Response to Issues for Consultation

on Implementation Model for BharatNet

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Q.1 The "Report of the Committee on NOFN" has recommended three models and risks/advantages associated with these models. In your opinion what are the other challenges with these models?

Improved version of **NOFN** renamed as BharatNet is cornerstone of Digital India being **pillar no.1** of the programme.

New version seeks to take ICT benefits to masses at BoP by creating infra at estimated cost of Rs 72,000 crore vis a vis incremental version of Rs 20000 crore

While lauding the lot of appreciable refinements proposed by committee in project design over previous version all that effectively gets finally delivered on the ground in each GP in tangible/visible terms is connectivity to 3-institutions:-2 located 1km away from GP office and 1 co-located in GP office. For public one Wi Fi hotspot of 100-200m radius around GP office. Obviously arrangement as such is not sufficient to cover even one HH in every to empower have nots through use of ICT technologies. **CSCs/Kiosks have been left out** which normally act as first level of BB proliferation recall country wide PCO revolution and internet Dhabas of urban areas.

No doubt the committee proposal attempts to create good infrastructure in back end but its Utilisation has been left wide open to assumptions to investors to serve masses in challenging rural turf to fulfil its vision *"to provide on demand, affordable broadband connectivity of 2 Mbps to 20 Mbps for all households and on demand capacity to all institutions, to realise the vision of Digital India, in partnership with States and the private sector."* **(Para 1.19)**.

While construction BharatNet its is challenging task so was NOFN but ***UTILISATION, Maintenance and Sustenance of such mammoth infra called BharatNet is much more challenging than implementation itself***. Left unaddressed will lead to unintended consequences. **Therefore it is better to begin with end in mind. Stitching of outcomes is required as PPP arrangement is involved in end result for all implementation models.**

As experience there are still challenges left due to **missing links & foundational issues** in the central theme or premise itself around which NOFN or its new version is based. These are irrespective of implementation model & missed in the above referred report and CP. **These are critical to success of project & its sustainability**. Least one can do is broadly work out the total end to end costs to cover one HH by this tandem chain to arrive at order of investment further needed beyond proposed investment of Rs 72000 crore to put BharatNet to use. This is

middle mile from District to GP is akin to a hollow pipe and bits & bytes to fill this pipe have to come from access networks whose users constitute demand.

BharatNet eventually is a project of sustained partnerships even if theoretically assuming that middle mile is perfectly constructed by SPV it still needs partners to form value chain who come with their connectivity segments upstream and downstream domain which get stitched to middle mile. A framework would still be required to stitch pieces of connectivity together.

Elaborate discussion these vital foundational issues may please be seen in response to Q 18 of CP. In view their critical nature it would be desirable to first go through answers to Q18 first to appreciate answers in remaining Qs 1 to 17.

Below is gist of foundational issues brought therein with suggestions for way forward:

i. There are gaps in project design which has lot of assumptions be tested with existing experience acquired in NOFN project. Detailed Experience on various aspects shared with all stakeholders on continuous basis and once in a while. This will tell which assumptions & uncertainties are barriers to investment & constitute risk.
ii. To complete E2E connectivity needs stitching of 4 segments in tandem viz. (a) international connectivity, (b) domestic backbones, (c) Middle mile-BharatNet (d) local connectivity. Any mismatch in tandem of any of 4-segments or at any stitching interconnecting points could be bottleneck in BharatNet utilisation. Unstitched arrangement cannot be called i-ways like free flowing highways(foreword of report).
iii. Mismatch could be any kind capacity, technical, commercial, legal, coordination or investment viability etc. Committee itself in Para 2.03 b(ii) acknowledges that international bandwidth for internet is very costly and is to be provided based on demand. While demand may be there but earning may not be there from this demand. Let us remember: Demand is always at a price. Here we are talking of affordable low tariff BB. Need for subsidising other segments apart from middle mile may arise.
iv. For extending affordable E2E connectivity to rural turf framework for stitching all the 4 segments together to form complete the end to end value chain of which middle mile BharatNet will be just first starting point.BB ecosystem challenges are in addition
v. Well synchronised roll out of both upstream and downstream segments with associated stitching links to. This needs alignment resolution of upstream & downstream issues and corresponding investments.
vi. Frame should facilitate sustainable alignment of each segment and risk mitigation measures for investors to participate in program.
vii. Signing of advance long term agreements with upstream and downstream providers for purchase of Bandwidth or DF like in PPA in power sector. This has been also been resorted to successfully in Malaysia as give in Annex I of CP.

viii. Parallel action for missing Grass root works arising from BB Ecosystem needed at bottom of pyramid to seed new BB markets in challenging rural turf in diverse environment of our country. BB adoption is a challenge even in cushy urban turf.

ix. BharatNet programme is highly partnership & coordination intensive. Its success hinges on gluing and stitching institutional mechanism & framework. Previous mechanisms to resolve upstream & downstream issues Advisory body, Coordination-committees, Joint working groups of industry & Government need to rejuvenated with learnings acquired so far. Desired success has not come as already lit GPs show. Transparent continuous communication with stakeholders is necessary to convey BharatNet. BharatNet itself deserves a exclusive portal to keep stakeholders in touch and vibrant.

x. Each State Governments need to create their motivated **Broadband ambassadors**. They should have full understanding of ITUs ITU ICT development index which presently ranks our country at 131 out of 167 counties as well as understanding BharatNet. They should start preparatory grass root works to understand local needs by involving local communities & creating BB committees in each GP involving its Mukhiya and identify **local Broadband champion(s)** of that committee. We have to ensure that all Mukhiyas are digitally literate. Digital Literacy program of DietY should give target them first on priority. This mechanism and frame work will act as conduit of info for TSPs/ISPs and state government committees. This grass root involvement will undo many of urban oriented assumptions take things towards reality. Investors and stakeholders will get confidence in BharatNet program.

xi. Along with grass root actions there DOT should own this project with end outcomes and not feel helpless. It should have Member for BB with rural mandate in TC as priority and ensure utilisation of network. It should coordinate with Deity & all central line ministries and states.

xii. Amongst the BRICs we come last – behind Iran and Indonesia. What's more, only 18% of India's population have access to the net as against 43.4% of the global population.(Source TOI Edit 03 dec 15).We now have challenge of Digital India. We need to analysis to identify states which contribute to this pulling down country below world average.

xiii. To identify the causes that ail us in poor rank ICT dev index we now need to breakdown this index of national ranking to state wise and district wise and block wise and status & gaps to get GP wise picture. It must be remembered **all states are not equal** in terms economically, terrain and diversity etc. **No one size fits all.**

xiv. Free Row be provided same way as done for NOFN for all partners who form E2E value chain.

Challenges with CPSU models:

This arrangement has not delivered over past several years and repeatedly rolled targets in place of rolling out Network.

Experience with this model now shows that work gets delayed due to complex agreements between BBNL & CPSU seeking approvals for expenditure lack of autonomy leading to blame game as brought out in committee report. Effectively it means one CPSU supervising another means duplication of efforts & resources leads to time delay. CPSUs have felt that they should be given flexibility. Each CPSU be given full autonomy each can be allotted work independently with outcomes well defined cost and time delay and duplication of activities. Otherwise this model will continue to give same results.

In respect State led & EPC models need to be tried in parallel. These should be backed by advanced homework by BBNL. Capacity building both for willing states as well as BBNL is absolutely must. Empowerment of BBNL and its restructuring has already been touched upon in committee report.

Q.2 Do you think that these three models along with implementation strategy as indicated in the report would be able to deliver the project within the costs and time-line as envisaged in the report? If not, please elucidate.

Each model while working in parallel will expedite the works but present respective challenges. Therefore Dec 2017 target is too optimistic given the ground realities rural areas as well as government framework and structural challenges of BBNL brought out in chapter 8 of committee report. Presently there is no system of accountability, ownership. To begin with first thing that could be done is to post full time CMD with project management experience with continued tenure of 3- 4 years given the continuous need for intensive coordination with stakeholders challenging rural turf This is to be backed along with other changes proposed for empowerment of BBNL in chapter 8 of report.

Q.3 Do you think that alternate implementation strategy of BOOT model as discussed in the paper will be more suitable (in terms of cost, execution and quality of construction) for completing the project in time? If yes, please justify.

BOOT model is not a panacea for all kind situations. Context gives it a meaning. BOOT works well in an environment of certainties i.e. where proportion of certainties is reasonably high vis a vis uncertainties e.g. in arena of Airports at Delhi and Mumbai metros where mature markets are well established demand certain. Same air port if proposed to be constructed in jungle in isolation will have no takers for BOOT as no Ecosystem exists there.

Similarly here in case of rural areas for selling BB the markets are yet to be seeded. Off take of BB even in urban needs much to be desired & kind of usage. There is need for certain prerequisites to be present by addressing fundamental issues dependencies involved for success of project(brought out in answers to Q 18).In case of Broadband arena which is complex Ecosystem issue with lot of variable and dependencies e.g. affordable devices, charging facilities, digital literacy felt need & relevant application which truly help them earn bread & butter & empower them apart from affordable & reliable connectivity. It is further compounded by diversity of languages and need for Internet based simple applications needed in 28 languages-relevant local content. No other nation has this unique challenge not even China. It is still made more complex by challenging rural turf and diverse, difficult, & remote terrain of country, lack of infra roads & power, frequent power-

cuts Low digital literacy and lack of awareness. BB is a challenge even in urban/semi urban areas. Recall poor off take of BB and poor usage of BB except entertainment. Bank counters & post office in still witness long customer queues in city like Delhi even though they have smart phones, recall call drops and QoS challenge where call drop is rampant phenomena despite stiff competition amongst 8-11 operators per LA and matured markets-**a paradox-a contradiction**. Success of voice mobile is no guarantee for success of data. Voice Ecosystem is far simpler. There is no worthwhile example in India or globally of a pan India telecom infrastructure of this kind with open ended outcomes in BB data services that too on a highly challenging rural turf. Five years past May 2010 winners of 3G/BWA spectrum auction have not at all met rural roll out obligations to be completed by 2015 even today. **In such uncertain environment**s telecom operators have moved in a calibrated manner as it constitutes a risk. Their investment appetite has been more centred around acquisition of auctioned spectrum to secure themselves for future.

BOOT model will not address the problems as it is not suited for this project in kind of vastly uncertain environment described above even if funding itself comes from government or partially with VGF.

Besides quality of construction quality the real issue is that quality broadband to every citizen that will empower them. No studies or thoughts have been brought out neither in report nor in CP on addressing issues related to quality of maintenance and operational sustenance arrangement of network that too on a challenging rural turf.
NOFN is positioned as B2 B relationship with BBNL serving the downstream TSPs/ISPs/CATV operators at GPs while BBNL being in middle itself depending on upstream core providers at districts to serve its downstream clients. This relationship Upstream -Middle mile - downstream forms a value chain. For this chain to function smoothly without bottlenecks anywhere. Bottlenecks any where in any segment of chain would constitute investment risk for remaining segments Now four years are over since project approval. Operational experience already gained so far in NOFN in 59 pilots GPs in existence for 3 years as well remaining 3250 GPs lit gradually needs to be shared & necessary lessons drawn & incorporated in implementation models. The details should include GP outages, time and capacity to handle restore faults present O&M arrangements model adopted, QoS parameters of Bandwidth achieved so far for different type of multimedia applications while in operation. Service levels achieved and can be committed innovations done after initial rural challenges faced. OPEX per GP achieved with arrangements so far. Details also need to be shared about technically suitable adequate space for housing assets and of
Sharing above details will clear uncertainties & doubts in minds of downstream investors allow them to do their due diligence to come forward with confidence to complete value chain. All this is essential Without sustainable chain BB proliferation cannot occur in rural turf and will not trigger or crack the complex Ecosystem.
The **main challenge** is availability of **sustainable operational & financial arrangement and** framework for delivering BB to masses. Rest all is assumption. To what extent operational experience acquired so far has been able to test & resolve assumptions made in original project design is subject of way forward and is central to project success.
All above is important question for separate consultation.

Q.4 What are the advantages and challenges associated with the BOOT model?

In view of above following advantages traditionally associated with BOOT are no applicable to this environment with vast uncertainties such as

- The majority of construction and long-term operating risk can be transferred onto the BOOT provider.
- Accountability for the asset design, construction and service delivery is very high given that if the performance targets are not met, the operator stands to lose a portion of capital expenditure, capital profit, operating expenditure and operating profit.
- BOOT operators are experienced with management and operation of infrastructure assets and bring these skills to the scheme.
- Corporate structuring issues and costs are minimal within a BOOT model, as project funding, ownership and operation are the responsibility of the BOOT operator. These costs will however be built into the BOOT project pricing.

On the contrary following disadvantages associated with BOOT are prominently applicable to BharatNet viz.

- BOOT is likely to result in a higher cost of BB for the end user. This is a result of the BOOT provider incurring the risks associated with partial financing in form of VGF in this model acceptance of the on-going maintenance liabilities vis a vis other 3 models where 100 % funding is envisaged.
- BOOT has no real track record in India and is still a relatively new concept internationally.
- Local Community may not be enthused by project unless they are involved from early stage thus may not generate adequate demand.
- Management and monitoring of the service level agreement (operating contract) with the BOOT operators can be time consuming and resource hungry. Procedures need to be in place to allow users to asses service performance and penalise the BOOT operator where necessary. This is particularly the case with maintenance requirements. No one wants to take over an asset at the end of the operating period that has no useful life remaining and high deferred maintenance requirements.
- A rigorous selection process is required when selecting a BOOT partner.

Q.5 What should be the eligibility criteria for the executing agency so that conflict of interest can be avoided?

No comments in view of answers to Q 3 and 4.

Q.6 Should there be a cap on number of States/ licensed service area to be bid by the executing agency?

Cap on number of states should always be there irrespective of implementation model and timeframes of 2017 for gigantic task. it also behoves well in view of traditional wisdom not to put all eggs in one basket to avoid single point of failure.

Q.7 What measures are required to be taken to avoid monopolistic behaviour of executing agency?

No comments in view of answers to Q 3 and 4.

Q.8 What terms and conditions should be imposed on the executing agency so that it provides bandwidth/fibre in fair, transparent and non-discriminatory manner?

Irrespective of model of implementation it should allocate bandwidth or DF access non discriminatory manner both at all levels viz. District, Blocks and GPs. Time to deliver as per SLA or B2B charter which means day to day QoS, advance timely investments for up gradation on reaching 70% capacity exhaust situation

Q.9 What flexibility should be given to the agency in terms of selection of route of laying optical fibre, construction, topology and deployment of technology?

Flexibility is required for implementing agency irrespective of model. It should stem from risk distribution involved in the project.

Q.10 What should be the methodology of funding the project? In case of VGF, what should be the method to determine the maximum value of VGF for each State/ service area and what should be the terms and conditions for making payments?

No comments in view of answers to Q 3 and 4.

Q.11 What kind of fiscal incentive and disincentive be imposed on the agency for completing the project in time/early and delaying the project?
No comments in view of answers to Q 3 and 4.

Q.12 What should be the tenure/period after which the ownership of the project should be transferred to the Government?

In telecom networks technological obsolescence occurs rapidly leading many times non availability of spares for maintenance support. Some times may occur as early as 7-10 years. This period may not suffice for BOOT operator to recover return on investment as Ecosystem & BB adoption and demand build-up takes time that too in rural markets. So transfer of depreciated asset has little relevance. Another unintended consequence of transfer back is once agency knows that network is to be transferred it slows down preventive maintenance efforts, does not replace redundant network elements once goes faulty compromises wherever possible allows network to degrade & compromises performance will also not provide for depreciation fund. Similarly dark fibres also may suffer. There cannot be any practical way to define condition of a depreciated network at time of handover for transfer back.
In view of above Transfer makes model more complicated and raises more question than it seeks to answer. Who will be takers of depreciated assets at end of period? Of what utility it will be to new taker or the Govt itself? What methodology will be adopted transfer to new taker if any? Takeover by new agency would require advance preparations for getting familiar maintenance service continuity & take

over? What happens to fate services under transition? How a depreciated arrangement would be benchmarked for bids? A full fledged department would be necessary in Govt along with consultants who would be required to manage this transition & benchmarking & develop this exercise in futility. Therefore BOOT in instant case is only academic in nature.

Q 13 Do you think that some measures are to be put in place in case the executing agency earns windfall profits? How should windfall profits be defined?

Each state or LA would have viable & unviable areas so possibility of windfall profits are remote in challenging rural turf where BB markets are yet to be seeded with complex Ecosystem dependencies. In such an environment of lot of uncertainty defining the outcome of windfall gain has little relevance and remote. Conversely agency takes a risk and may suffer huge losses. Measures will have to be in place for risk mitigation compensations in such reverse scenario. Such extreme stances would only deter investments. BOOT which is a form Public private partnership can work out profit sharing as well as loss sharing in spirit of partnership.
Even in power sector with lot of unmet demand in country with certainities we have huge generation capacity manufactured lying idle see news **"Electricity generators sit on hundreds of gigawatts waiting for buyers" june 30,2015**
http://www.mydigitalfc.com/2015/power-games

Q.14 Whether there is a need to mandate the number of fibres to be offered as a dark fibre to other operators to ensure more than one operator is available for providing bandwidth at GP level?

Mandating of number of fibres is required in scarcity scenario such as 24 OFC between GP and block as prescribed in committee report. "No one size fits all" principle be applied to dimensioning of cable size in different areas as need based infrastructure however 24F size being minimum in Block GP domain. Needs may include existing population its growth potential and its strategic location on the route where other future OFC routes are likely to transit though this location and may utilise the fibres of such infrastructure etc Such places may have cable size higher than 24F as cost of additional cable fibre is insignificant compare to laying costs.

Q.15 What measures are required so that broadband services remain affordable to the public at large?

1. <u>There exists Connectivity Conundrum which must be resolved irrespective of implementation models</u>:-Dependencies involved in formation of Value chain along with middle mile BharatNet
2. The basic elements of End to End connectivity in the broadband ecosystem comprises of four segments: (a) international connectivity, (b) domestic backbones, (c) metropolitan connectivity (aka **Middle mile**), and (d) local connectivity **All the four segments must be simultaneously present** neatly stitched together in tandem to deliver meaningful connectivity for BB services to end customer. In other words these four segments should form a value chain in tandem finally to deliver value to end user. Forming a complete well stitched end to end connectivity which includes all four

segments essential for launch of services is essential as start up connectivity configuration.

3. It means we must ensure a start up arrangement of minimum of following network pieces:
   a) Minimum one access network (Horizontal connectivity at GP) and
   b) Minimum one core network(Vertical connectivity at Block/District)
   is immediately available as soon as middle mile BharatNet is rolled out in a linked manner. This linkage could be achieved by way of well administered advance commercial agreements of middle mile provider BBNL with licensed vertical and horizontal providers who rollout these properly dimensioned pieces of in synch with BharatNet. This measure will ensure timeliness of availability If investors are not coming forward in advance for partnering connectivity then simultaneous VGF for access networks will be essential in interest of utilisation of middle mile which otherwise would languish otherwise consuming only OPEX without outcome and may add to costs runs risk of becoming unsustainable. If time lags between these pieces of connectivity cost of provisioning as value chain will be higher broadband proliferation will be in fits & starts Ecosystem will evolve slowly.
4. Timely grant of free RoWs for all related network pieces for E2E connectivity serving NOFN from district to GP and further villages.
5. Ensure policy linkages of various programs of GoI viz. Make in India, digital literacy, skill development, readiness of e- Gov services centred around BharatNet utilisation. Meaningful utilisation will lead to sustenance.
6. Security and legal frameworks of ICTs under IT act and awareness programs
7. Easing Tax related measures for cheaper devices
8. Opening up more internet CSCs/kiosks for public access of internet like PCOs in rural. Urban areas also went through this experience for BB proliferation. One may go a step further by opening Villageplexes a shared place where multiple facilities for multiple needs of villagers are met e.g. internet dhabas, digital knowledge centre, post office and other utility centres for services and related complaints all co-located to address accessibility, affordability. This will have multiplier effect lead to faster BB adoption in villages.
9. Involve local communities and village level entrepreneurs VLEs.
10. Apart from affordable 4- segmented connectivity timely availability of affordable **user devices** in Government institutions & those required by retail end users at bottom of pyramid is very essential. **Affordability**, supply of user devices and respective **financing mechanisms** for each have to **be addressed in advance** and have to be in place in synch. It is expected that state governments along with DietY are all ready working on relevant make in India program for **manufacturing** as well as development of government **applications and content** for use in rural areas.
11. Last but not least **individual user** devices cannot be forgotten apart from **institutional users**. Also their **powering & charging** arrangements have to be in place in rural pockets owing to gaps in electricity availability. In other

words **Access-Backhaul-Content-D**evices the **4- pillars** are in place and in alignment to support BB ecosystem benefiting citizens.
All measures are simultaneously necessary not either or approach i.e. fragmented approach will make BB costly.

Q.16 What safeguards are to be incorporated in the agreement entered between Government and executing agencies if RoW is not being granted to the executing agency in time?

Free RoW should be granted to all stakeholders involved in implementation of pieces of connectivity that get stitched with BharatNet middle mile vertically or horizontally and its utilisation such as access operators and core operators in same spirit as tripartite agreements. Risk of such delays in grant of RoW should be absorbed by GoI or state governments and implementing agency who should be insulated from this risk. States and other RoW authorities should now upgrade and gear themselves & grant RoW quickly online to operators and declare G2B charter of SLAs for time bound grant of RoW permissions. They should allow reasonable time to restore after digging and laying work is over.

Q.17 The success of BOOT Model depends on participation of private entities which will encourage competition. What measures should be adopted to ensure large scale participation by them?

BOOT is not suitable for implementation model in BharatNet/NOFN.
Irrespective of models various measures have been already described in answer to other questions of CP.
For large scale participation various uncertainties caused by unaddressed foundational issues described above & more particularly prerequisites describe in answered to Q 18 must be addressed to enthuse investors participation.

Q.18 Please give your comments on any other related matter not covered above.

For success of Data domain BB connectivity is only a starting point. To make good start *several foundational issues as prerequisites and central to the project to be met/ must be addressed first as resulting uncertainties would deter investments in upstream downstream networks in absence of which project will experience unintended outcomes. As BharatNet provider has a roll out lead time so have upstream & downstream providers. Any mismatch in any of 4- segments will not only act as bottleneck in seeding new data markets in rural but impinge on subsequent growth. This also gives clue as to why there are no takers at already lit GPs with 100 Mbps ready for use.*

Without ensuring following pre-requisites NOFN/BharatNet infrastructure pipes would remain idle and without any outcomes and only consume CAPEX and OPEX devoid of any revenue and therefore become unsustainable as no one can fund BharatNet in perpetuity. Due diligence is essential & learnings so far be incorporated. These prerequisites are irrespective of implementation models in NOFN/BharatNet. Non resolution of these issues result in barriers in use of BharatNet.

Connectivity Conundrum:-Dependencies involved-formation of Value chain

The basic elements of connectivity in the broadband ecosystem comprises of four segments: (a) international connectivity, (b) domestic backbones, (c) metropolitan connectivity (aka **Middle mile**), and (d) local connectivity

All the four segments (a+b+c+d) must be simultaneously present neatly stitched together in tandem to deliver meaningful connectivity for BB services to end customer. In other words these four segments should form a value chain in tandem finally to deliver end value to end user. Besides investments involved & market structure each segment have their respective ecosystem issues which affect their sustainability.

Apurnta se Purnta ki Aur (connectivity conundrum):

NOFN/BharatNet is positioned as middle mile **c** segment (Standalone it is incomplete by itself- **Apurna**). To get completeness (**Purnta**) of desired E2E connectivity other three parts **a, b**(upstream)-Vertical connectivity as well as **d segment**(downstream)-Horizontal connectivity are also simultaneously needed in tandem and also need proper stitching of all segments and respective investments to be in place so that potential value of middle mile BharatNet can be unleashed. There are lot of dependencies which are crucial to success of Project since BharatNet needs Horizontal & vertical connectivity to form E2E connectivity.
To form a value chain and therefore all 4-segments need not only stitching and continuous actions during life time of BharatNet. In absence of arrangements utilisation of BharatNet will be a challenge.
The growth in broadband subscriptions is accompanied by continuous growth in upstream national backbone capacities and international Internet bandwidth. Indeed, without further deploymentof backbone infrastructure, service providers are unable to expand their markets to previously underserved regions. Thus any mismatch in any of four connectivity segments acts as barrier to proliferation of BB in rural markets Thus critical to success.
However incompleteness of scheme assumes that upstream and downstream investments related issues will start happening by itself once middle mile gets rolled out-both an **assumption & a riddle**. **Experience has shown that assumption not workable**.

NOFN Experience so far:

To begin with Pilots based on concept of laying incremental OF cable & leveraging existing cables of BSNL in 59 GPs in 3 Blocks of Arain, Parvada & Panisagar spread over 3 different states were completed in Oct 2013. This created 100Mbps bandwidth at each GP.

Government usage in pilots:

To put this network to government usage the vertical and horizontal connectivity needed along with NOFN (not its part) funded by Deity at cost of Rs 23.7 crore. This also included provisioning of computers, UPS etc and handholding of states by Deity for connecting around mix of 150 institutions comprising of schools PHCs & GP offices etc spread over 3 states. BSNL formed End to end connectivity was with

NOFN middle mile by providing both vertical & horizontal connectivity and internet services. Horizontal connectivity was provided to 150 institutions by installing point to multipoint microwave links called BBWT terminals of CDOT make in unlicensed band. This model was not found scalable.

Citizen usage in pilots:

In order to use 100 Mbps this bandwidth **Intel** in coordination with **DEF** started follow the fibre program at 59 GPs. Program entailed training one person per HH in these GPs in digital literacy and use of internet at single class room. Digital literacy forms part of NPIT-12 objectives.

For this CSR effort DEE/Intel had to run from pillar to post to arrange for both a ISP at Arain- **horizontal connectivity** and also vertical connectivity from Arain Block to internet cloud by to put NOFN to use in order to give it internet connection in class room to launch a digital literacy program. Eventually BSNL after lot of follow up and commercials was the provider of both vertical as well as horizontal connectivity. So much to stitch various parts of connectivity to get E2E connection. Such coordination intensive approach & efforts by user to stitch E2E connectivity does not form form a value chain with NOFN in middle. Obviously will not result in mass scale BB proliferation.

Learning & way forward: Problem can be addressed by having prearranged signing of advance commercial agreements with providers of various pieces of upstream & downstream connectivity as partners as a stitching mechanism. This is a must. NOFN has to play this active role for this. As a first step for start up purpose administrative arrangement with BSNL can be made for stitching and it can be compensated base on some commercial arrangement. Since it is Government initiated it can facilitate by right intervention amongst its own PSUs under same ministry.

Four years past so far only 3384 GPs lit with GPON equipment providing 100 Mbps ready for use spread over several states as of 31/10/15.
In practice there are hardly any takers for bandwidth at these GPs by TSPs/ISPs already lit for quite some time nor any visible enthusiastic activity to seize the huge opportunity created for them at these GPs.

In absence of any visible well publicised end to end tariff plans, product specification documents, maintenance philosophy/ operational policy and business models NOFN will remain unutilised and already lit GPs will get switched off due to batteries degradations of solar plants. Cable cuts naturally take several day to restore in rural turf. This does not build investors confidence to come and connect to such a middle mile.

Here question also arises **why are government's own PSUs** viz. BSNL, Railtel & Powergrid who already have NLD/ISP licenses & presence in rural, and are also implementing partners in NOFN not enthused to use 100 Mbps bandwidth at GPs connecting Block PoPs in BSNL exchanges to deliver services at bottom of pyramid despite well known advantages of ICTs in empowering have nots.

Obviously there clear challenges for all operators in rural turf in delivering BB services even in urban areas which already have matured markets with business case, affordability, literacy in place not to talk of rampant voice call drop phenomena despite stiff competition amongst 7 to 10 operators per LA serving the urban markets. Not out of context to say that voice Ecosystem is far simpler than data Ecosystem.

All this needs introspection to go into reasons & learnings acquired enthuse investments for utilisation of BharatNet in rural turf for mass proliferation of BB.

Based on above experience following are the challenges in design assumptions of project.

These prerequisites are irrespective of implementation models in NOFN/BharatNet. Non resolution of these issues result in barriers in use of BharatNet.

This is just to say that creation of meaningful E2E connectivity has its own challenges and measures.

Supply side prerequisites

1. **Formation of value chain of NOFN**- (Stitching middle mile with upstream & downstream connectivity to form E2E connectivity)-**Plug & play interconnection**

   NOFN as originally envisaged is a pan India wholesale infrastructure project to be funded by USOF for 5 years at cost of Rs. 20,000 crore. It seeks it address supply side through govt. initiative. The funding model entails funding of CAPEX & OPEX, net of revenue.

   NOFN as an infrastructure between GP and block alone by itself does not have any revenue earning potential. Standalone infrastructure derives value by interconnection.

   The interconnection arrangements to be provided by BBNL at GP and Block or District level have to be hassle-free and non discriminatory in nature. **In simple terms plug & play.** If these conditions & assumptions are fulfilled then and only then the bottom up traffic generated through potential access networks will flow in the NOFN pipes being created and derive revenues thereof. *That means NOFN must not only provide robust connectivity fit enough QoS for variety of applications with different characteristics & peak loads to enthuse investors of access networks there should be thoughtful interconnection arrangements to realise investment in potential access networks.* This pre-requisite is crucial to success of NOFN as infrastructure so that QoS can meet B2B customer requirements and who in turn create an

end to end effect for B2C customers, thereby triggering new markets at bottom of pyramid.

Without ensuring above pre-requisite NOFN infrastructure pipes would remain idle and without any outcomes and only consume CAPEX and OPEX devoid of any revenue and therefore become unsustainable as no one can fund BharatNet in perpetuity. This requires proper planning by BBNL/DOT and serious consultation with TSPs/ ISPs to firm up the arrangements. These **are investment risk for upstream downstream providers and acts as deterrent. Following Uncertainties constitute** Barriers to Interconnection & hence E2E connectivity & eventually utilisation of NOFN/BharatNet. If some access operator ventures to connect at GP and upstream issues remain unresolved they would suffer & risk their investment as no end customer will stick to them and hence no revenue.

Absence of Inter-connect Policy

BharatNet middle mile Infrastructure provider whether State SPV or BBNL has **B2B relationship** with upstream & downstream service providers to whom it sells its **Products** called **Bandwidth /Dark fibre**. It interconnects with them at District/Block/GPs. It could be active or passive interconnection. Interconnection should not only be **non discriminatory** but **hassle free** and **plug & play** for upstream/downstream investors manner.

Investors in upstream downstream will tread carefully on **Rural turf** with its own challenges & **Rural markets for BB yet to be seeded in diverse environment**. **4 years past they are awaiting clarity on the critical issue.**

For creation & success of well stitched value chain of BharatNet there has to be clear interconnection policy for selling its products viz. DF or BW with proper provisioning of terms and conditions viz.

i. Adequate Physical arrangements (Power, space and charges) at GPs/blocks/districts
ii. Types of interconnection (active/ passive)
iii. Technical parameters at interface
iv. QoS performance parameters of BW such as availability, jitter, delay etc for multimedia applications
v. Health parameters of Dark fibres and outage restoration commitment

vi. Middle mile BharatNet forms **"Carrier's Carrier"** situation in network parlance & creates a need for tandem connection monitoring of value chain. This constitutes important aspect of Policy & needs advance clarity this to enthuse investing operators.(For context here please see foot note from ITU tutorial at end)

vii. Time to deliver interconnection

viii. SLAs

ix. Tariff for various products & services BBNL offers Products being DF & BW and its variants e.g. Best effort/committed

x. Billing arrangements

xi. Fault control and restoration mechanism for BW and DF.

xii. Terms for timely up scaling/ up gradation during expansion

xiii. Phased data traffic projections from both parties

xiv. Dispute resolution mechanism

xv. Similarly BBNL's expectations from upstream/downstream also need to specified otherwise BBNL's revenue and sustainability is in question

xvi. Standardised template for B2B commercial agreement covering above T&Cs for stitching of value chain

Adequate provision for power, space access arrangements for interconnect carriers at BharatNet PoPs at all its PoPs viz. 250,000 GPs, 6500 Blocks & 628 District apart from BharatNet's own consumption and scalability for hassle free growth need clearly **defined standard lay out** for equipments for active/passive interconnects at these PoPs to be clearly **spelled out in advance** documents by BBNL ***so that TSPs/ ISPs can plan*** procure their networks accordingly & ***make informed investments decisions*** with certainty on already challenging Rural turf. ***Clarity is very important as bottlenecks or any barrier during initial interconnect or during subsequent expansion will jeopardise their investment & business*** in new rural markets. *In turn it will also put investment in middle mile to risk due to non- utilisation.*

The **B2B delivery processes** need to be standardized spelled out in advance to remove uncertainties in minds of investors as four years are all ready past. The policy should be developed in consultation with stakeholders.

Barriers to Interconnection -**Distances or lengths of stitching PoP to PoP links:**

PoPs of BharatNet & user TSPs PoP will be located at some distance. These need to be

Upstream/downstream stitching links will call for investments in planning, laying OFC end links between these PoPs to utilize NOFN. These will have due lead times for creation/testing & commissioning.

(a) Distances between NOFN PoPs & TSP PoPs at Block/District-Upstream stitching link

NOFN/BharatNet PoPs located in BSNL exchanges will be at distances may be ranging to few Kilometres from existing core network PoPs of private TSPs. **Upstream stitching links** will call for investments in planning, laying OFC end links between these PoPs to utilize NOFN. These will have due lead times for creation/testing & commissioning.

Solution lies in mapping, operator locations (PoPs) w.r.t. NOFN PoPs and advance coordinating prior to NOFN roll out by floating expression of interest in advance so that investors can plan their investments mange lead times creating stitching links.

(b) Distance between NOFN PoPs at GP and TSPs PoP planned in GP area-Downstream stitching link

Similarly NOFN PoPs located in GP buildings will be at distances may be ranging to few Kilometres from existing/planned access network PoPs of private TSPs. **Downstream stitching links** will call for investments in planning, laying OFC/wireless PoP to PoP links between these PoPs to utilize NOFN. These will have due lead times for creation/testing & commissioning.

As already stated to put middle mile to use long tandem chain comprises BharatNet middle mile +upstream network at District + upstream stitching link+ Downstream access network at each GP of that district +downstream stitching link

This is critical to success and sustainability of program. Unless appropriately focussed plug & play interconnect will not happen. More serious consequence is that unless planned, implemented & maintained correctly **investments** of **each piece of network is at risk**. Uncertainty in these areas acts as barrier to investments. Unless professionally addressed uncertainty & coordination problems may become barrier to investment and participation by TSPs/ISPs in already challenging rural environment coupled much more complex BB ecosystem.

Thus in short Framework Mechanism for utilisation of BharatNet/NOFN needs to be created for synchronisation of NOFN roll out with investments and roll out of 4- dependencies keeping in mind that *dependencies* too have lead time in terms planning survey, procurement, installation testing, commercial

arrangements, capacity building for forming meaningful timely plug and play hassle free interconnect. Dependencies for forming end to end connectivity include:

1. **Matching augmentation of upstream core networks to suit NOFN traffic**
2. **Creation of stitching links from districts Pops of NOFN & to district PoPs of Core provider to interconnect. (ranging from 2-4 km)**
3. **Creation of access networks at GPs in downstream direction**
4. **Creation of stitching links from GP Pops of NOFN & to GP PoPs/towers of Access provider to interconnect. (ranging from 2-4 km)**

Start up configuration/ arrangement for NOFN

To put BharatNet to use to begin with we have to ensure it be rolled in minimum one start up configuration i.e. following are segments are ready simultaneously along with it

(i)one upstream network

(ii)one access network

BSNL becomes a logical choice for start configuration as BharatNet PoP at block is co-located at BSNL exchange and extend it upstream using its core therefore obviates need for corresponding stitching link saves cost and time and speeds up Digital India. Advance agreements with BSNL need to be signed to provide start up to middle mile at the least. Same is required with other TSPs/ISPs.

Thus for middle mile to be truly useful there are clear dependencies on which are crucial to success of Project. This is just to say that creation of E2E connectivity has its own challenges.

Summary of Dependencies for E2E connectivity

Framework Mechanism needs to be created for synchronisation for NOFN roll out with investments and roll out of 4- dependencies keeping in mind that dependencies too have lead time in terms planning survey, procurement, installation testing, commercial arrangements, capacity building for forming meaningful timely plug and play hassle free interconnect. Dependencies for forming end to end connectivity include:

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Quantum & time involved in stitching links needed for mere NOFN start up configuration

Thus there are minimum 2.5 lakh downstream stitching links and 628 upstream stitching links needed to complete BharatNet connectivity.
For simplistic view for minimum start up of NOFN assume one tower of one access operator to be served by NOFN PoP located 1km away
minimum OFC required =2.5 lakh km
One tower would only serve very few customers and limited coverage. Actual practice will need much more for proper coverage
Assume upstream only one start up core network of only one NLD operator located 2 km away would need
minimum OFC of 628 districtsx2 km = 1256 km (ignoring Block interconnects)
Besides investment business case justification by private operators would need a clarity frame work for policy on NOFN interconnect, free ROW, more band in licensed & unlicensed spectrum etc to be in place before they are enthused & plunge into the game. In addition government needs to share outcomes & progress on various programs such as digital literacy, domestic manufacturing for affordability as per triad of ICT policies and other policies.
Signing of advanced stitching agreements value chain segment providers each segment gets rolled out in synch-Signing Bandwidth purchase agreements;
As a way forward we may follow Malaysian example as illustrated on page 36, Annexure I of CP itself reproduced here "Four major operators had signed up for HSBB access services where HSBB is repackaged and sold to their own customers, and 19 had signed up for HSBB transmission services used to enhance their own backhaul network." HSBB in Malaysia is equivalent of our BBNL. Apart from Malaysia we can draw lessons from power sector.
This practice is also resorted to globally in power sector where it is well known that power generating companies both private & PSU like NTPC who invest in power plants sign advance long term power purchase agreements (called PPAs) with state SEBs/ power distributing companies in the last mile for specified amount of power. It is worthwhile to note here that Investors in power generation do not make open ended investments and risk it with assumption unlike NOFN that distribution companies will automatically come and purchase their power once power plant is ready. It may be noted that this is despite power Ecosystem is far simpler vis a vis Broadband that to in challenging rural turf. In power sector lot of **readymade pending demand** and we are power hungry nation.
In the case of BharatNet there are both upstream and downstream issues for connectivity alone further compounded by BB Ecosystem like user devices, local content, literacy & affordability etc. Private investment for BharatNet utilisation will not be easy unless their concerns raised above are addressed. After their concerns are addressed long term Bandwidth and Dark fibre purchase agreements can be signed with downstream and upstream providers so as to form a value chain.
Now we come to demand generation side of BB.

Demand side:

Sustainability aspects arising from demand side issues and NOFN utilization are:

Nature of Rural Market creation / seeding for BB:

a) Generation & Aggregation of demand a must vis-a-vis Demand fragmentation:

In case BBNL enters into access services even for govt. user institutions, this will create a conflict of interest and vitiate non-discriminatory nature of SPV. In addition this will also lead to (i) Fragmentation of total potential demand at bottom of pyramid (Govt. user demand plus demands to serve B2C and users in e-commerce etc.) and further weakens the business case of TSPs in nascent BB market being attempted to be seeded in already challenging rural turf. (ii) Cause duplication of resources in access provider space with hardly any market pie of village customers. This will deter TSPs/ ISPs from making fresh investment and create entry barriers. Govt. user services should be rendered by existing BSNL as a TSP which already has a requisite experience and network resources and wherewithal and licenses to carry out work. The case of BBNL stepping up into this arena only arises when telecom operators refuse to provide the services. For provision of government user service first right of refusal should vest with already licensed PSU TSPs like BSNL, Railtel, PGCIL & other private TELCOs before BBNL or state SPVs step themselves into this arena as a last resort. If this be so that no taker comes forward then there is serious need to relook at assumptions made in BharatNet justification. Further, BBNL which has a NDL license will also have to acquire a license for access network in case it wants to serve govt. user alone. Similarly all 16 or 17 states too would also need to acquire licenses for NLD licenses as well as Access service license to serve Govt users. *This duplicates licensing costs makes affordable BB in unheeded rural markets a distant dream.* One thing also must be observed here that cost of providing services by existing TSPs/ ISPs will be marginal as they already have the license and necessary resources such as billing lawful interception, NOCs personnel, experience and compared to this cost of providing access services by any new entrants like BBNL or state SPVs which acquires resources de novo will be much higher as it will have to incur license cost, acquire material and resource even though out sourcing is resorted to. This

will be counterproductive & impinge upon affordability of broadband service to be delivered to rural masses as per NTP-12 objectives which seeks to provide affordable broadband to rural citizens. Instead of funding new entrants with no wherewithal we can leverage on existing strengths of operators in partnership with local communities.

Development of local communities to facilitate/enable participation to back BharatNet programme;

Action for development and facilitating work to enable participation of local communities should start in parallel now itself. This would include (i)Preparatory works like Awareness programmes giving priority to such GPs already equipped with digital literacy programmes(ii)Easy Financing schemes for user devices (iii) creation device charging facilities in areas with poor electricity supply(iii) Initiate dialog to understand their priority needs for BB services which will truly enhance their bread earning capabilities and capacity that lead to empower them. Outcomes of such grass root ground work programmes be widely publicised to create a mass movement of small and big investors, startups so that potential new bottom of pyramid markets open up economy develops otherwise much hackneyed statement that for every 10% rise in BB penetration GDP rises by 1.4% remains in theory unless backed by crash preparatory work in challenging rural markets in diverse Indian environment.

Investment in Access Networks:

Apprehensions in the minds of the access operators about viability of the rural market in and around GP and business case will need to be cleared through dialogue and through structured consultation with them. USOF had initiated a wireless broadband scheme and draft tenders were placed in public domain in 2011-12. However, due to rural roll out obligations of 3G and BWA spectrum auction held in May 2010, the scheme was kept on hold in view of roll out obligations are to be completed by the auction winning mobile access operators by around 2015 end. DOT may review this roll out progress as enshrined in the spectrum auction conditions and also can try to synchronize their roll out plan with NOFN roll out plan so that NOFN backhaul can be put to use by them. The NOFN backhaul can help them to fulfil their roll out obligations. This will be win-win situation for operators as well as for NOFN infrastructure. Based on this review, assumption in NOFN design that infrastructure will enthuse telecom operators to make

investment in bottom of pyramid will also get tested. Then a call can be taken by DOT/ USOF to fund BB access schemes areas which market find it unviable.

Sustainabilty of value chain versus funding in perpetuity & Business models of the Value chain:

As observed earlier USOF funding is for 5 years. Apart from business models of BBNL business models of stakeholders in the interconnected value chain of NOFN also needs to be considered. Otherwise apart from investments in NOFN investment by other partners are at risk as well making entire value chain unsustainable jeopardizing Digital India programme.

Foot note:

Tandem Connection Monitoring

SONET/SDH monitoring is divided into Section, Line and Path monitoring. A problem arises when you have **"Carrier's Carrier" situation** as shown in Figure 8, where it is required to monitor a segment of the path that passes another carrier network.

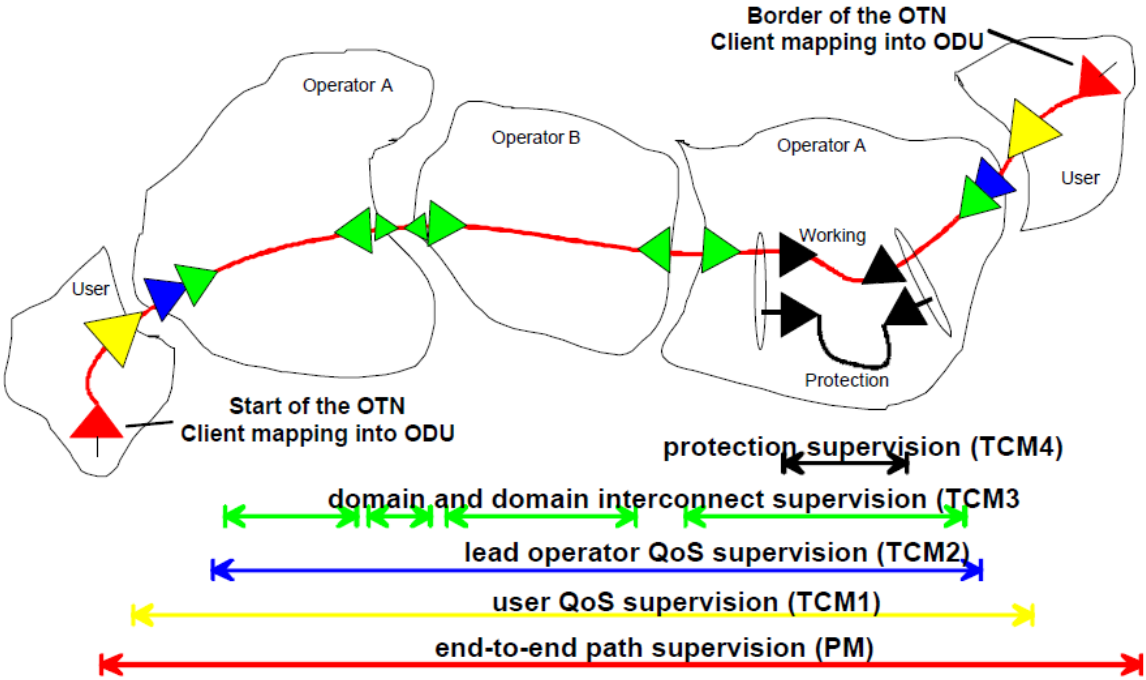

Figure 8 Tandem Connection Monitoring

Here Operator A needs to have Operator B carry his signal. However he also needs a way of

monitoring the signal as it passes through Operator B's network. This is what a "Tandem connection" is. It is a layer between Line Monitoring and Path Monitoring. SONET/SDH was modified to allow a single Tandem connection. G.709 allows six. TCM1 is used by the User to monitor the Quality of Service (QoS) that they see. TCM2 is used by the first operator to monitor their end-to-end QoS. TCM3 is used by the various domains for Intra domain monitoring. Then TCM4 is used for protection monitoring by Operator B. There is no standard on which TCM is used by whom. The operators have to have an agreement, so that they don't conflict.
Source: ITU Optical Transport Network (OTN) Tutorial.

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