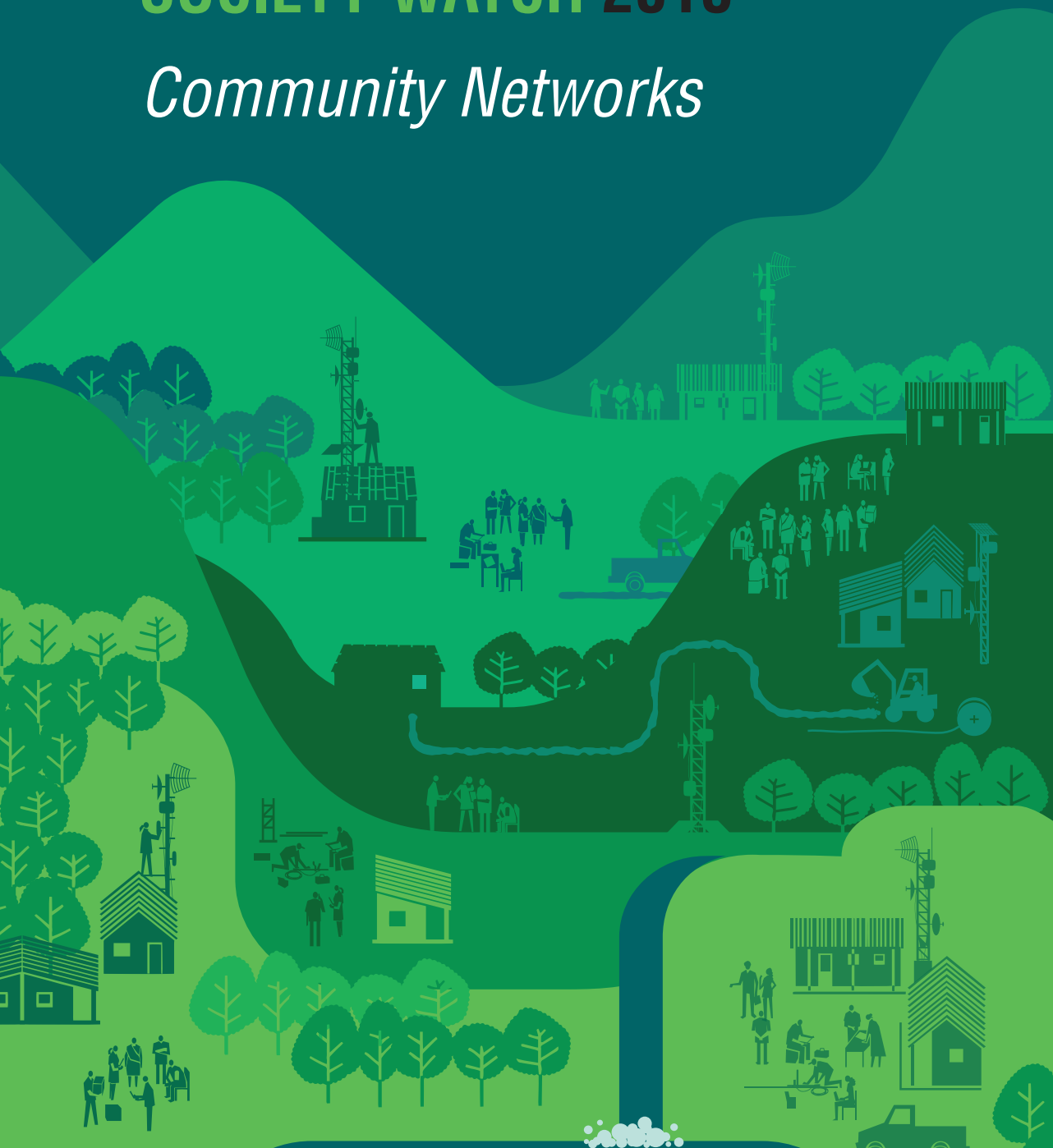
GLOBAL INFORMATION SOCIETY WATCH 2018

Community Networks



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This edition of GISWatch came into being alongside a brand new baby boy. Welcome to the world, Ronan Diga!

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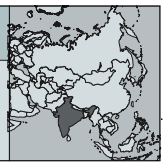
INDIA

ADDRESSING SUSTAINABILITY IN RURAL CONNECTIVITY: A CASE STUDY OF GRAM MARG COMMUNITY-LED NETWORKS



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Introduction

India's digital landscape has rapidly evolved with the introduction of the government's "Digital India" initiative.[2] This has led to an unprecedented growth in communication technologies. Internet connectivity, with the aim of achieving "accessibility for all", has penetrated at a rapid pace. This has impacted and revolutionised lives in a manner that perhaps no other technology has achieved so far.

In spite of this growth, approximately 49.5% of the population of India is still unconnected.[3] Wide rural-urban connectivity gaps exist that evidence a stark digital divide. While urban India is almost completely covered with voice and data service, rural India still suffers from inadequate connectivity. In a country with a population of 1.34 billion, there are only 325 million broadband subscribers.[4] Internet penetration in rural areas stands at 21% compared to 65% in urban areas.[5]

The Indian government, through the BharatNet initiative, aims at digitally connecting 250,000 Gram Panchayats[6] (local self-government offices at the village level) by 2019,[7] extending this to villages and households in villages through local internet service providers (ISPs), run by both government and private telecom operators. Such large-scale deployments involve significant cost to the government and, as a result, there is a need to enable this connectivity to be permanent and sustainable.

The sustainability of rural internet connectivity is based on the basic premise of supply and demand. The demand is by and large dynamic in nature due to a lack of digital awareness and an unstable customer base (primarily farmers) with no fixed monthly income. On the supply side, a lack of digital infrastructure and services, the ineffective use of available connectivity, and low profitability of investment play major roles. Due to this unevenness of demand and supply, rural areas are underserved and unreached.

In order to address this, partnership models have been identified as a suitable method for enabling sustainable connectivity.[8] There have been several types of such partnership models, such as the BOT (build operate transfer) model, BTO (build transfer operate) model, and joint venture model.[9] Globally, the private and public sectors are the

1 I thank the Gram Marg team members, in particular M. Khaturia, N. P. Rao, J. Singh, T. Ghadge, A. Patil and V. Kavale. Special thanks to the principal investigators of this project, Prof. A. Karandikar and Prof. P. Chaporkar, for their valuable insights. This study is also a part of IEEE-SA's Digital Inclusion Through Trust and Agency (DITA) programme (the affordability and accessibility work streams).

2 The Digital India initiative was launched by Prime Minister Narendra Modi on 1 July 2015 with the objective of connecting rural areas with high-speed internet connectivity and improving digital literacy. The vision of this programme is centred on three key areas: digital infrastructure as a utility to every citizen, governance and services on demand, and the digital empowerment of citizens.

3 Broadband Commission for Sustainable Development. (2017). *The State of Broadband: Broadband catalyzing sustainable development*. https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.18-2017-PDF-E.pdf

4 Telecom Regulatory Authority of India. (2017). The Indian Telecom Services Performance Indicators: July-September, 2017. https://www.trai.gov.in/sites/default/files/PIR_July_Sept_28122017.pdf

5 Indo-Asian News Service. (2018, 20 February). Acute Urban-Rural Divide in Internet Penetration in India: Report. *Business Television in India*. www.btvi.in/news/acute-urban-rural-divide-in-internet-penetration-in-india--report/57421

6 All villages in India are either Gram Panchayats or only "villages", depending on the population size of the villages. Villages that are small will fall under the same Gram Panchayat. So a Gram Panchayat may have three to four villages under it.

7 Indian Institute of Technology Bombay. (2016). *Planning for BharatNet Phase 2*. Bharat Broadband Nigam Ltd. bbnl.nic.in/WriteReadData/LINKS/Rpt_Nw_Plg_tool6cad24a7-eea8-4adc-91ff-468d7119eeb0.pdf

8 Nungu, A., & Pehrson, B. (2011). Towards Sustainable Broadband Communication in Rural Areas. In R. Szabó et al. (Eds.), *AccessNets 2010: Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, 63*, 168-175. https://pdfs.semanticscholar.org/13a6/88fc3d27f7f9b507424203c6acb5659b-1fe6.pdf; Belur, S. B., Khaturia, M., & Rao, N. (2017). Community-led Networks for Sustainable Rural Broadband in India: The Case of Gram Marg. In L. Belli (Ed.), *Community Networks: The Internet by the People, for the People. Official outcome of the UN IGF Dynamic Coalition on Community Connectivity*. https://bibliotecadigital.fgv.br/dspace/bitstream/handle/10438/19401/Community%20networks%20-%20the%20Internet%20by%20the%20people%2C%20for%20the%20people.pdf#page=194

9 In the BOT model, the private service provider provides the capital required to build, maintain and operate the service for a contract period under a concession from the government and then returns the service to the government after its contract has expired. In the BTO model, the private service provider builds the infrastructure and then transfers it to the public owner. The public owner is given the right to operate and a return on investment. This could also be called a private investment and public facilitation model. In a joint venture model, the investment is shared between the private service provider and public sector.

two key players that collaborate on initiatives to bring voice and data connectivity in rural areas and in most cases they work in partnership with each other. However, planning and maintenance delays, inadequate monitoring, funding gaps and improper management are some of the shortcomings. Because of this, these models are unable to sustain themselves in the field for very long. Apart from this, a key feature that these models lacked was involvement of local people for whom the network has been facilitated. In India, these models largely follow a top-down approach, concentrating on a customer base and a suitable return on investment. The local and regional needs are sidelined and unattended to in such partnership models, making them unviable in rural areas. As a result, in order to make connectivity sustainable in rural India, there is a need to develop a suitable partnership model with village involvement as the crux.

This report[10] discusses the Public-Private-Panchayat Partnership (4-P) model developed and validated on the ground for its sustainability in villages where connectivity has been enabled through our project. We also discuss how the 4-P model is implemented in Gram Marg villages and generates revenue, thereby making it a sustainable model. Currently this model is working successfully in the villages in the Palghar district of Maharashtra, where internet connectivity has been enabled by Gram Marg. The first part of the report gives a short overview of Gram Marg community-led networks. In the second part of the report, the development and validation of the sustainable 4-P model will be discussed. The final section highlights relevant policy measures needed for the adoption of a sustainable model in rural connectivity.

Towards rural connectivity: Gram Marg

The Gram Marg rural broadband project[11] at the Department of Electrical Engineering, Indian Institute of Technology Bombay (IIT Bombay), aims at connecting the unconnected by overcoming the barriers and challenges to connect rural India. In order to provide ubiquitous connectivity to rural, remote areas, research and development at the Gram Marg lab has suggested that a shift is required from traditional technologies to a more affordable, efficient and robust technology. To this effect, Gram Marg has deployed two large-scale test beds since its inception in 2012.

The first test bed that was set up by Gram Marg was based solely on TV white space (TVWS) technology, covering seven villages in Palghar, spanning an area of 25 km^2, in 2013-2014. The purpose of setting up a TV UHF band test bed was to check the feasibility of using TV UHF for middle-mile connectivity to provide high-speed broadband access to the villages. The test bed consisted of a single base station which connected to 12 clients situated at selected locations at varying distances. A 20 Mbps leased line was provisioned at the base station. A total of 10 Wi-Fi access points were deployed as well as three community kiosks, which were backhauled using the TV UHF band. Detailed results from this test bed have been published in papers.[12]

The second test bed is a scaled-up version of the earlier test bed which experimented with the feasibility of unlicensed bands such as 5.8 GHz for middle-mile connectivity covering 25 villages in Palghar, Maharashtra. The test bed spans an area of about 300 km^2, a network diagram of which is shown in Figure 1. Villages are divided into clusters of four to five villages, resulting in six clusters. Each cluster has one base station that has a fibre point of presence. In one cluster group of 15 villages, access is offered at Gram Panchayat offices only. In a second cluster group of 10 villages, Wi-Fi access points are deployed at strategic locations that can be accessed in and around those locations. In all, a total of 60 Wi-Fi access points have been deployed in the 10 villages, with six access points per village. These access points are set up at the Gram Panchayat office, primary health care centres, at least one school and one community centre. A total of 106 Mbps bandwidth has been procured to serve the 25 villages.

Establishing a community-led network

Seeding the growth of a community-led network has been an important achievement of the test bed. An internet needs assessment survey suggested that enabling connectivity was not enough for the villages. There needs to be ownership of the network by the village authorities so that local and regional needs will be prioritised. Community involvement in the connectivity can help in the maintenance of the network and take care of the security of the devices. Local youth from the village community can also be effectively engaged through skills development and training.

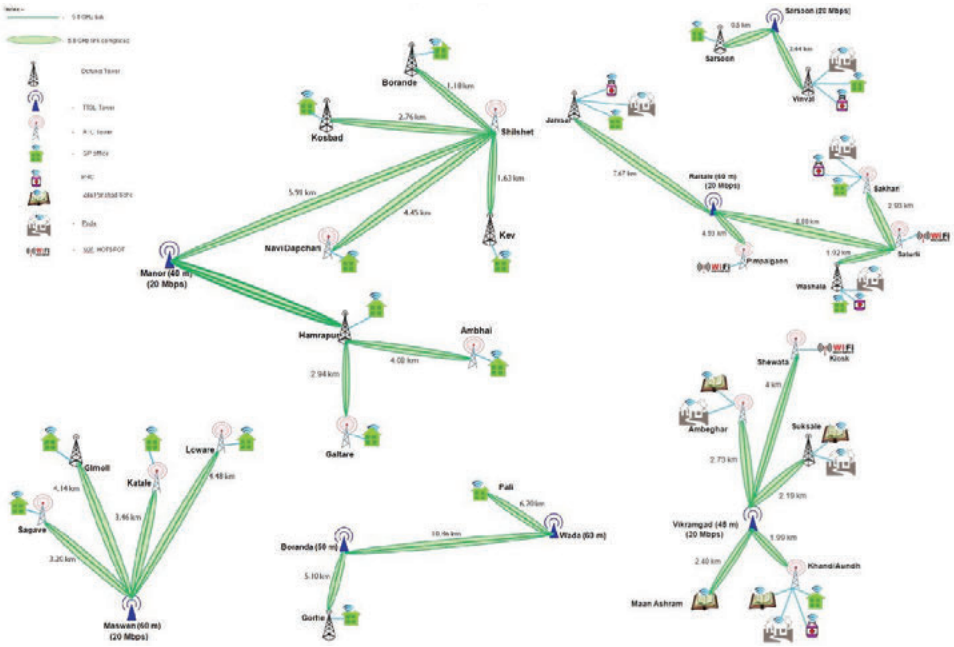
10 This report has been an outcome of a research project partly funded by Tata Trusts.

11 www.grammarg.in

12 Kumar, A., Karandikar, A., Naik, G., Khaturia, M., Saha, S., Arora, M., & Singh, J. (2016). Toward enabling broadband for a billion plus population with TV white spaces. *IEEE Communications Magazine, 54*(7); Khaturia, M., Belur, S. B., & Karandikar, A. (2017). TV White Space Technology for Affordable Internet Connectivity. In R. Stewart, D. Crawford, & A. Stirling (Eds.), *TV White Space Communications and Networks*. Woodhead Publishing.

FIGURE 1.

Network diagram of 25 villages in the Palghar project



Out of the 25 villages covered in the second test bed, community networks were set up in 10 villages only. They were selected for two reasons: i) the location of these villages was in remote pockets and hilly areas, and ii) there was no mobile coverage in these villages. Figure 2 depicts the network diagram of the 10 villages where the community network is currently operational. As seen in the figure, a point-to-point 5.8 GHz link has been set up from the tower at the base station to the Gram Panchayat office. Connectivity is further distributed inside the village in a mesh network through six access points that are placed strategically inside the village. As a result, the entire expanse of the village is Wi-Fi enabled.

The network in the 10 villages is maintained through community participation. A village youth is nominated as the Village Level Entrepreneur (VLE) who undergoes training and skills development to maintain and operate the network in the village. The VLE is registered with the government's Common Service Centre (CSC) programme to ensure citizen service centres operate in all Gram Panchayat offices in India. CSC e-Governance Services India Limited, a special purpose vehicle, has been created by the Ministry of Electronics and Information Technology (MeitY) in order to extend digital services in rural areas. Wi-Fi Choupal[13] was set up alongside this to extend connectivity using Wi-Fi-based network infrastructure.

As an ancillary to the CSC, Wi-Fi Choupal has partnered with Gram Marg in the 25 villages Palghar project. Wi-Fi Choupal, as an ISP licence holder, uses the VLE to sell bandwidth inside the village through fixed-pricing plans. In these villages the connectivity is currently being used both on smartphones as well as in the village Gram Panchayat office for accessing and enabling e-governance services.

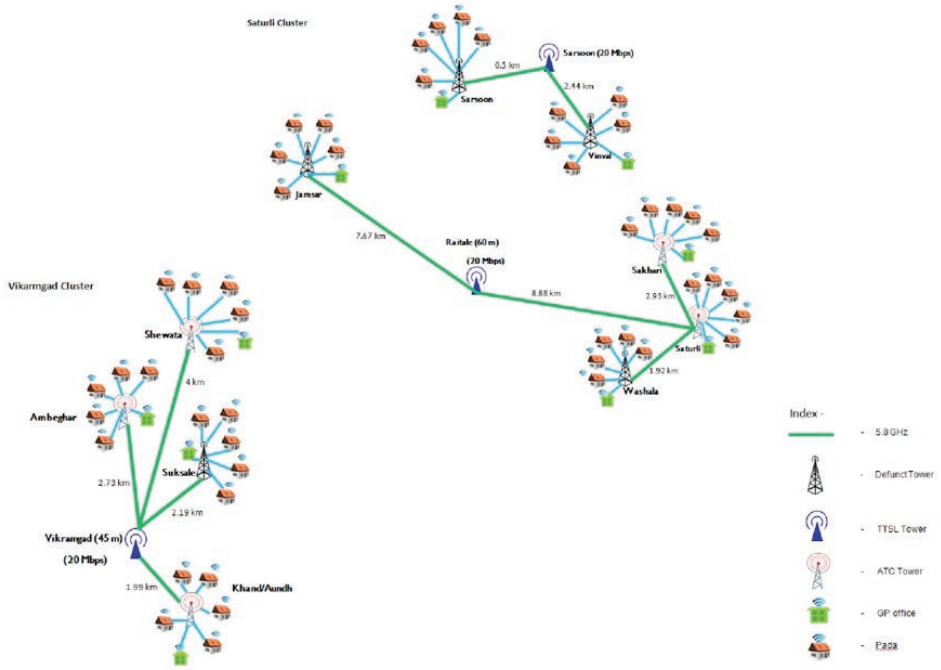
Sustainable economic partnership model

As mentioned, in order to make the connectivity sustainable, the 4-P model was developed. This partnership model was developed for all the 25 villages in Palghar. The main reason behind developing the partnership model has been to throw light on how different partnerships can facilitate connectivity to remote, rural villages. The model also lays stress on the fact that no single entity (i.e.

13 www.wifichoupal.in

FIGURE 2.

Community network villages in Palghar



private telecom operators) or the government is responsible for enabling connectivity to the unserved. Important aspects of the model are: i) the Panchayat (i.e. the village administration) has been introduced into the partnership model alongside the public and private partners, and ii) the partnership model adopts a bottom-up approach with the involvement of the villagers, focusing on the local and regional needs with regard to connectivity. As the Panchayat represents the village administration, and is elected by the people of the village and backed by the district and state government, its participation adds value to the partnership in terms of authority, ownership and financial disbursement.[14]

The role of each of the partners in this partnership model is as follows:

- The Panchayat owns the network at the village level. It plays a major role in defining priorities for the local digital needs of the villagers. In one revenue model it purchases the bandwidth and enables revenue generation by reselling the bandwidth to the villagers. In another revenue model, local youth from the villages are appointed as VLEs by the Gram Panchayat and operate and maintain the network in the village, also selling bandwidth to the villagers.
- The private sector partner provided the bandwidth which enabled connectivity to the 25 villages.
- The public sector partner plays a vital role in technology innovation, deploying the network and providing the capital expenditure (CAPEX) funding for setting up the network infrastructure in the villages.

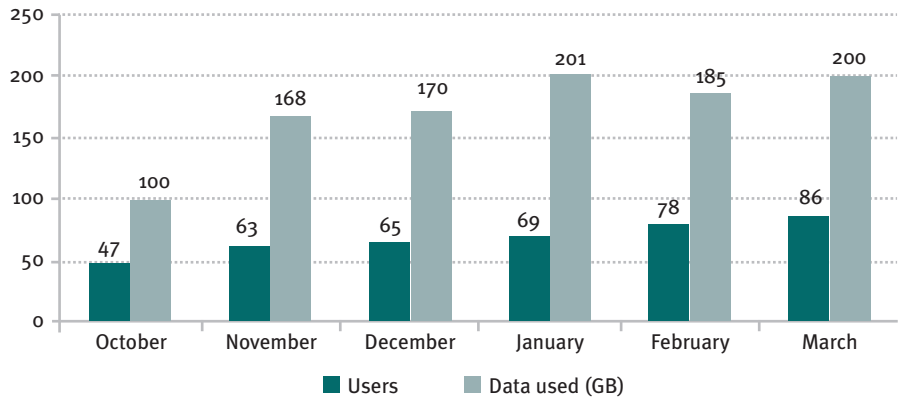
Validation of the 4-P model on the ground

A partnership model is not sufficient in itself if it does not have revenue generation as an important part of it. The revenue generation aspect of the partnership model addresses the sustainability of the connectivity after the unconnected villages are connected. For the validation of the 4-P model on ground, the first step has been to identify the two important cost indicators, i.e. CAPEX and operational expenditure (OPEX). For setting up a network,

14 Further details about the 4-P model can be found in Belur, S. B., Khaturia, M., & Rao, N. (2017). Op. cit.

FIGURE 3.

Data usage and number of users from traffic data



there is a CAPEX investment that is needed and the OPEX needs to be recovered. Revenue generation has, as a result, been identified as an important aspect of the model, without which the model cannot be sustained. This incentivises the Gram Panchayat and the VLE to maintain the network in the village. Usage of the connectivity was also analysed through monitoring traffic data, which helped in understanding the bandwidth requirement at each Gram Panchayat.

In order to test the sustainability of the 4-P model, the 25 villages have been divided into two groups each with a different revenue-generation method. The villages were separated into groups based on their proximity to the highway (Mumbai-Ahmedabad Highway): 15 villages that are located close to the highway comprised one group and 10 villages that are located in the remote tribal areas comprised the second group. The 4-P model is being validated in the two groups to test the model's viability, scalability, replicability and adoption in different village contexts.

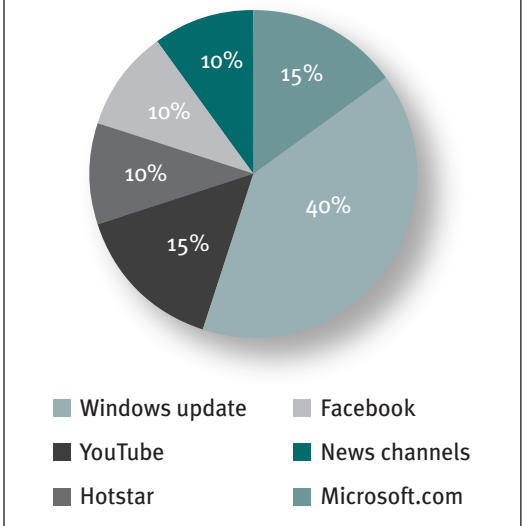
The first step in the validation process has been to look at the traffic data of all 25 villages. The network went live in October 2017. Initial analysis of the traffic data from all the villages suggests that connectivity is being used by the people. Data from October 2017 to March 2018 (as illustrated in Figure 3) show an increase in number of users and in data usage. This can be viewed as a satisfactory service in terms of internet availability and speed.

Data on monthly uploads and downloads by the internet users in these villages shows that there are more downloads than uploads. From October 2017 to March 2018, downloads increased from 96 GB to 154 GB. While uploads account for less data usage than downloads they are also increasing, from 6 GB to 15 GB. This is in line with consumer patterns where downloads are more than uploads.

The traffic data of the 25 villages also gives a broad overview of the utilisation of bandwidth by the

FIGURE 4.

Data usage and number of users from traffic data



users in the form of websites most visited. As shown in Figure 4, 40% of the bandwidth has been used for Windows updates, followed by YouTube, Hotstar[15] and visits to Microsoft.com. In the case of Windows updates, this is likely to be the result of automatic updates by the software vendor. Due to the high illiteracy levels (60% in these villages), users say that they are unable to do keyword searches. As a result they prefer sites like YouTube and Hotstar.

Revenue generation as part of the 4-P model

In the 15 villages cluster (the first group), the revenue model is through the local ISP. The local ISP has enabled 2 Mbps bandwidth at each Gram Panchayat office and gets directly paid by the Gram Panchayat. The local ISP further sells the bandwidth inside the village as part of its marketing strategy and generates revenue from the connectivity. The Gram Panchayat office pays a fixed price of INR 1,000 (USD 14) for 2 Mbps of bandwidth. This cost includes the bandwidth cost, operation and maintenance of the link and device cost if the device needs replacement due to damage. However, as the Gram Panchayat office does not use the entire bandwidth, the unused bandwidth is sold to the villagers in the form of "pay as you use" daily coupons of a duration of one hour each costing INR 10 (USD 0.14). This connectivity is accessed at the Gram Panchayat office. It has been observed that an average of five to 10 people use the internet at the Gram Panchayat office per day, which totals INR 50 to INR 100 (USD 0.70 to USD 1.40) per day and results in a monthly income of INR 1,500 to INR 3,000 (USD 21 to USD 42). This contributes to the monthly revenue of the Gram Panchayat. Out of this amount, INR 1,000 (USD 14) is paid to the local ISP, as noted above. The Gram Panchayat office plans to use the accumulated amount for development activities within the village.

The second set of 10 villages has a VLE-focused revenue model, where CSC Wi-Fi Choupal has acquired 30 Mbps bandwidth from a local ISP[16] and distributes the same to different villages depending on internet use and number of customers in each village. The VLEs maintain the network in these villages and sell bandwidth to the villagers in the form of coupons based on the fixed pricing plan. The monthly customer base of the VLEs includes new customers as well as returning customers. The revenue plan of the VLEs has been devised in a way that it maximises profit for the VLE, thereby providing incentive to perform. It has been observed that of the coupons sold per month, 40% of the coupons are of INR 10 (USD 0.14) in value, which gives 500 Mb of data for 10 days. The next most popular coupon amount, accounting for 22% of purchases, is INR 100 (USD 1.40), which is valid for 28 days and gives 12 GB of data.

Revenue information suggests that in those villages where there is a substantial use of internet data and a large customer base, the monthly revenue generated by the VLE is in the range of INR 5,000 to INR 6,000 (USD 70 to USD 84). In other villages, the monthly revenue generated is INR 3,000 to INR 4,000 (USD 42 to USD 56) on average.

In the months to follow, it is expected that the number of broadband subscribers will increase, which will directly have an effect on the revenue generated by the VLEs. A steady growth in revenue generation by the VLEs suggests that the model will perform well and also offers lucrative value for the investment made. A nominal pricing plan for data will facilitate greater usage by rural villagers.

Conclusions and the road ahead

In this report, we address the importance of sustainability of broadband connectivity in rural areas of India. We have discussed Gram Marg's 25 village Palghar test bed and how it has attempted to answer various issues regarding rural connectivity through test bed deployments and setting up community networks in 10 villages in Palghar, Maharashtra. We also discuss the 4-P model which has been developed and successfully validated in the field with regard to sustainability. As the 4-P model takes a bottom-up approach, it is a robust and scalable model which generates revenue, enabling the internet to thrive and grow sustainably.

Even though the 4-P model has been successfully validated in the Gram Marg villages, we need to replicate the model in different village contexts, and with different CAPEX contribution scenarios, to understand the model in its entirety. As of now, the model is based on actual expenditure and real field data on usage, revenue generation and recovery of OPEX. In time we shall come up with a projection model taking into account the growth rate of internet subscribers, expected growth in internet demand, and yearly increases in the monthly cost of internet usage. This will enable predictions of revenue accrued by the VLEs and the Gram Panchayat over a period of time.

The district administration also needs to have a voice about their need to be connected and take ownership of the network as soon as connectivity has

15 An Indian digital and mobile entertainment platform. https://www.hotstar.com

16 Wi-Fi Choupal is an ISP licence holder only. It acquires bandwidth from private telecom operators and then distributes the bandwidth and generates revenue.

been enabled. With the Panchayat at the core of the 4-P model, the model becomes very localised, which will eventually help in the betterment of the model.

This sustainable economic model can be the foundation for making rural broadband become financially self-dependent at the village level. As the model focuses on broadband usage, supply and demand, it can effectively formulate the cost effectiveness of technologies used. Unless such a self-sustainable model is implemented, it will be difficult for the internet to penetrate rural areas.

Action steps

We would like to emphasise the following policy recommendations in support of community networks in India:

- Community networks are allowed to operate in India but there are no specific policies that support such networks. They should be promoted and encouraged by the government.
- Mere internet connectivity should not be the only agenda when connecting rural villages. Seeding the growth of community networks, developing community technologies and encouraging the meaningful use of connectivity should be set as priorities by the government.
- Sustainability of connectivity is a serious issue that needs to be addressed. In most cases, this is thought about only after the network deployment has taken place and the project funds are running dry. However, if the sustainability plan is chalked out and conceptualised during the planning phase of network deployment, all stakeholders in the model can take equal responsibility.
- The village administration (i.e. Gram Panchayat) should be given the authority to address connectivity challenges in their own villages. Government policy measures should help Gram Panchayats to form cooperatives or groups with a legal status to own the network. There can be a provision for such groups to acquire a special ISP licence, making them eligible to procure and sell bandwidth.
- Internet connectivity is still not a part of the development plan of Gram Panchayats in India. As each Panchayat is expected to develop an annual development plan, internet for development can be included in it. In this way, the money for enabling connectivity to the Gram Panchayats can be financed by the state government.
- It is necessary for a sustainable partnership model to grow within a community network. This will enable better community participation and involvement for the sustainable model to thrive in rural areas.

GLOBAL INFORMATION SOCIETY WATCH 2018

Community Networks

THE 43 COUNTRY REPORTS included in this year's Global Information Society Watch (GISWatch) capture the different experiences and approaches in setting up community networks across the globe. They show that key ideas, such as participatory governance systems, community ownership and skills transfer, as well as the "do-it-yourself" spirit that drives community networks in many different contexts, are characteristics that lend them a shared purpose and approach.

The country reports are framed by eight thematic reports that deal with critical issues such as the regulatory framework necessary to support community networks, sustainability, local content, feminist infrastructure and community networks, and the importance of being aware of "community stories" and the power structures embedded in those stories.

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