Everything on Tower (EoT) – Enabling Broadband Access in Rural Areas Through License-Exempt Spectrum – Making the Business of Rural Broadband Happen

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Abstract

This paper mainly aims to throw the light on telecom technologies of today and tomorrow. It briefly discusses, how technologies are now starting to be available to connect every village and also it details challenges faced by the technologies in rural areas. With these in mind, a total innovative business model is required to deliver Internet services to rural areas. In order to meet this need, a Danish technology start-up called BLUETOWN took the initiative to significantly enhance the quality of life of rural people in India in various villages of Eastern India by setting up a network of public Wi-Fi hotspots in various villages of India. The challenges from a technology point of view were many. The systems that provided the solution needed to be cost-effective, low maintenance and affordable to the rural masses [1].

Keywords: Rural connectivity, Wireless internet, Access technology, Broadband internet, High-speed internet, Backhaul network, Low Mobility Large Cell (LMLC), Village Level Entrepreneur (VLE), Managed Hotspot Service Provider (MHSP).

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1 Introduction

We are stepping into a new age of mobile communication where everything is expected to be connected: high-speed information sharing shall be enabled between all kinds of devices, i.e. cell phones, tablets, smartwatches and wearables, at any time and no matter where we go. Thus, to meet the ever-increasing user demand in high data rate service with seamless connectivity, 5G wireless access must extend far beyond the previous generations of mobile networks with revolutionary solutions utilizing new radio access technologies.

A cross-nation study of mobile broadband affordability in ethic perspective pointed out that affordable broadband internet connectivity should be considered as a vital aspect in social justice and 5G is at the danger of losing its next million users entirely without affordable wireless access. It is widely observed in the global map the close relation of internet connectivity gap and GDP growth gap between urban and rural communities. The rapid growth in internet connectivity and mobile internet access has accelerated the economic boost in the urban communities around the world, and it in turns leads to improvements in public service sectors, such as education, health, and banking, and attract investment in business and industrialization, which motivates further development of the region [2]. Thus, there is an urgent need for continuous efforts from governments and information and communication community to devote in development of mobile broadband access network and related research to connect the remote rural areas.

Mobile access to the internet in all areas is considered to be one important component of social justice that cannot be compromised due to economic reasons, just as the equal rights to other important resources for everyone like water, electricity and education. Low revenue per user in rural areas compared with casein urban scenarios has been dragging down the development of the mobile network in rural areas for years. With growing attention and support from the governmental and academical field. In this scenario, our Government should motivate network operators to better drive network development in rural areas, by proposing and evaluating cost-efficient solutions targeting rural scenario [3].

2 Internet in Rural India

Rural areas of the country continue to be sparsely covered and are not considered as a viable business case by telecommunication operators. The

recent growth of teledensity in urban areas, fuelled by mobile technology, has shown that the digital gap between rural and urban areas has widened.

The rural population needs to be provided with mobile telephony with data and wireless broadband access in addition to simple voice mobile telephony, by connecting remote areas to the broadband core networks. Choosing efficient, cost-effective and fast-deployment technologies – whether wired or wireless networks – will improve digital accessibility [4].

The key challenges for the provision of telecommunication services in rural areas are driven by both technological and economic considerations. Setting up backhaul connectivity remains a high-cost exercise. **Erratic power supply or complete lack of power sources** is a major barrier, wherein Solar Power supply is increasingly becoming a viable alternative. But the requirement to maintain alternate backup systems raises CapEx costs substantially.

There is a gap in internet adoption between rural and urban areas and a lack of infrastructure is responsible in many cases for this division. In 2020, enabling digital connectivity in rural areas is still an underlying issue for the developing nations, however, there are upcoming developments in place to ensure there is a range of technologies that can deliver next-generation connectivity [5].

To achieve country-wide Internet access is an important goal to sustain the progress of our societies. Nevertheless, there is an important gap between the urban and rural areas in terms of Internet Connectivity that is mainly due to a lack of interest by Internet Service Providers (ISPs) in deploying a wired infrastructure in these areas; such lack of interest is expected to be maintained since the estimated Return of Investment (ROI) is not attractive [6].

Also, it is widely accepted that new information and telecommunication technology are needed to alleviate a wide range of obstacles for economic and social development in rural areas. This is particularly true for internet accessibility since it offers a global platform for retrieving and sharing information.

During the past few years, there has been remarkable progress in the most developed countries in terms of telecommunications facilities [7]. However, outside the main urban areas, there are significant handicaps that make Internet connectivity a complex and costly task.

There is a real sense of excitement about the role Wi-Fi will play in the 5G era. Rather than becoming a dusty old delivery mechanism, Wi-Fi expects to play a complementary role in 5G, to an even greater extent than it has in the later days of 4G, Wi-Fi will be an essential technology in the 5G era

especially for providing internet connectivity to the rural areas while using the unlicensed ISM band, and thus bridging the rural-urban digital divide [8].

3 Challenges in Rural Broadband Access

Deployment of Broadband in rural areas is constrained by a multiple number of infrastructure, economic and social factors. Hence, it is imperative to first understand the unique traits that characterize these regions and the key challenges that impede the deployment of a broadband network there [9]. The special type of challenges for rural Broadband deployment and their solutions are discussed below [10]:

i. Nonexistent or unreliable electric grid supply:

For the operation of Broadband infrastructure, availability of reliable electric supply is must, but, most of the rural areas, all across the world, still do not have reliable grid supply. As an alternate, fossil fuel-based DG sets are extensively used. Due to high operational cost, logistics and spillages etc., this does not provide a sustainable solution to the power requirement. Moreover, the use of diesel in the DG contributes to increasing the carbon footprint.

One solution appears to be in using efficient and low power wireless-based architecture for Broadband network that can work on renewable/non-conventional sources of energy without depending upon the grid power supply/DG sets.

ii. Sparse Population Density and Clustered Settlements:

Unlike urban areas which are uniformly populated, rural areas are populated in clusters which are generally far apart from each other. This implies providing a similar type of services over a large geographical area may be economically inefficient.

iii. Low Mobility:

People in rural areas, especially in developing countries like India, are either pedestrian or move at low speeds, typically lower than 50 km/h. In such a scenario, supporting high-speed mobility (up to 500 km/h) may not have much relevance. Support for high mobility poses various challenges on the design of a cellular system such as developing highly complex channel estimation and synchronization techniques.

iv. Unavailability of Backbone Network Access in Rural India:

Providing fibre-based backbone in sparsely populated remote and inaccessible rural areas is a daunting task. Planning and laying fibre in such areas is time-consuming and capital – intensive activity and it does not make a business case in terms of return on investment on capital employed. In many developed countries, this activity is undertaken by the government by its own funding or through USO support, treating the Broadband Backbone as a National infrastructure. The same strategy is required for developing countries as well as there are no alternatives.

Till such time fibre network comes into existence through the Government/USO funding, it is advisable to use a terrestrial microwave or satellite-based Backhaul in in-accessible areas as the backbone for connectivity to the service provider's core network. The OPEX of the satellite-based backbone is much higher in comparison to the terrestrial microwave-based backbone and hence satellite-based Backhaul is recommended only in locations where terrestrial types of backbone systems are technically-not-feasible (TNF).

v. Computer literacy and Access devices issues:

A major part of the rural population, by and large, are habitual of remaining the passive users of any technology without using the facility of interaction with the technology. They generally are not confident to work with any interactive digital device to start with. The computer is a new device which most of the rural masses are unable to use without some training and supervision. Also, computer literacy without any immediate purpose related to day to day lifestyle of the rural masses does not become interesting. Hence, it is advisable to get these masses a comfort of familiar devices and applications to start with, followed by hands-on training on interactive devices such as a computer. Mobile phones with Wi-Fi connectivity or TV sets with Broadband connectivity appears to be an attractive starting option in such instances.

vi. Different Operation and Maintenance (O&M) need:

The requirement of network operation and maintenance in rural areas is entirely different from the densely populated high ARPU urban areas. Hence the retrofit of urban centralized and remote-controlled network and business models of present-day telecoms cannot serve the purpose.

For rural Broadband networks, it is essential to use simplified and easy to maintain architecture with the involvement of local communities/

entrepreneurs to take care of operation and basic maintenance of Broadband system with some initial training in operation as well as service provisioning.

vii. Non-availability of relevant applications and content:

The rural masses are required to be provided with the solutions for their day to day problems to enhance their quality of life as well as opportunities for new businesses and employment in their own ambience. The application and the services over Broadband are required to be tailored to meet their current and latent needs. This can only be achieved with the proper support and encouragement for local content and application development in their own languages. The Governments, the NGOs and local bodies should take the responsibility to support such activities and popularise relevant applications and contents in other similar communities/ markets.

viii. Remote/Inaccessible Areas:

Many parts of the rural areas may be remote and not easily accessible. The maintainability and the availability of the network equipment deployed in such remote regions may be of significant concern.

The above-mentioned characteristics highlight various requirements that rural communication network must be based on and are enumerated as follows: (i) affordability, (ii) limited mobility support, (iii) localized communication, (iv) capable of running on renewable energy, (v) device/equipment security, (vi) clustered service provision and (vii) facilitation of local content generation and storage [11].

4 Rethinking Rural Connectivity Requirements

As a part of Digital India mission of the government to make "Broadband for All" a reality in the near future there is a great buzz about Wi-Fi everywhere especially in urban areas wherein people are expecting free Wi-Fi access in times to come. Though there is not much talk about rural Wi-Fi. Everything on Tower (EOT) concept appears to be the only solution to provide broadband access to rural masses in a cost-effective, timely affordable & sustainable manner.

For making delivery of high-speed broadband access in the hands/homes of rural people some very low cost, low power & low maintenance technical

solution is required which can reduce the cost too minimum possible by making use of existing infrastructure and unlicensed spectrum which is free. Also, in many villages of rural India, there is an acute shortage of grid power supply which is also highly unreliable. In addition, there is the unavailability of suitable indoor space for installing the network equipment's and keeping it safe and secured. Due to all the above challenges, there is a perceived lack of a business case for rural broadband access and that is why not many players are talking about it [12].

Knowing the fact that there is no business case for telecom operators in rural areas. So, there arises a question – Are we prepared for that and how this rural-urban digital divide will be bridged? Actually, the objective is to reach the bottom of India's digital pyramid with the inclusion of these far-flung rural areas, Digital India programme is really helping to bridge the digital divide, but a lot is still to be done. It is the fact that rural Indians have been increasingly getting online and are expected to catch up with urban India by 2020 where 48% of the online population will be from Rural India. But such same trends would exist during 5G also? That we have to check.

The penetration of broadband networks in such remote and rural areas demands new thinking and methods to make broadband network operations economically viable [13]. Suitably modified deployment architecture needs to be explored to address the rural broadband internet requirements and innovative business model developed to operate in a sustainable model [14].

Actually, the connectivity requirements of the rural areas are very different from that of the urban areas. Thus, in order to make rural broadband connectivity better feasible and have better penetration in the un-served and under-served remote and rural areas, we need low cost, indigenous and high-performance solutions. ***The Frugal 5G approach is an economical and cost-effective way of connecting the remote, un-served rural areas of India in an efficient and standardised way enabling greater innovation [15].***

3GPP Releases 15 and 16 provides interworking between the 5G and Wi-Fi networks by enabling access to the 5G Core via untrusted and trusted non-3GPP access networks such as Wi-Fi for **Low Mobility Large Cell (LMLC)**. These efforts are focused on defining the architecture and messaging to provide secure transport for the 5G control plane and data plane over non-3GPP access via gateway functions: N3IWF – Non-3GPP Inter-Working Function and TGNF – Trusted Non-3GPP Gateway Function.

Recently, some significant standardization activities have been initiated which aim to develop innovative architectures to facilitate broadband communication and Internet access in rural areas. **IEEE has also initiated a working group called Frugal 5G Network.** The standard development project, under this working group, aims to design an architecture for a low-mobility, energy-efficient network for providing affordable broadband access in rural areas. Under the project, it is envisaged that the proposed network would comprise of a wireless middle mile network, an access network and its associated control and management functions.

Here, we present a novel communication network architecture for rural areas based on our learnings. We consider the rural characteristics and requirements while designing the network. The proposed architecture presents a framework for the rural broadband internet connectivity network which can be realized by utilizing components from the evolving 5G cellular standards and other existing wireless technology standards [16].

5 The Implementable Solution for Development of Rural Broadband Access Network

For early adoption and deep penetration of Broadband in rural areas, it is necessary to have a technical solution that is low cost & easy to be managed and operated by the local communities/entrepreneur and making use of existing backbone connectivity of main national/regional networks of telecom operators. The local communities/entrepreneur needs to be involved in the whole gamut of operation, maintenance, marketing, sales support and application etc. to take the overall responsibility for the business at a local level [17].

For the Broadband backbone network, optic fibre is the best and future proof solution for Broadband connectivity with long term perspective. However, laying fibre cables is a time consuming and capital-intensive activity. It needs to be funded by Government/USO agency and investment treated as a sunk cost for the purpose of societal return on investment like any other national infrastructure such as highways, Railroads, Power and other public utilities, as discussed in the previous chapter. To start with the existing infrastructure of public sector telecom operators can be used on a Revenue share basis.

For the access network, it is advisable and cost-effective to go for wireless-based Access system with different Backhaul solutions depending

upon the terrain, geography and existing infrastructure, availability of conventional telecom system and backbone network etc.

6 Ideal Technology Architecture for Providing Internet Connectivity to the Rural Areas [18]

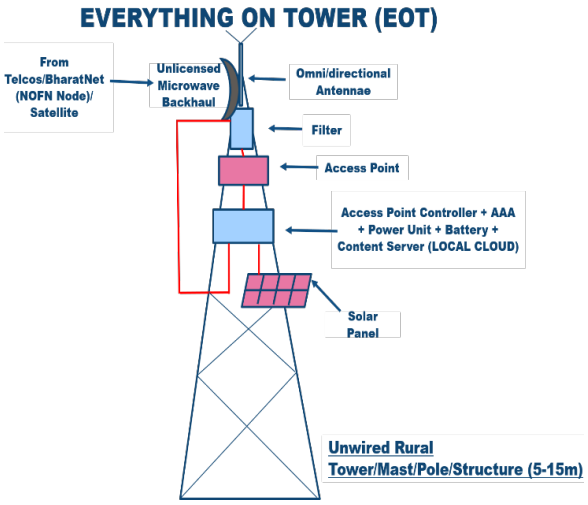
The cellular technology is mostly an urban technology that has been unable to serve rural areas well. This is because the traditional cellular models are not economical for areas with low user density, lesser revenues and also because of the challenges as explained above. In 5G cellular networks, the coverage dilemma is likely to remain the same, thus widening the rural-urban digital divide further. It is about time to identify the root cause that has hindered the rural technology growth and analyse the possible options in 5G architecture to address this issue. We firmly believe that it can be accomplished.

Our aim is to ensure the availability of the Internet in a cost-effective manner. This is only possible if the 5G rural model adopted is able to attract the attention of the service provider in the first place. By focusing on cost-effectiveness, parameters such as throughput and latency can be compromised because these are managed according to the user requirements and are not deemed critical for a new user located at a remote/sparsely populated area. In addition, the infrastructure cost has also to be practicable because the vendor would never risk a huge sum for a pilot project. Since the profit-loss breakeven point would occur at lower revenues, therefore more rural population would be encouraged to reap the benefits of low-cost Internet. Once the rural access to Internet gains momentum and results in an increase in the number of users, the core problem would be addressed and would subsequently be wiped off the 'investment blacklist' from a service provider's perspective, then the increased rural demand would motivate the service providers in facilitating the users with better connectivity and improved performance that would invariably lead to technological advancement in the rural areas and bridge this technology gap.

With respect to the service delivery, 5G has the potential to handle services that 4G cannot handle efficiently, such as IoT services, M2M etc. Therefore, 5G is one technology, in which service possibilities exist before the network is perfected. And some of these services will be of great value to rural areas. An example of such services is platform services aimed at enhancing commercial activities. It was cited that network operators shy away from rural areas because they are not commercially viable (Barela et al.,

2016). However, research has proven that the commercial viability of rural areas can also be enhanced by mobile and wireless networks. **The secret to such endeavours has been the provision of tailor-made mobile or wireless services that supports existing commercial activities in such rural areas and such architecture can be possible by the innovative deployment of unlicensed technologies like Wi-Fi.**

Hence, we recommend for supplementing the existing Cellular Network (2G/3G/4G) of rural areas with the Wi-Fi for Data-Access need and the ideal way of doing that is making use of the existing infrastructure of Telcos to fill the connectivity gap using the **"Managed Hotspot Service Provider"** model to enable the delivery of Broadband services to rural masses in a cost-effective, timely and affordable manner. **One of such kind innovation is the concept of 'Everything on Tower' which brings out a solution for the creation of a public Hotspots for use of the telecom service providers to enable them to provide much-needed broadband access to rural masses as a business case without any perpetual subsidy**. It is based on the availability of subsidised internet backhaul as a part of NOFN project of Govt. and making use of abandoned/discarded telecom towers or some other existing structure of around 10–15 metres height. This makes use of an innovative rural access technology 5L principles of value innovation namely; **Low Cost, Low Power, Low Maintenance, Local Control, Local Content.** Which is the answer to all broadband connectivity challenges as discussed in the starting.



This solution does away with many cumbersome and costly requirements and physically put everything on top of the tower in a secured and safe manner. The various network elements which are mounted on the tower are Omni antenna, filter, backhaul dish. BTS (Controller, power unit, battery, local content server) and solar panel. Such installation which will have no cable connected to the tower has the potential to convert a small village into a hotspot to provide Wi-Fi-based broadband access in a very cost-effective manner. The advantage of such a solution is it does not require indoor space, no cabling from building to the tower and no grid power supply connection and more than anything else it is totally Green. Such a solution can work for more than 30 hours without charging and free from any requirement of external power supply. This solution is the live example which is being deployed at more than 5000 sites by BLUETOWN (India), a Danish innovation start-up. **Such solutions and the business strategies (as explained later) are the only alternatives to 5G services or it can be assumed that this combination of the existing cellular network plus Wi-Fi is actually the 5G for rural.**

It is all known that 5G brings with it – **Extremely high speeds of data connectivity with Ultra-low latency. Also, 5G possess all capacity to support technologies like IoT, M2M etc. But as far as the remote and sparsely populated rural areas are concerned the things like low latency, IoT and M2M do have no meaning. So, what will offer few years with the expensive network topologies can be offered today itself using the Wi-Fi and that too at 1/100 of the cost of 5G network deployments.** There are standards of Wi-Fi which can compete with the 5G offerings, one such standard is IEEE 802.11ax (or Wi-Fi 6), the 802.11ax promises improved performance, extended coverage and longer battery life. 802.11ax can deliver a single stream at 3.5Gbps, and with new multiplexing technology borrowed from the world of LTE cellular, can deliver four simultaneous streams to a single endpoint for a total theoretical bandwidth of an astounding **14Gbps**.

802.11ax delivers a nearly 40 per cent increase [19] in pure throughput thanks to higher-order QAM modulation, which allows for more data to be transmitted per packet. It also achieves more efficient spectrum utilization. For example, 802.11ax creates broader channels and splits those channels into narrower sub-channels. This increases the total number of available channels, making it easier for endpoints to find a clear path to the access point.

Features of IEEE 802.11ax standard which is the basis for Wi-Fi 6, which are at par with the 5G technology [20]:

- 802.11ax will provide comparative download speeds than 5G Technology.
- 802.11ax adds uplink capability, so multiple users can upload video simultaneously.
- 802.11ax has a more spectral efficient modulation scheme, moving from 256 QAM to 1024 QAM, which translates to better throughput and 25% higher capacity with 10 bits per cycle (Hz).

802.11ax is also designed for cellular mobile data offloading. In this scenario, the cellular network offloads wireless traffic to a complementary Wi-Fi network in cases where local cell reception is poor or in situations where the cell network is being taxed, in the overall scenario, this is a win-win situation.

Wi-Fi standard IEEE 802.11ax is one such offering which can be deployed in rural areas too and can add to the network, the speeds like 5G.

7 Why Wi-Fi, for Rural?

1. **Ubiquitous** – Each smart device (including Mobile Phones) is Wi-Fi enabled.
2. Uses unlicensed spectrum *(ISM Band)* which is free (690 MHz in 2.4GHz and 5GHz Band).
3. All IP Technology which is very efficient and future proof which is based on open and ever-evolving standards of IEEE (802.11x) [21].
4. Plug-n-Play ecosystem, which is Non- Interfering, Non-Exclusive, Non-Protected) – Free for All.
5. Low Power consuming and Low Cost – overall infra cost about 10% of licensed mobile infrastructure.
6. Potential to conserve scarce licensed spectrum through **Mobile Data Offload (MDO), Fixed Mobile Convergence (FMC).**

8 Great Opportunity with Wi-Fi 6 for Rural Broadband Challenge

Wi-Fi 6 Will Play a Pivotal Role in Bridging the Digital Divide, there remains an undeniable fact – there are still Internet access disparities between residents of rural and urban areas. And the digital divide between lower-income

and higher-income communities can only be closed with new approaches and solutions.

This progress in both cellular and Wi-Fi technologies will help service providers and governments connect the next billion resulting in improved online education, better health services with telemedicine to rural areas, local economic development, increased productivity, social inclusion, as well as the use of the internet as a catalyst for change.

The 5G may be stealing headlines but the new standard 802.11ax (now going by the name Wi-Fi 6 following the Alliance's recently introduced new naming scheme) is staking a claim for itself, interestingly borrowing a number of techniques from cellular.

A number of new mechanisms implemented in Wi-Fi 6 for the first time which essentially represents better recognition of the unlicensed nature of the spectrum and resultant interruptions.

The 802.11ax standard includes a broad range of PHY layer and MAC layer features for efficiently handling demanding applications in dense network environments, even on the network's edge, notes a recent Wi-Fi Alliance whitepaper.

- 3GPP has already developed specifications to ensure tight integration of 3GPP and non-3GPP radio technologies, such as Wi-Fi [22]. In order to better serve customers and provide the full 5G experience, the tight integration of non-3GPP technologies needs to be ensured also within the 5G Core Network. Solutions enabling some of these objectives have already been adopted by 3GPP and Wi-Fi 6 (802.11ax), such as the EAP authentication framework similar to Wi-Fi, to accommodate different wireless service subscription-types (e.g. mobile, wireless or fixed broadband) and their native authentication methods.
- 3GPP Release 15 provides some support for interworking between 5G and Wi-Fi. In particular, 3GPP Release 15 provides support for untrusted non-3GPP access (such as Wi-Fi) to the 5G core via Non-3GPP Interworking Function (N3IWF), with secure transport of Control-Plane/User-Plane (CP/UP) messages over IKEv2/IPSec tunnels between the terminal devices and the N3IWF [23].
- 3GPP Release 16 [24] is continuing the work by enhancing capabilities for Wi-Fi integration, including trusted Wi-Fi support and access traffic steering, switching and splitting.

However, challenges and needs remain – including the enablement of Wi-Fi-only devices to connect to the new 5G core, further study to ensure the tight

integration between 5G and Wi-Fi networks, an interface to enable a certain level of network manageability and policy control between 5G core and Wi-Fi networks, and the ability of a client to route traffic over one or more accesses, making optimal use of the available connectivity.

But, it is guaranteed that the outcomes and insights of the Wi-Fi 6 deployments and field trials will encourage governments, organisations, communities and individuals to look beyond our urban environments and into the exciting future of rural India: a place where connectivity, industry and innovation can thrive for the good of us all.

9 Model Business Case for Rural Areas

In the absence of any possibility of needed ROI (Return on Investment) on the CAPEX, as well as the restricted potential for revenue due to affordability constraint, the success of the rural Broadband business will depend upon the Government's policy and regulatory environment, investment support and incentives provided by the local governments in creating underlying infrastructure as well as making use of the existing infrastructure of operators. Also, involvement of a local entrepreneur or community under public-private partnership (PPP) model with an opportunity to create a business case through Government/ Public funded backbone infrastructure is the key for the sustainability of Broadband business in the rural areas. One option for this scheme can be the involvement of an independent infrastructure provider, who creates the access node as "Managed Hotspot Service Provider" (MHSP).

Involving the local community/village local entrepreneur (VLE) which could be used in MHSP will require selection and basic training to a local entrepreneur in a village or a cluster of villages through schemes like "Skill India". Government/local bodies will be required to provide majority financial support for initial setting up of the infrastructure for Village Level Entrepreneur (VLE) and help this entrepreneur to get funding from the bank/ financial institutions under the plans like "Startup India".

The VLE will become Franchisee/agent of an Internet Service Provider/ Telecom Service Provider and will operate and manage Wi-Fi Access infrastructure, and work as a single point of contact for rural Broadband services, billing and customer support etc. VLE will also use this infrastructure to generate extra revenue scheme by providing various content, value-added services and application services in addition to providing basic Broadband access at an affordable price point.

Box The Business Model Canvas- Managed Rural Broadband Service Provider Diagram based on template sourced from https://www.strategyzer.com/canvas/business-model-canvas

<table>
<tr>
<td rowspan="2">Key Partners

• PSU Telcos
• Private Companies
• ISPs/TSPs
• Social Networking/ Content companies
• Investors, VCs
• NGOs
• Academic Institutions
• System Integrators</td>
<td>Key Activities

• Local Manufacturing & Sourcing
• Alliances & Partnership formation
• Proposal & Responses to EOI/ Tenders
• Sales & Promotions</td>
<td rowspan="2">Value Proposition

• Low cost, Low power & Low maintenance (3L)
• High QoS & Coverage
• Multi-faced system
• Rugged, Rural, Outdoor fit
• Open platform (Standard Wi-Fi APs)
• Environment-friendly green-solution DG-less)
• End-to-End IP platform
• Cloud server for localized content</td>
<td>Customer Relationships

• 24*7 Customer Care Centre
• Micro Operators/ VLEs
• Regional Sales Executives</td>
<td rowspan="2">Customer Segments

• Rural Retail Market
• Govt. users in villages
• Institutional users
• SOHO (Small Office Home Office)</td>
</tr>
<tr>
<td>Key Resources
• Investors & Venture funding
• Proven Technical Solution
• Innovative Business Model
• Passionate Management</td>
<td>Channels
• Micro Operators/ VLEs
• Co-branded outlets
• Partnership Telcos/ISPs
• CSC (Common Services Centers)
• Direct Sales</td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Manufacturing & Sourcing
• Wi-Fi hotspot integration, funding, deployment, operation & maintenance
• Employees & office
• R&D & Training
• Sales & Marketing</td>
<td colspan="2">Revenue Streams
• Sales of Prepaid Vouchers to retail customers
• Content/ Application services revenue share
• Postpaid Connections to institutions/ SOHO
• Govt. Anchor usage payments receipts
• Mobile Data offload revenues</td>
</tr>
</table>

The Internet Service Provider (ISP)/ Telecom Service Provider will provide the interconnectivity to the MHSPs access network through available Backhaul network to be created through Government/ USO/ Public funding in PPP mode. In absence of the existing backbone, the operators may need to arrange for the satellite-based Backhaul to the MHSPs network. Since the ISP/Telecom operators will get the rural franchisee/ VLE with established access network by MHSP and new market, at no cost to them, they could be motivated to provide services to the rural masses at incremental cost basis and share the revenue with MHSPs & VLEs based on the work done [25].

Taking into account the learnings from our experience, a sample business case has been prepared for a typical rural area to demonstrate how a Broadband network infrastructure can be commercially deployed and sustained as a business through joint efforts of stakeholders. This sample model with varying options and assumptions is described below:

Sample Business Model for a Typical Rural Locality of Developing Country

For successful deployment of the Broadband in the rural areas it is necessary for the respective government agencies/public institutions/ Telecom service provider to support local Village Level Entrepreneurs (VLE) and provide the backhaul connectivity at a subsidised cost Revenue Share.

[The technical solutions and business models for different rural areas will have to be selected depending upon the availability of existing infrastructure to reduce the cost of deployment with a sustainable business model for MHSP/Village Local Entrepreneur (franchisee) ISP/ Telecom Service Provider (franchisor)]

Case 1: Rural areas with telecom infrastructure but no Broadband Connectivity:

In such cases, it is recommended to use terrestrial microwave middle mile in the unlicensed band (5.7 GHz) with Wi-Fi (2.4 GHz) as Access node capable of working on alternate source of energy. Such solar energy-based systems along with Li-Ion batteries are in use in some developing countries.

10 Managed Hotspot Service Provider (MHSP) Model [26]

For provisioning of Broadband in such rural areas, an MHSP in partnership with Telco/ISP installs a 5-meter high pole/mast mounted microwave backhaul radio and Wi-Fi hotspot with solar panel and Li-Ion batteries along with BTS all in a box mounted on this mast. MHSP will appoint a VLE from Local folks for managing Hotspot. This VLE will be given basic training by the MHSP for regular maintenance and operation of Hotspot infrastructure and to provide Wi-Fi of assisted Broadband services to the villagers.

The VLE working as a franchisee of MHSP acts as a single point of contact for all Broadband related products and services. VLE also takes the responsibility of digital literacy and assisted Broadband services (such as e-governance) to the rural masses. VLE will also use this WI-FI infrastructure for generating revenue through other activities (such as mobile charging providing rail-road ticketing, getting market prices of crops and assisting in doing business transactions, rural e-banking, help in getting medical facilities from urban health centres etc. to name a few).

Following is the Gist of a typical business model for such case:

Different possible modes of funding for establishing a rural Broadband business:

- MHSP funded through Managed Services (CAPEX)/Revenue share (OPEX) route
- Investment by VLE through microfinancing/startup fund
- Subsidy by Government/Local bodies Contribution/Direct benefit to users through USO fund, Guaranteed Revenue by the Anchor Users (Govt.)

11 Key Benefits of MHSP Model

For VLE:

- Opportunity to become an Entrepreneur.
- Contributing to the village community for improving the quality of life, in addition, to generate employment and livelihood for self.

For VILLAGE PEOPLE:

- Assisted Broadband services at doorstep/hands
- 24/7 connectivity to the world wide web
- Improved productivity efficiency and life study enhanced

It is worth mentioning that some of the innovative rural Broadband network solutions are based on self-contained, maintenance-free, low OPEX, renewable energy-based systems involving local entrepreneurs for basic maintenance and operation including managing the Backhaul connectivity and service provisioning. These solutions need to be emulated in the developing countries for the spread of Broadband in rural areas.

12 Conclusion

It has become obvious that the business of rural Broadband needs an ecosystem jointly created by multi-stakeholders from Public, Industry as well as Society. The major investment for the infrastructure, especially the backbone infrastructure, needs to be funded by Government/Public as is the case for any other infrastructural project. The Industry has to pitch for the last mile access network making use of innovative technologies and the existing infrastructure, which is the only way forward for efficient creation of sustainable rural broadband access network.

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