Setting Up a Low Cost Sustainable Telecommunication Infrastructure for Rural Communications in Developing Countries

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Abstract

This paper provides information on Government of India initiative to provide Broadband services to Rural India. In the absence of reliable grid supply in rural areas, deployment of alternate power system plays major role to power the Broadband systems deployed in rural areas. Service expansion requires fast site setup and low power consumption. This is being challenged by site acquisition and construction issues because of inconvenient access to many rural areas and energy supply that is often unstable or cannot keep up with demand. This contribution paper provides methodology based on the experience of the actual on-site techniques adopted in Broadband Network resulting in huge savings on operating expenses due to fuel consumption of diesel gen-sets and to optimize & harvest maximum renewable energy from available renewable sources in the rural areas having either no grid or poor grid.

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The power of broadband and ICTs to transform the lives of individuals economic & social wellbeing of nations is well recognized world over and so is the power of Optical Fibre as an underlying infrastructure for Broadband. As a result Broadband is critical and dear to hearts of nations. Transformation through Broadband however requires pre-requisites of various factors of its eco-system to be in place for its take off. The complexity of eco system in Indian scenario amongst other factors is characterized by vast linguistic, cultural, terrain, diversity, affordability and digital literacy. This would mean multipronged parallel efforts on many fronts on parts of government, industry and all stake holders to contribute towards development of ecosystem before the true benefits of Broadband can reach masses there by changing fortune of nation. Already some work has been done by various stakeholders in various areas which have a good bearing on off take of Broadband. The experience needs to be leveraged.

The important property that can make Information and Communication Technology (ICT) interesting for human is human welfare and development. ICT bestows upon humanity the ability to defy distance and time. Human development is quantified in the annual World Human Development Report of the United Nations as progress in health and education. A healthy nation means more productive labour and an educated nation means more creative labour. ICT has many facets. The most visible part is the bandwidth used for communication. Modern technology delivers gigabits through a fibre optic medium and several megabits through the wireless medium. A combination of the two technologies along with specialised devices often called routers and switches (equivalent to post offices and beat constables) can enable flow of gigabits of information from one village to another. The villagers can have access to high quality medical help, quality education, and relevant information pertaining to crops, fertilizers, entertainment, and access to the Internet as is enjoyed by their urban counterparts.

Around 70% of telecom towers are in rural areas, where grid connected electricity is not available and as a result, a very large chunk of the towers are powered by diesel generators which produce a total of 5.3 mnliters of CO2 every year. Due to this high dependence on diesel, the operational costs of these cell sites increase drastically to about 200% more than those where grid power availability is regular. So operators are left with no other option than to look for alternate power supply solutions like wind power, solar power, hybrid, or bio-diesel solutions. With decreasing ARPU and increased opex, operators need a future-oriented wireless network solution to handle the challenges and boost profits. Instead of looking for green solutions for their energy

requirements for the 0.35 mn plus towers, they looked for power efficient processes and more energy saving equipments for their entire network, and not just at tower sites. The major challenge today is also the high capex for the hybrid solutions, even though the ROIs are better. The telcos are looking out for the financial model, which is based upon opex.

1 Background

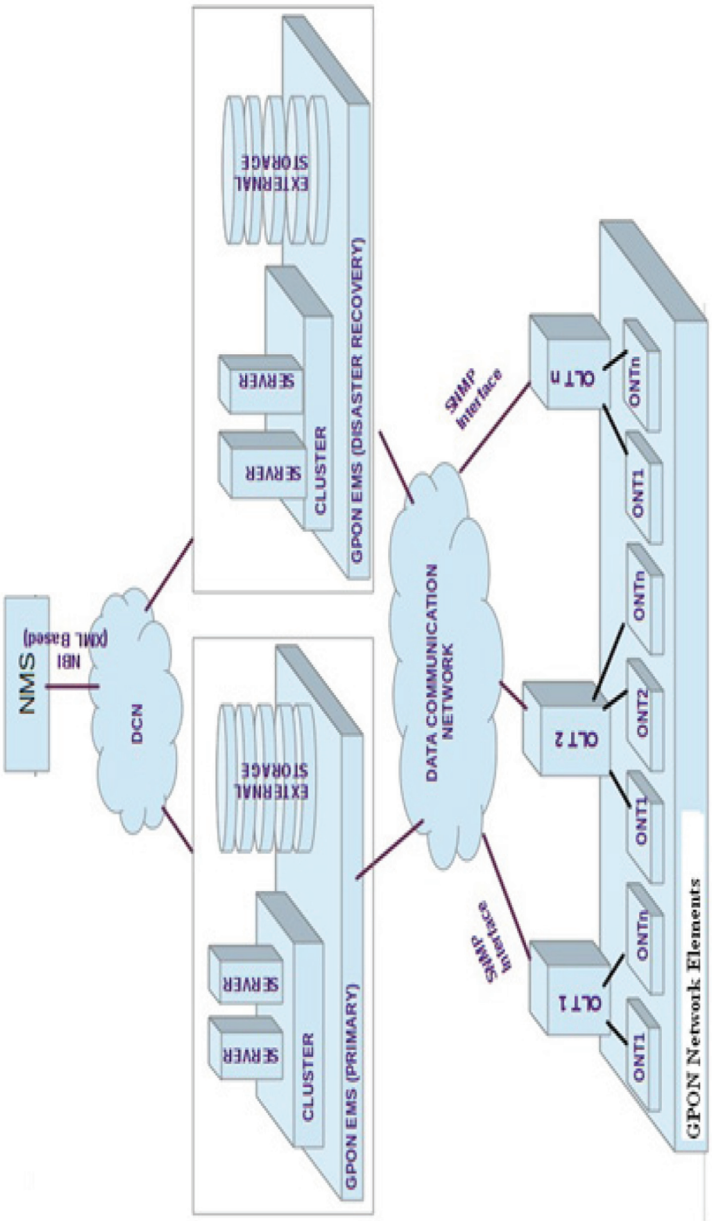
The purpose of this contribution is to develop recommendations that identify the general necessities on the requirements of rural area telecommunication infrastructure in developing countries. These recommendations may be helpful for equipment manufacturers to develop products or architect solutions, which are more appropriate for rural areas which are sparsely populated and under-served areas; and would help network operators/service providers in procurement process with business case to set up a low cost sustainable telecommunication infrastructure for rural communications in developing countries.

The power of broadband and ICTs to transform the lives of individuals economic & social wellbeing of nations is well recognized world over and so is the power of optical fibre as an underlying infrastructure for Broadband. The complexity of ecosystem in Indian scenario amongst other factors is characterised by vast linguistic, cultural, terrain, diversity, affordability and digital literacy.

2 Discussion

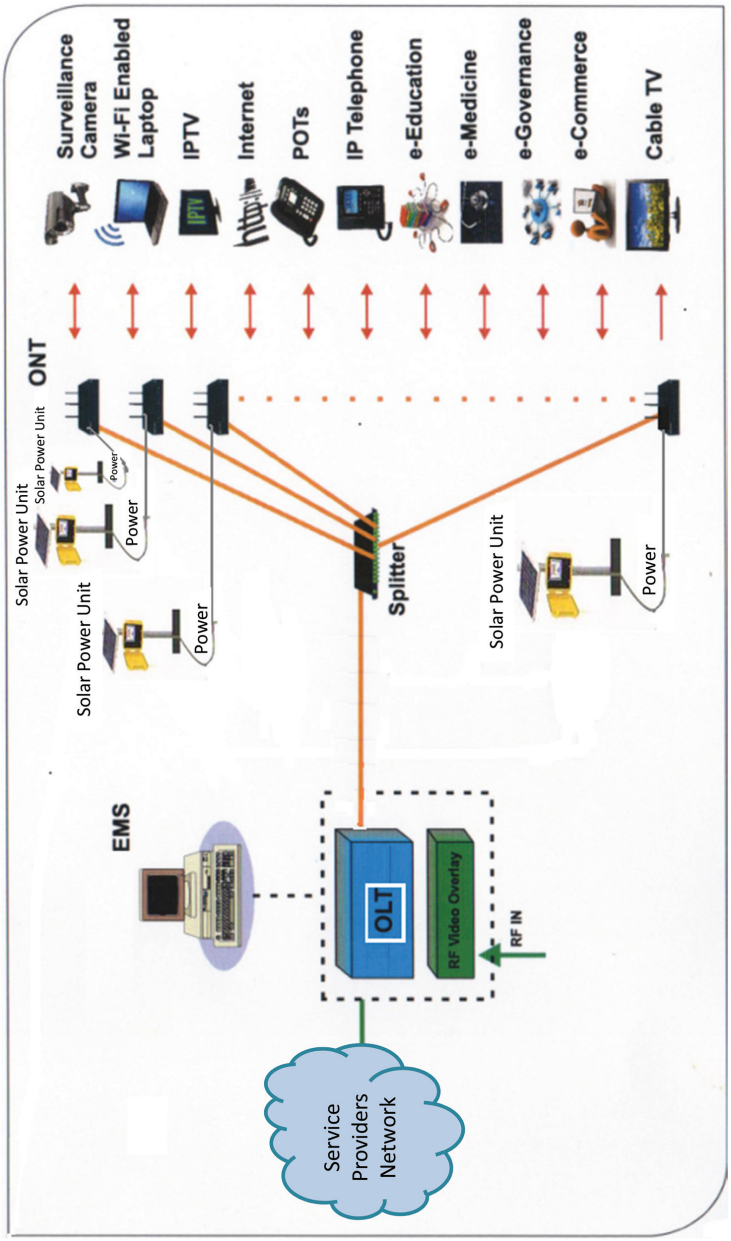
Fibre technology has something very interesting for economists. The concept of marginal cost deals with increased production with incremental investment, once the basic system is in place. In fibre technology, a mere two per cent incremental investment creates more than 100 per cent production capacity. This is mainly because when the fibre is laid, it has 6/12/24/48 cores inside and only one pair is put to use. The rest can be utilized as and when necessary to increase bandwidth or carrying capacity. That is the incremental cost. India has fantastic facilities to produce fibre optic cables in bundles up to 96 cores and beyond. *Fibre optic cable holds the key to a rural revolution. It is creating a multi-purpose infrastructure for the villages of India.*

India with its vast population of 1.21 billion (0.833 billion i.e. 69% rural population) and area of 3,287,240 sq. kms. with 29 diverse states and 6 union territories is administratively divided into districts (640), blocks



(a)

Figure 1 **(a)** GPON in the network to provide triple play services to the end customers.



(b)

Figure 1 **(b)** The interconnection of various elements of GPON in the network.

(6382) and villages (6,38,619). There are 250,000 Gram Panchayats (Village councils) as part of administrative set up to govern these 6,38,619 villages i.e. on an average 2–3 villages per Gram Panchayat (hitherto referred as GP in the article). Even in urban India, Broadband is to realize its full potential, rural India is still far away. Factors which create urban-rural divide are (i) Difficult terrain & Scattered Population (ii) Lack of Infrastructure (Roads, Power etc.) (iii) Low income (iv) Higher capex and opexin rural areas.

The Communication technologies deployable in the rural areas need to meet the following requirements:

- Provide broadband connectivity at 100 Mbps or higher for community services.
- Be reliable and rugged.
- Require low power and be operational on alternative sources of energy such as renewable energy sources e.g. solar, wind and fuel cells.
- Have an attractive price/performance ratio for low cost transmission lines with sufficient bandwidth.
- Conform to international standards for service interoperability.
- Easy support for wireless and wired networks.
- Require easily available, low cost and end user friendly equipment.
- Preferably be maintenance free or utmost require low skill maintenance.
- Be easily and locally repairable.
- Do not demand mandatory operating environments like air-conditioning.

3 GPON as an Access Technology

Gigabit Passive Optical Network (GPON) technology can offer an excellent mix of triple play services to end users. It provides the backhaul as well as Access for provisioning of broadband services in rural areas. The indigenous GPON equipment developed by government body namely Centre for Development of Telematics (C-DOT) offers advantage in terms of appropriateness for Indian Environment, innovation, easy & fast deployment and local manufacturing. Current technology delivers a downstream data rate of 2.5 Gbps and an upstream data rate of 1.25 Gbps on a single fibre over a distance of 20 Km. One optical fibre from OLT can be shared up to 128 users. Signals from OLT to the ONTs are encrypted and then broadcasted to work station devices. Signals from the work station devices are then multiplexed back to the OLT.

4 National Optical Fibre Network (NOFN)

The NOFN project will build a strong middle-mile, but to build sustainable economic models around relevant e-services for the rural masses, there is a need to deliberate on the core and the last mile. The salient features of NOFN are:

- NOFN is being built using dark fibres leased from government owned three Public service units (or any other desirous Telecom operator) and laying incremental fibre.
- To offer interconnection at Block level and Gram Panchayat (GP) level.
- To offer guaranteed Bandwidth of 100 Mbps at Gram Panchayat.
- Uses technologies that are scalable, maintainable, observable & controllable meeting ground realities of diverse rural environment.
- NOFN to be operated and controlled by NMS centrally.

5 Use of Alternate Source of Powering

This technology has one of the lowest power requirements per customer. The customer premise equipments (ONTs in case of GPON) are low power devices which use between 8 to 15 watts of power. Since the electric power availability in rural areas is dismal, alternate use of powering the devices is required. These CPEs can be powered with solar energy by having solar panels installed near the end devices. In fact, the Wi-Fi terminals installed

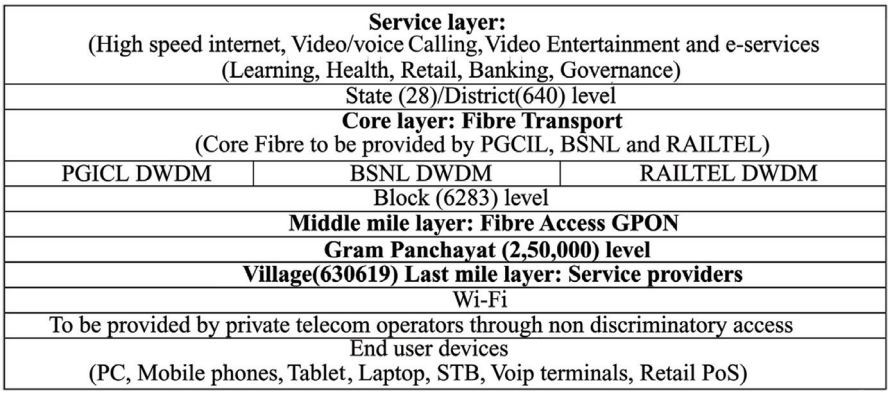


Figure 2 (a) NOFN infrastructure.

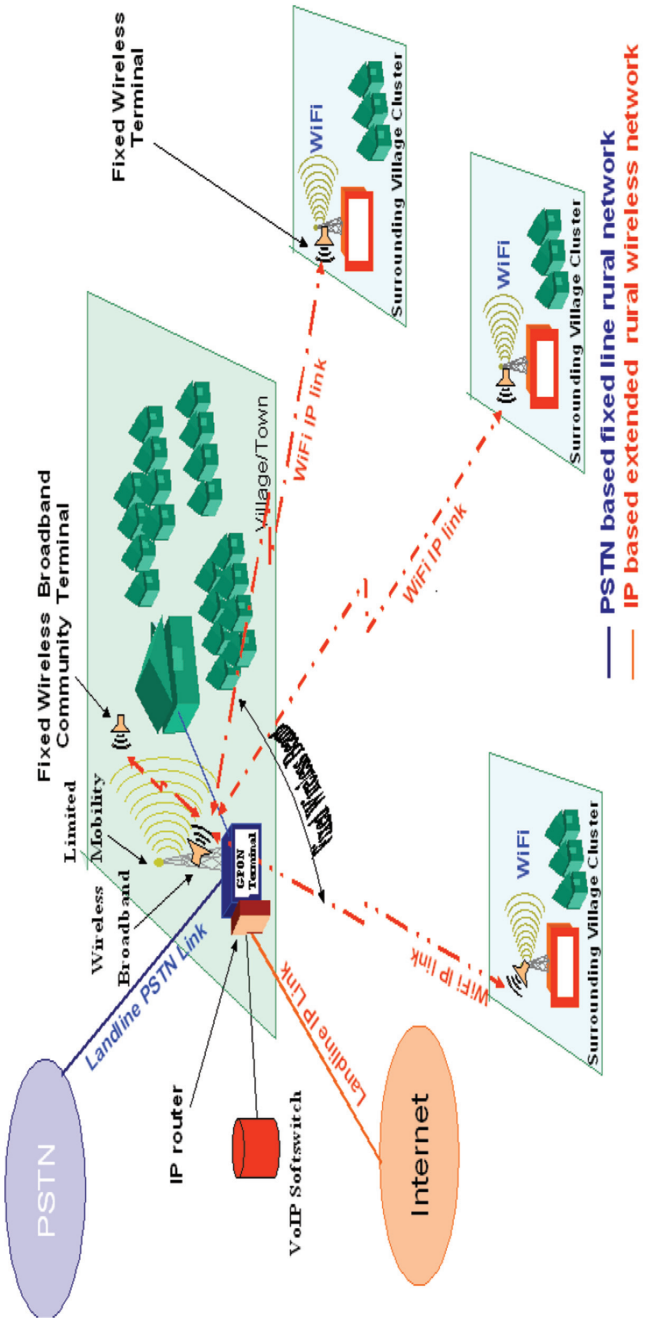


Figure 2 (b) NOFN rural applications.

for last mile connectivity can also be powered through solar solution. This is essential to keep the network up and working with uninterrupted services to the customers.

6 Lightning and Surge Protection for Photovoltaic (PV) Systems

PV systems being located and installed in exposed positions are subject to all conditions of weather. The measures to protect the sensitive electronic system components from failure due to lightning flashes and surges are absolutely necessary. Surges in PV systems may be caused by inductively or capacitively coupled voltages due to lightning discharges and switching operations in the upstream alternating current system. *The surge protective device combines a type1 lightning current arrester with a type2 surge arrester. It incorporates the proven Y circuit with the short circuit interruption (SCI) technology.*

On the DC side, a PV surge protective device is to be installed in each generator junction box/string combiner box. Surge protection devices shall have three-step d.c. switching element. This consists of a combined disconnecting and short-circuiting device with Thermo Dynamic Control and an additional melting fuse. The integrated parallel fuse disconnects the arresters safely from generator voltage in case of overload and allows for a safe and dead (arcless) replacement of the respective protection modules. The formation of a d.c. switching arc is prevented. The synergy of technologies applied in the Surge protection reduces the risk of protective devices being damaged due to installation or isolation faults in the PV circuit, clearly reduces the risk of fire at an overloaded arrester and puts it into a safe electrical state without interfering the operation of the PV system.

7 Core Network Considerations

NOFN would enable access and usage of several e-services such as healthcare, education, financial services, agriculture, e-governance, entertainment, etc,. The planned provisioning of 100 Mbps bandwidth through NOFN at the Gram Panchayat level translates into demand of 60 Gbps (average demand assuming 10 percent concurrency) per State Head Quarter. Further, as per various estimates, data growth is expected to increase around five times over a five year period. Current core capacities of service providers may not be adequate to cater to this demand. A parallel upgrade of core capacities may therefore, requires to be considered along with NOFN rollout.

8 Last Mile Considerations

While NOFN is a commendable step in bridging the urban-rural divide in broadband penetration, last mile access would be critical for realizing the policy objectives of inclusion and universal access. As we explore viable economic models for rural e-services, the critical need for the last mile becomes apparent. Middle-mile fiber layout enables affordable delivery of critical services at the Panchayat level through community-based service provisioning. However, efficient and viable delivery of certain community services would require extending connectivity to the last mile (for example, school premises in the case of education). Extending the last mile access to individual households would prove conducive to awareness and uptake, as rural users get accustomed to electronic delivery of essential services. This would require collaboration between the Government and private sector enterprises to work out strategies that make the proposition viable for all stakeholders. The last mile connectivity from Panchayats to adjacent schools, hospitals etc can be done either extending the fibre to those places or alternatively through wireless, if fibre is not a viable solution. Wireless solution based on Wi-Fi technology is the best option to provide services beyond panchayats to connect schools, hospitals, IT Centresetc in rural areas. Broadband wireless solutions with Wi-Fi technologies are available which work on license-free band. This technology can be used to connect remote areas where possibility of laying cable is difficult.

9 Economic Models for Sustainable Development

The model/approach followed is whole-seller/retailer model. Bharat Broadband Nigam Limited, a Special Purpose Vehicle (SPV) is a whole seller of bandwidth at 2.50 lakh Gram Panchayat level using which TSPs/ISPs can launch access services in conjunction with content/application providers. There will be two types of usage – Govt. to Customer (G2C) and Business to Customer (B2C). First use of NOFN to trigger broadband system through government lead uses e-governance, education in school, tele-medicines in hospitals, etc., to address the inadequate ratio of teachers to students, doctors to patients, police to citizens.

Providing relevant broadband-enabled services through a Public-Private-Panchayat ecosystem requires strong economic models with clear returns for each stake holder. While the state bodies would demand tangible social returns in the form of employment generation and skill-building for the

rural population, private sector enterprises would seek long-term commercial viability.

There are certain basic prerequisites for creating practical economic models for rural areas. For instance, the availability of basic infrastructure, such as continuous power supply and uninterrupted connectivity, is imperative for delivery of e-services to rural consumers. Furthermore, building for these services is vital to ensure commercial viability of these initiatives. The availability of G2C services such as issuance of birth and death certificates, land records, Right to Information (RTI) services, etc. would attract people to the CSCs, thereby, giving them an opportunity to look at other low cost e-services such as e-learning modules, banking, etc. Economic models that involve delivering broadband to the household level also necessitate last mile connectivity – a subject which still awaits clear decisions and policies.

9.1 Economic Model I: Education

The private sector has also taken several initiatives towards improving the state of Indian education through ICT. Some cases in point are Microsoft India's Shiksha program and Sahaj e-Village's e-learning offering, described below.

9.1.1 ICT centers in Government schools set up by private enterprises

Delivery of quality school education in rural areas through ICT intervention is the main objective behind this model. It evaluates setting up ICT Centre(s) or digital classrooms in rural Government schools to deploy learning methodologies such as audio-visual modules, animation and remote learning. The real value will be derived from virtual classrooms, using which, a teacher located in an urban area (district/block level) can conduct a class with school students located in rural schools. The job of supply, installation, maintenance of IT infrastructure and supply of learning content can be awarded to private education service providers under a Build Own Operate Transfer (BOOT) model (Figure 3).

9.1.2 Revenue potential

The Government of India will provide funds to the government primary schools to cover per student usage fee in lieu of connectivity through NOFN. The government primary schools at Panchayat level will pay per student usage fee to the private education service provider in lieu of digital learning set up to

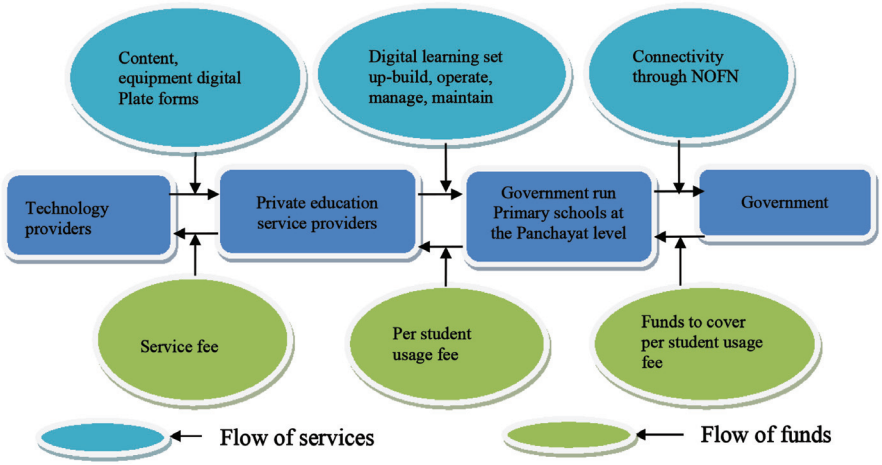


Figure 3 Economic model for digital classrooms in government schools.

educate the students. The private education service providers will share their revenue with technology providers for the provisioning of contents.

9.1.3 Vocational training delivery via CSCs

Skill development and employment generation through certified vocational training courses delivered remotely with the help of ICT is the main objective under the scheme. Job creation and the creation of a skilled workforce are of utmost priority for rural India. However, the lack of suitable teaching personnel and other infrastructure forms a key bottleneck. Using the NOFN infrastructure, it is possible to train rural youth through e-learning content spanning important skills such as basic accounting, BPO training, basic paramedical training, computer fundamentals, web designing, spoken English courses, computer hardware engineering, etc. Advanced courses such as MS-Office, CorelDraw, Tally, etc. can also be made available. Along with training, it is also important to be able to provide placement assistance to the trainees. Unlike primary education, the willingness to pay for such courses is relatively high, and this demand-pull can be used to create sustainable Economic models in vocational training. One of the possible delivery models for vocational e-training could be private training service providers partnering with the CSCs to deliver such content. The infrastructure in connected primary schools can also be leveraged for this service after school hours, with some additional manpower requirement. There is no economic support required from the government in this model, but the government can lend support by

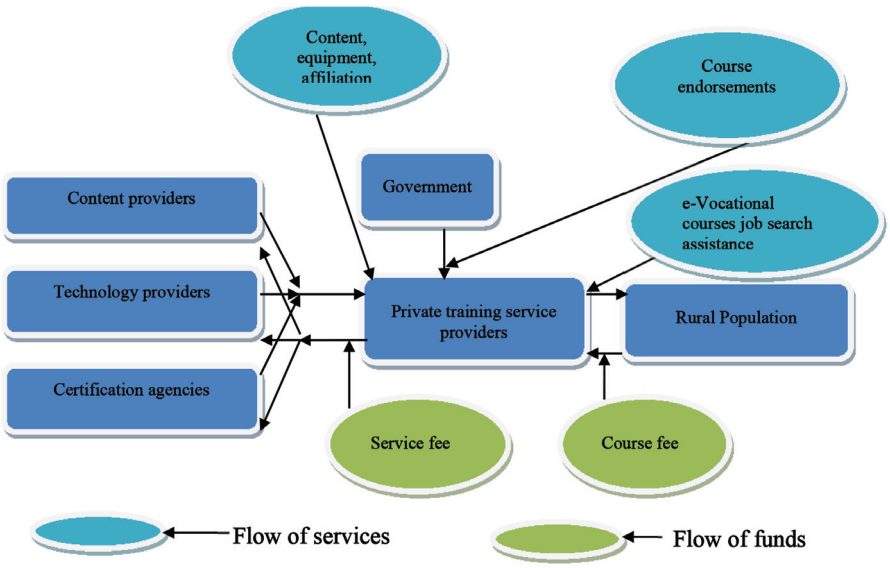


Figure 4 Economic model for vocational training and employment generation.

endorsing or certifying some of the courses offered through this model. Such endorsement is likely to enhance the credibility of these courses in the job market, and therefore, create demand (Figure 4).

Revenue Potential: The revenue earned by private training service provider by way of imparting e-vocational courses and job search assistance to rural population will be shared with content providers, technology providers, and certification agencies for contents equipment and affiliation. Government of India will endorse the courses to be run by private training service providers.

9.2 Economic Model II: Healthcare

Improving healthcare in rural India is one of the priority areas for the Government of India. The 12th Five-Year Plan intends to raise healthcare expenditure (Center and State allocation combined) from 1.3 per cent of GDP in Five Year 2012 to 2.5 per cent of GDP by Five Year 2017–27. The Planning Commission also aims to achieve Universal Health Coverage (UHC) by 2022–28 and the Government intends to achieve this in collaboration with the private sector (including NGOs and non-profits).

9.2.1 Commercial telemedicine centers owned and operated by private healthcare providers

Delivery of quality medical advice to rural patients at their doorsteps through Telemedicine in rural India is not a new concept. Many of the broadband pilots and trials under progress in the country are already using this alternative form of healthcare delivery. This model looks at widening access to good quality primary healthcare at the Panchayat level through telemedicine centers that can facilitate real-time two-way video calls between rural patients and doctors operating from urban hospitals.

The model should be able to remotely draw on the expertise of trained and qualified medical personnel available in urban hospitals.

- **Access issues:** The model should be such that rural patients get access to healthcare facilities nearer home.
- **Low ability to pay:** The model should not impose high additional usage charges on the patients.

All the above can be achieved through telemedicine – the exchange of medical information from one site to another via ICT tools using two-way video over a high-speed communication network.

Telemedicine centers are equipped with technology that enables access to specialist consultants situated in urban centers through real-time video conferencing techniques. This addresses the problem of low doctor to patient ratio in rural areas and also makes it possible for rural patients to access specialist advice. The staff manning the unit are also capable of providing basic medical treatment and procedures, eliminating the need to travel far to access basic care. The telemedicine centers can either be mobile (e.g. mobile vans) or stationary (housed in a brick and mortar premise, e.g. the Primary Healthcare Centers, or CSCs, Figure 5).

Revenue Potential: The revenue earned by primary health care service provider in the form of consultation fee from the patient for telemedicine services will be shared by technology providers as service fee towards equipment and technology platform provided by technology providers and other alliance partners.

9.2.2 Rural entrepreneur provides telemedicine services in collaboration with private players

A slight variation to the model described above would be a rural entrepreneur acting as the primary interface of service delivery. This model assumes

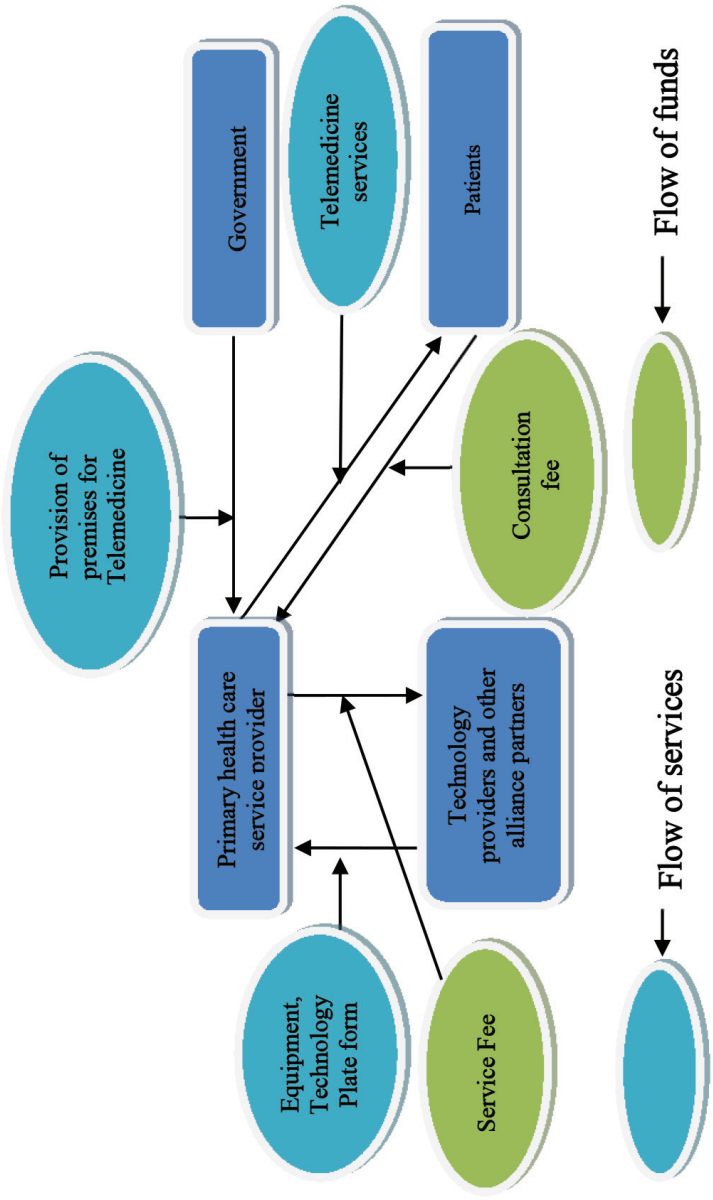


Figure 5 Telemedicine service through a private health care service provider.

leveraging the existing CSC infrastructure. The Village Level Entrepreneur (VLE) running a CSC can tie up with a private healthcare service provider to offer telemedicine services. The incremental cost of setting up a telemedicine unit in a CSC will be lesser compared to the complete build-out cost in model 1 because many of the cost elements are already in place at the CSC – e.g. the space, the basic computer and peripherals, manpower, power back up, web-cams, furniture, etc. The acceptability of the service is likely to be higher, as it is provided by a rural entrepreneur. Leveraging existing infrastructure to offer more acceptable telemedicine services, while building skills, encouraging rural entrepreneurship, and generating employment are the main propositions (Figure 6).

Revenue Potential: The revenue earned by primary health care service provider in the form of consultation fee from the patient for telemedicine

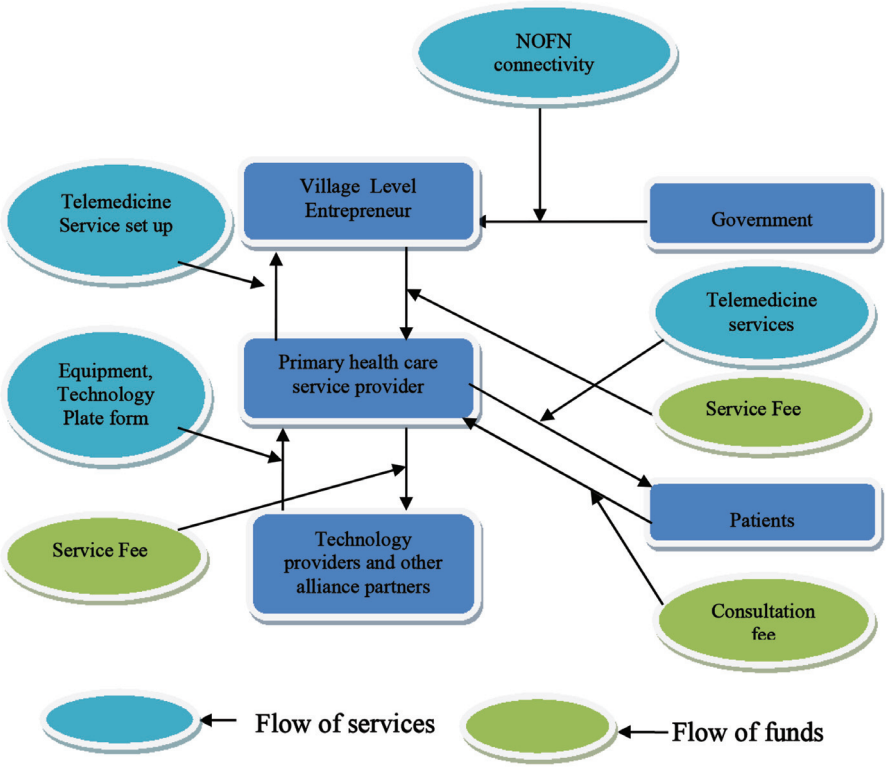


Figure 6 Telemedicine service through a private health care service provider.

services and service fee earned from the village entrepreneur towards the telemedicine service setup will be shared with the technology providers as service fee towards equipment and technology platform provided by them.

9.3 Economic Model III: Banking

Nearly 70 percent of the Indian population resides in rural areas; however, approximately 61 percent of the rural population remains unbanked. The banking network in the country has not yet been able to penetrate into many parts of rural India. While close to 31 percent of villages (about 200,000 villages) have at least one branch of a commercial bank, about 46 percent of the rural households still do not avail of banking services.

9.3.1 Banks tie up with ICT-enabled post offices

Leveraging Post Office infrastructure to offer banking services in rural areas is the objective for providing banking services. This model harnesses the strong presence of Post Offices in rural India to drive ICT-enabled financial inclusion. As of December 2012, the 169 banks in India – including 82 regional rural banks – had a branch network of 100,277, of which only about 37 percent were in rural areas. In contrast, India Post has 154,822 post offices, of which 139,086 (or $\sim$90 percent) are in the rural areas. Using this significant coverage to offer banking services could boost the Government's financial inclusion initiatives. Similar models have been implemented internationally and could be explored in India, given that certain prerequisites to the model, such as banking license for India Post and connectivity at post offices, are already under consideration. In this model, bank appointed Banking Agents (BAs) in the villages access the nearby post offices (as against bank branches) to carry out cash transactions (e.g., deposit the money collected from account holders). The post office would, in turn, carry out settlement with banks (for which they would require a banking license, Figure 7).

Revenue Potential: The revenue earned by the bank from government in the form of service fee for delivery of welfare payments will be shared with the postal department in the form of share of the transaction fee based on the value of the transaction in lieu of Infrastructure for banking services to BC's and with technology providers in the form of service fee towards software and card readers to handle basic banking services. Banking agent will be getting account opening fee from the account holders for banking services and commission/salary from the banks for acting as bank representative in remote areas for extending the banking services to the account holders.

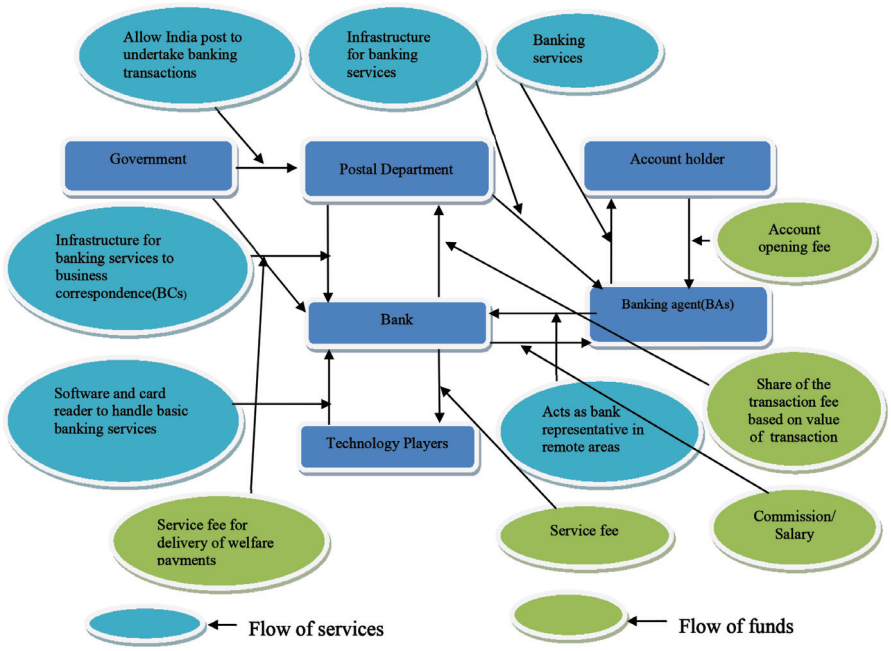


Figure 7 Bank led Economic model using the post office network.

9.3.2 Third party-led BC model

This model is led by a third-party service provider which acts as the Business Correspondent for the bank(s). This model is already under operation in India and could be extended to unconnected regions with the advent of NOFN. The third-party BC recruits and trains Banking Agents (BAs) to offer banking services in remote areas through handheld Point-of-Transaction (POT) terminals provided by the third-party service provider (Figure 8).

Revenue Potential: The revenue earned by the bank from government in the form of service Fee for delivery of welfare payments will be shared with the third party service providers/business correspondence as onetime fee for customer acquisition and for transaction towards acting as a bank representative in remote areas. The third party service providers/business correspondence will make payment as service fee to technology players towards software and card reader to handle basic banking transactions and payment to banking agent in the form of commission/salary towards customer reach. Banking agents will also get account opening fee from the account holders for banking services.

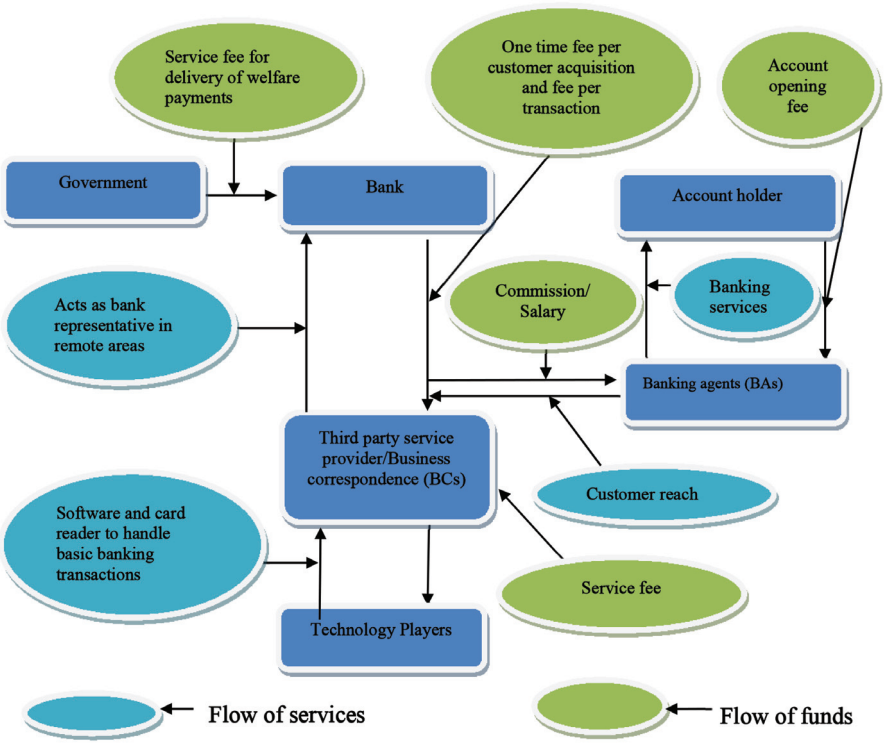


Figure 8 Third party led economic model harnessing a BC network.

9.4 Economic Model IV: Agriculture

Agriculture is the principal source of livelihood for 58 percent of the Indian population and hence, plays a major role in the overall development of the country. ICT plays a vital role in uplifting the agricultural community by providing technology enablers that enhance farm productivity and lead to increased income levels of farmers. Initiatives such as e-Choupal, e-Kutir, and e-Krishi have demonstrated that deployment of ICT tools can increase farmers' income by up to 400 percent. The infusion of ICT in agriculture not only benefits farmers but also creates an entire commerce ecosystem for agro input providers, agro product purchasers and consumer goods companies. More importantly, ICT reduces information asymmetry (e.g. price asymmetry, lack of awareness with respect to latest technological trends, seed types, and demand for various crops) which is crucial to equitably distributing the fruits of development among all sections of the agriculture community. Acknowledging the fact that timely access to agricultural information is one

of the major challenges faced by Indian farmers, the Government of India launched 'Kisan Call Centers' with an objective of providing agricultural information to farmers. While this is a commendable step, information asymmetry could be further reduced by providing additional services such as real-time alerts, e-commerce etc. This is a concept which has been experimented successfully in various pilots undertaken by the private sector in India.

9.4.1 Rural entrepreneur-led model

This model involves training and empowerment of rural Entrepreneurs who work closely with farmers towards real time access to agricultural information through ICT, building rural entrepreneurial skills in the process. Social businesses such as eKutir have proved that a scalable model can be built on these lines and the various relevant ICT offering – applications for seed selection soil analysis, crop planning tools, etc., – can be offered. The social businesses, with their affiliation networks, can source the necessary tools and content for farmers. Offerings can include low-cost information on seeds, fertilizers, cultivation, types of crops grown, crop prices, and other key aspects of agriculture (Figure 9).

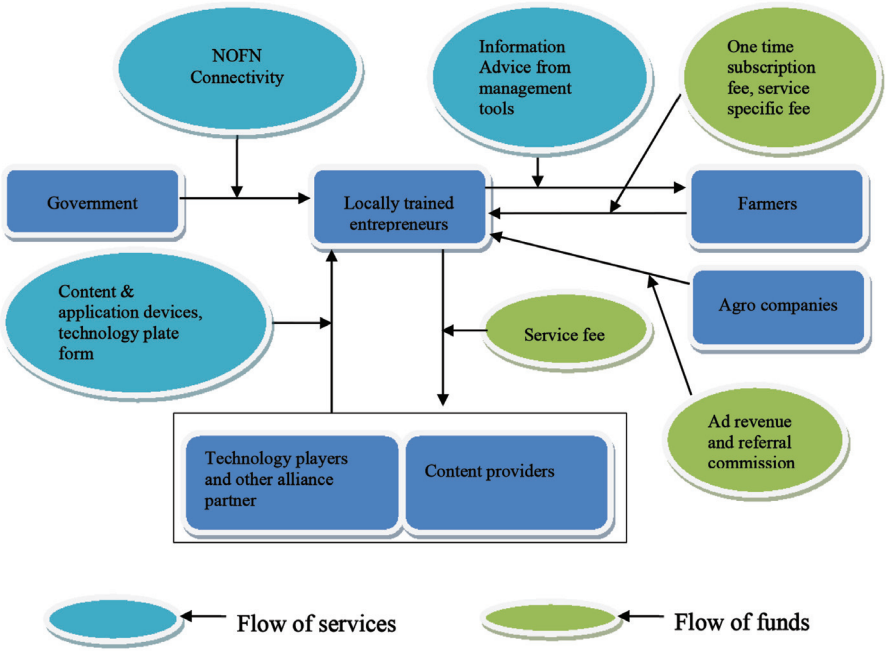


Figure 9 Economic model for rural entrepreneur-led agri. knowledge hub.

Revenue Potential: The revenue earned by the locally trained entrepreneurs from the farmers for providing information advice from management tools and earned from the agro company as advertisement revenue and referral commission will be shared with technology and content providers towards provisioning of contents & application, devices and technology plate form.

10 Proposal

Keeping in mind about the ensuing boom of Broadband penetration expected in rural areas, it is hereby submitted that development of recommendation for defining general aspects/parameters for Telecom infrastructure in rural areas of developing countries can be considered. This may require study of power consumption scenarios in the equipments being deployed in rural areas of various developing countries. Some of the requirements which could be incorporated may be:

1. Providing details of energy efficient Broadband equipment which may help to bring down cost of equipment being deployed in rural areas.
2. Providing typical advantages of moving towards use of Hybrid Renewable energy Sources Including wind energy, solar energy and fuel cells for powering Broadband equipment in the rural areas.
3. Providing typical gains by using wireless backhaul systems for access transport specially in rural environment.

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Biographies

R. Krishna, an M.Tech. (Electronics) is serving in Department of Telecommunications, Ministry of Communications, Government of India as Deputy Director General (Fixed Access) and is responsible for formulation of standards on Telecom Equipment to be deployed in Indian Telecom Network on fixed line access technologies which includes the broadband access Technologies on copper and fibre. He has also been responsible for validation of GPON access equipment for Technology approval developed by Center for Development Telematics (C-DOT) in India which is being deployed In Indian Telecom Network for provisioning of Broadband services in Rural Areas. He is also working on standardization of Telecom Equipment to be performance and energy assessed and certified Green passport. He has varied experience of working in various disciplines for installation, Testing and certification of Telecom Equipment on Digital Coaxial, Satellite, GSM and Optical Fibre technologies deployed in Indian Telecom network.

R. Ambardar has done his Engineering in Electronics from MNNIT, Allahabad and is presently working in C-DOT- a premier telecom technology centre of Government of India, as Group Leader. He is currently involved in various activities like product specifications design, validation and testing, field support and customer interactions in the area of optical communication. He is responsible for successfully deploying India's first indigenously developed GPON system in India at Ajmer, Rajasthan in 2010 and later on

successful field trial completion of GPON system in the NOFN netwok. He has been a member of core group for NOFN whose task was to design and deliberate on the Architecture of the network for providing broadband connectivity to 2,50,000 village Panchayats in the country. He was also the Member of Technical Committee formed by DeitY for devising strategic plan for providing G2C services on NOFN and member of NII 2.0 architecture committee setup by DeitY for easier implementation and maintenance of e-governance for state and central line departments. He is also the member of Technical Audit methodology committee set up by DOT to discuss on the recommendations of preferential market access (PMA) for electronic products in the telecom sector.

S. Chandran had served as Assistant General Manager in Bharat Sanchar Nigam Limited (BSNL), a premier telecom service provisioning unit of Department of Telecommunications, Ministry of Communications, Government of India. He has been associated with the validation and acceptance testing of various kind of telecom equipment being inducted in BSNL's Telecom Network for service provisioning. He has also been responsible for formulation of validation schedules, test schedules and test procedures for testing and certification of Core, Infra and other sub-elements of different telecom technologies both TDM and IP based for induction in the BSNL's telecom network prior to commercial launch. He has also been a key person to extend the technical support in formulation of standards on Telecom Equipment to be deployed in Indian Telecom Network on fixed line access technologies by TEC which includes the broadband access Technologies on copper and fibre. He has varied experience of working in acceptance, testing and certification of Telecom Equipment on GSM and Optical Fibre technologies deployed in BSNL's Indian Telecom. He has been conferred with the many awards for his meritorious services in acceptance, testing and certification of telecom equipment for use in BSNL telecom network.