.4 Last mile connectivity should be provided through/to private players on non discriminatory basis.

3.4 Consolidated Recommendations

Based on the above detailed recommendations, the following actions are recommended:

a) Actions by DoT

3.4.1 Establish a Unified Broadband Infrastructure entity to bring together and manage the complete fiber infrastructure in the country

3.4.2 To undertake an assessment of the Backhaul requirements of bandwidth at District and Block level and to appropriately design and set up the required infrastructure

3.4.3 To provide complete Block to GP connectivity through BBNL fiber building upon the work done by BBNL under the NOFN project

3.4.4 To consider reserving spectrum upto 20 MHz in the range of 800/900 MHz and creation of 'eGov' band

3.4.5 BBNL PoPs to be created at District level in order to achieve the objective of providing a common unified infrastructure between District and Panchayat which could be utilized by Government and private sector

3.4.6 To conduct Pilots for assessing the feasibility of fiber / coax networks of cable operators and wireless connectivity (e.g. Wifi mesh) to determine the best options for last mile connectivity.

3.4.7 Based on the findings of the Pilot, prepare a blueprint for providing last mile connectivity.

b) Actions by DeitY

3.4.8 To prepare detailed plans with the line Ministries to ensure integration of Localization framework with all e-services to maximize access to e-services by the users

3.4.9 To promote use of DeitY's Cloud initiative in development and implementation of e-governance initiatives by Ministries and States to optimize the use of e-governance infrastructure

3.4.10 Integration of existing infrastructure laid under the NEGP- SWAN, SDC etc, with NOFN network

3.4.11 DeitY to issue instructions for the integration of NOFN with PoPs of NICNET, NKN and SWAN

4 Business Model and Implementation Committee

The business model and implementation strategy for NOFN must ensure that broadband access is both available and affordable for both institutional and individual users. An integrated approach that addresses availability of bandwidth, end-user devices as well as services is critical to ensure adoption. With a large number of stakeholders, it is also important to establish a well-defined framework to ensure expeditious and effective utilization of NOFN.

Delivery of e-governance services has been the responsibility of individual departments, with DeitY providing technical and other inputs under NeGP. It is now time to **adopt end-to-end e-service delivery across the government in a time-bound manner**, and leverage NOFN to address the network issues to ensure high quality and efficient services across rural India. This must be taken up as a policy priority with regular review at the level of Cabinet Secretary. All Ministries should prepare a list of all services offered by them, and prepare a plan for the enablement of all possible services.

The actual utilization of NOFN requires **addressing the issues of District-to-Block connectivity and last mile connectivity beyond the Panchayat**. In the immediate term, the creation of a GUN (Government User Network) as approved by Telecom Commission is being taken up with capital expenditure from USOF and recurring expenditure from MoRD. However, government-wide usage of NOFN-based connectivity will require the resolution of the district-to-block and last mile connectivity issues and creation of an institutional mechanism for implementing and monitoring. Simultaneously, it is expected that private service providers- TSPs, ISPs and Cable Operators- will leverage the network to provide value added voice and data services to citizens and business users.

The first step in this direction can be the establishment of **State-level Broadband Taskforce**. While DoT / BBNL are responsible for national level policy initiatives for linking up TSPs and ISPs with NOFN, the State Taskforces will coordinate the actual last-mile connectivity and the enablement of services across State departments. The State Broadband Taskforce can be

integrated with the Apex Committee established under NeGP, under the chairmanship of the Chief Secretary, for integration of the NeGP infrastructure with NOFN and monitoring e-service development. A **Digital Inclusion Fund** should be created, with contributions from government (including USOF), stakeholder contributions and CSR funding, to provide seed funding for last mile connectivity and service adoption at the village.

There is a need for **bandwidth aggregators** to ensure backhaul connectivity to service providers of last mile connectivity. The specific monitoring of the implementation of connectivity and services must involve the **District e-Governance Societies as ISPs**.

Several State governments are distributing computers / tablets to students as well as departmental field employees under various programs. These initiatives can be augmented by **bundling device costs along with access to bandwidth and content** to enable users to leverage internet connectivity not merely computing power. This can be done vide an advisory to be issued by DeitY to all Ministries and States / UTs. The advisory should cover the issues pertaining to bandwidth access mechanisms both through mobile network access as well as access to the GUN proposed to be established by BBNL. The advisory should also provide for the integration of BYOD with the GUN.

There is a clear need to **expand the CSC network** and **provide CSCs with NOFN connectivity** to enable them to deliver services to citizens.

4.1 Detailed Recommendations

The detailed recommendations of the Committee are as follows

4.1.1 An integrated approach that ensures and enables non-discriminatory and affordable access to:

4.1.1.1 Connectivity

- a. Access to NOFN connectivity should be offered on a transparent and non-discriminatory basis to all Service Providers who want to access the NOFN

network to provide services. Shared infrastructure access (to both passive and active infrastructure) can be offered by leasing the bandwidth to private operators like ISPS, TSPs and Cable operators for reaching rural areas where they do not have a footprint.

- b. The business model should be technology agnostic. It should encourage the Service provider to decide the technology architecture to be implemented for last mile connectivity. Competition should be encouraged on the “cost-of-delivery” criterion.
- c. There is a need for licensed Aggregators of bandwidth and dark fibre to interface with NOFN / BBNL to provide upstream connectivity.

4.1.1.2 End-user Devices

- a. Access to just connectivity is not enough. Due to the limited penetration of affordable end-user devices, it is recommended that individual access is not only enabled across the village through mobile devices (smart phones, tabs, laptops) and PCs / thin clients but also in institutional campuses (school / health centre / panchayat etc).
- b. Low cost devices like tablets may be made available as community devices to citizens, which can be borrowed by them from institutions like user libraries, telecenters, etc.
- c. Expansion of the network of shared access centers and telecentres- Common Services Centres (CSCs) – to allow citizens to avail of assisted access services, without having to procure end-user devices.

4.1.1.3 Services

- a. Along with connectivity and access to end-user devices, Service Providers must ensure access to value added-services which leverage voice, video and data applications.
- b. It is important, especially in the case of institutional users, that anchor services are identified upfront. These could include e-learning for schools, tele-consultation for health centres, real-time data collection for field staff of

various departments etc. The Directorates for Electronic Service Delivery, being set up by States, may ensure availability of services through the network.

- c. Also, a “walled garden” approach which ensures that all service providers allow free access to selected public services-including- the eGov apps store, government service portals, public information portals, etc.
- d. Recommendations of the Portfolio of Services Committee may be referenced to identify various services, including but not limited to:
 - i. E-Governance (esp. land records and certificate repository)
 - ii. Education
 - iii. Healthcare
 - iv. Financial Inclusion
 - v. Utilities
 - vi. Agriculture

4.1.2 Implementation Strategy

A two-pronged implementation strategy is recommended to address the needs of government/ public institutional users and individual and business users:

4.1.2.1 Government User Network (GUN) over NOFN; DeGS as ISPs:

- a. A closed user group network may be established for public institutional users- Government User Network (GUN). This will require standardizing pricing models, SLAs and service offerings across departments.
- b. A single entity at the district level may be given the responsibility for the following:
 - i. Connectivity and bandwidth management
 - ii. Addressing infrastructure needs of institutions, including technical support services
 - iii. Service enablement and support
 - iv. Billing and subscription management

- v. Capacity building and training
 - vi. Awareness and publicity
- c. It is recommended that the District e-Governance Society (DeGS) may be appointed as a district level Internet Service Provider (ISP) to provide last mile connectivity to public institutions, to undertake the responsibilities of the above mentioned tasks. Formed in all districts across all States under NeGP, the DeGS has been mandated to coordinate with various service departments at the field level to ensure delivery of online government services. Thus it is ideally positioned to operationalize, monitor and manage the last-mile broadband network for public institutions that has been proposed as part of the national rollout of NOFN.
- d. The DeGS may be given the flexibility to operate this network by building in-house capacity, partnering with BBNL or outsourcing to a private entity through a transparent selection process.
- e. Further, DeGS would ensure availability of shared access- like Common Services Centers- to ensure equitable access across the districts.

4.1.2.2 Access to Citizen & Business Users:

- a. It is anticipated that private service providers- TSPs and ISPs will play a critical role in ensuring access to both home and business users. Shared infrastructure access can be offered by leasing the surplus bandwidth and dark fibre to various Private operators like ISPs, TSPs and Cable TV Operators for reaching the rural areas where they do not have their footprint.
- b. Availability of NOFN connectivity should augment existing business models of private service providers, providing incentives for enabling digital inclusion across all user-groups. It should offer dark fiber and duct services (Short term or Long term leased based model / IRU based model). It may offer fixed bandwidth leasing based on TRAI charges, and allow TSPs to connect existing telecom infrastructure (setting up and connecting of BTS for enabling 2G/3G/4G services).

- c. Existing license agreements may be modified/ extended as required to ensure that service provisioning at the village level.

4.1.3 State Broadband Task Force

In order to monitor the enablement of the last-mile connectivity, especially through DeGS, a State-level Broadband Task Force may be established under the aegis of the State Apex Committee for NeGP, with the mandate to ensure:

- i. Appointment of DeGS as a internet service provider
- ii. Deployment of the last mile network for institutional access
- iii. Ensure connectivity of public institutions
- iv. Monitoring and ensuring adoption by institutional users
- v. Providing funding through the Digital Inclusion Fund
- vi. Overall monitoring and implementation of the last mile network

4.1.4 Upstream Bandwidth Aggregation

NOFN provides only mid-mile connectivity between the Block and Gram Panchayat. For seamless connectivity, there is a need to ensure availability of upstream bandwidth beyond the block. Currently, various service providers avail of upstream bandwidth, through their own backhaul infrastructure or by procuring bandwidth (leasing dark fiber) from existing infrastructure providers, as per the recommendations issued by TRAI. Most private service providers already have such arrangements in place.

However, the market is fragmented, with service providers varying from location to location. Organisations with a national footprint are often able to negotiate terms easily, but this will be a challenge for local service providers, including DeGS. Thus, there is a need to create an institutional mechanism to ensure standardized availability of upstream bandwidth.

It is recommended that a Bandwidth Aggregator may be considered as a separate licensed entity. This entity may buy bandwidth or lease dark fiber from both public and private infrastructure providers. It will be empowered to negotiate terms on behalf of all the DeGS, and will ensure enforcement of quality of service and SLAs. The aggregator may partner with other stakeholders to deploy the requisite infrastructure to address the infrastructure gaps between Block and the last point of available fiber.

4.1.5 Innovative financial models: An innovative financial model needs to be adopted by service providers to reduce operational costs and improve customer retention and service differentiation.

4.1.5.1 Connectivity bundled with end-user devices

One of the reasons mobile phone usage grew exponentially was because the cost of mobile phones was bundled with subscription plans. Similarly, service providers should offer innovative bundled plans that allow users to access end user devices along with connectivity plans. For example, States offering its citizens end-user devices may bundle connectivity along with device distribution.

4.1.5.2 Bandwidth consumption vs. pay per service model

Pure bandwidth based subscription plans are unlikely to encourage adoption from first time users. Innovative subscription plans need to be developed which ensure access to value added services- monthly usage with free access to certain services (social media, email, chat messengers, government services etc). Alternatively a pay per service model where the end user pays for the service consumed may also be adopted. For example, instead of paying for bandwidth charges, the consumer may pay for the services he wants to consume – Medical advice (Tele-medicine), or Digital library membership (e-books library), e-learning (pay per class or course).

4.1.5.3 Creation of a Digital Inclusion Fund

It is proposed that a Digital Inclusion Fund be created at the national level, to provide seed funding for last mile connectivity and service adoption at the village level. This Fund may be put together through funding from Government (including USOF) along with various ecosystem members-including service providers, device manufacturers, content providers etc. The private sector may be allowed to leverage their CSR budgets to contribute to this fund.

4.1.6 Regulatory

4.1.6.1 Non-discriminatory access

Access to NOFN connectivity should be offered on a transparent and non-discriminatory basis to allow fair competition between the public and private players. Issues relating to sharing of fiber, interconnect with existing infrastructure and bandwidth pricing need to be addressed.

4.1.6.2 Right of Way (RoW)

The Right of Way (RoW) for laying fiber needs to be addressed with State governments and local bodies for upstream and downstream linkage with NOFN for all TSPs/ISPs. RoW charges increase the cost of connectivity, making fixed wireline connectivity expensive. In order to reduce costs and to attractively price broadband for rural consumers, it is recommended that free RoW may be provided for service providers providing connectivity in Gram Panchayat and villages. Further, Right of Way must be allowed for provisioning of connectivity at end-user locations, including through electricity ports, access to terraces for placement of antennas, etc.

4.1.7 Integration with existing Infrastructure

In order to optimize the utilization of NOFN broadband network connectivity from Block to GP, it is recommended to aggregate and integrate the NOFN platform with the existing PoPs at District and State level provisioned under SWAN and NKN for the delivery of high speed broadband or closed user group connectivity from district and locations in the gram panchayats for government services that can be delivered to the public along with a community access to broadband. Existing fiber networks like RailTel, Powergrid can be leased and used exclusively for this purpose. As these players cover more than 67% connectivity between District and Block, it will be relatively easy to reach the districts.

4.1.8 Cost Estimates and ROI

The detailed cost estimates cannot be made at this time. Once the model is finalized, an estimate of costs can be made if necessary. However, prima facie it appears reasonable to assume that the costs will need to be shared between the government through budgetary funding and the private sector.

4.2 Consolidated Recommendations

Based on the above deliberations, the Recommendations of the Committee on Business and Implementation Model are as follows:

- 4.2.1 Establishment of Government User Network (GUN)
- 4.2.2 DoT / BBNL to share State-wise rollout plan with DeitY and Ministries / States to enable preparation of service rollout plans for the anchor services
- 4.2.3 DoT and DeitY to issue joint instructions for NeGP State Apex Committee to function as the State-level Broadband Taskforce, with detailed Terms of Reference
- 4.2.4 DoT to issue guidelines for

- a. Bandwidth Aggregators to enable creation of business entities to provide backhaul connectivity services for last mile service providers.
 - b. Shared infrastructure access (for both active and passive infrastructure) by TSPs /ISPs / Cable TV operators
 - c. Establishment of District-level ISPs
- 4.2.5 DeitY and DoT to issue guidelines for appointment of DeGS as the ISP to implement last-mile connectivity
- 4.2.6 DeitY to issue advisories for device integration with GUN (including devices provided by government and BYOD) by bundling device cost with bandwidth costs and content
- 4.2.7 DeitY to take necessary action for the expansion of CSC network across all Panchayats and attempting to co-locate CSCs with GPs, with CSCs leveraging NOFN connectivity
- 4.2.8 DoT to issue instructions for creation of a Digital Inclusion Fund

Annexure A

Opportunities for Government Departments to Leverage NOFN

- NOFN can enable Government Departments to leverage online services to augment processes in the following areas:
 - Data Collection and Digitization (survey, census, GIS mapping, etc.)
 - Monitoring & Reporting
 - Awareness & Citizen Engagement
 - Training and Capacity Building
 - Online Video Consultations
 - Grievance Redressal
 - Information Dissemination
 - Best Practices sharing
 - Over the Counter G2C Services
 - Digital Literacy
 - E-learning & Skills Development
 - Financial Inclusion
 - Health services

- Following is a suggested template that Government Departments may use to identify & develop relevant broadband enabled services

- Who benefits from the service deployment ?
- identify internal users - employees, partners, field workers, etc
- identify external users- customers, suppliers, funding agencies, etc

Identifying the Users



- Why should the user avail of this service? How will he benefit?
- How critical is the service for the user?
- Are there any service level requirements?
- How are the users expected to access the service?

Relevance/ Applicability



- Communication Needs impacted- can current communication processes be enhanced through email, instant messaging, video conferencing?
- Can machine automation create efficiencies and accuracies? Will the data be sent on a continuous period or over regular frequency? What is the type of information being sent?
- What are the applications required to be developed? Who will develop them?

User Needs Analysis



- Which business processes are impacted by the service?
- Will it change existing process? How?
- Will it enhance existing process? How?
- Will it create new process? How?
- What are the training and capacity building needs of the users?

Business Process Re-engineering



- What are the platform requirements- voice, video, data?
- Is there a need to integrate with social media?
- How will the content be localized? How many languages?
- Who will create the content? How will IPR be managed?
- Who will develop the application?

Application Requirements



- What is the bandwidth requirement for enabling the service as well as for the user to access the service?
- What type of connectivity is required- fixed, nomadic or mobile?
- What are the quality of service requirements?
- What are the security needs?

Connectivity



- What are the regulations / policy requirements to enable the delivery of the service?
- Are there any privacy concerns that need to be addressed?
- How will the SLAs for service delivery be addressed?
- Is there a need to authorize users to deliver or access the service?

Regulatory Environment



Following is a non-exhaustive example of how the Department of Healthcare may use the template above to enable services.

User Identification	Internal users: Doctors, health practitioners, healthcare centre staff External users: Patients, students, teachers
Relevance/ Applicability	Patients in remote areas, with limited infrastructure availability, can access good healthcare via telemedicine The healthcare workforce could be strengthened and increased by enabling virtual education. Skills of health care workers need to be upgraded through regular training
User Needs Analysis	Field healthcare workers can interact with experts across the country, through video conferencing/ instant messenger. Remote health monitoring can automate collection of vital statistics of patients that are high-risk/ Virtual classrooms (video conferencing) services can allow regular training to be rendered
Business Process Re-engineering	Tele-consultations require doctors to be trained to deliver treatment virtually and write e-prescriptions. Reengineer process for giving appointments to ensure virtual patients are also accommodated in the schedule. E-Medical records of patients require healthcare practitioners to maintain online databases.
Application Requirements	Healthcare applications often leverage video and are data intensive (images of tests like MRIs, XRays, etc). Virtual classrooms with student registration may be implemented to increase workforce and upgrade skills of existing workforce.
Bandwidth	Sharing electronic health documents demands high bandwidth and speed. For example, a standard chest scan alone can range anywhere from 40-50 megabytes. Since information needs to be accessed instantly by physicians, the shared network must support adequate bandwidth. Healthcare services are a 24x7 value proposition. Availability of the network must be the same to support this sector appropriately. The network must provide a QoS capability that ensures secure, always-on connectivity with built in redundancies.
Policy Environment	Policy changes around how and where healthcare is provided along with how it is paid for are needed should addressed, including allowing reimbursement for tele-consultations. Further, in order to provide remote services, practitioners need to be registered in multiple States. As patient information is shared electronically, privacy of patients must be protected.