GLOBAL INFORMATION SOCIETY WATCH 2018

Community Networks

Association for Progressive Communications (APC)
and International Development Research Centre (IDRC)

Global Information Society Watch

2018

APC

IDRC | CRDI

International Development Research Centre
Centre de recherches pour le développement international

Canada

Global Information Society Watch 2018
Community Networks

Operational team
Roxana Bassi (APC)
Valeria Betancourt (APC)
Kathleen Diga (APC)
Alan Finlay (APC)
Michael Jensen (APC)
Carlos Rey-Moreno (APC)

APC project coordination team
Namita Aavriti (APC)
Roxana Bassi (APC)
Valeria Betancourt (APC)
Kathleen Diga (APC)
Anriette Esterhuysen (APC)
Flavia Fascendini (APC)
Alan Finlay (APC)
Chat Garcia Ramilo (APC)
Michael Jensen (APC)
Carlos Rey-Moreno (APC)

GISWatch 2018 advisory committee
Carlos Baca (REDES)
Luca Belli (FGV)
Jane Coffin (ISOC)
Kazanka Comfort (Fantsuam Foundation)
Stéphane Couture (York University)
Alison Gillwald (Research ICT Africa)
Michuki Mwangi (ISOC)
Leandro Navarro (PANGEA)
Dorothy Okello (WOUGNET/Makerere University)
Nico Pace (AlterMundi)
Steve Song (Village Telco/Rhizomatica)
Ritu Srivastava (DEF)

Project coordinator
Kathleen Diga / Roxana Bassi (APC)

Editor
Alan Finlay

Assistant editor and proofreading
Lori Nordstrom (APC)

Publication production support
Cathy Chen

Graphic design
Monocromo
info@monocromo.com.uy
Phone: +598 2400 1685

Cover illustration
Matías Bervejillo

This work was carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada, as part of the APC project "Community access networks: How to connect the next billion to the Internet". More information at: https://www.apc.org/en/project/local-access-networks-can-unconnected-connect-themselves
The views expressed herein do not necessarily represent those of IDRC or its Board of Governors.

IDRC | CRDI Canada
International Development Research Centre
Centre de recherches pour le développement international

Financial support provided by
Sida

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

Published by APC
2018

Printed in USA

Global Information Society Watch 2018 web and e-book
ISBN 978-92-95113-06-0
APC-201810-CIPP-R-EN-DIGITAL-296

Towards financial sustainability in community-based networks

Mike Jensen
Association for Progressive Communications (APC)
https://www.apc.org

Introduction

Community networks are increasingly being seen as a means to help address the need for affordable connectivity where traditional commercial networks are not present or are too expensive to use. According to a 2018 report by the GSMA, these areas represent a substantial portion of the planet – up to 40% of the world's population will still not have internet access by 2025, while 30% will not even have voice connectivity.[1] Considering that after more than 20 years of deployments in developing countries, mobile network operators have been unable to respond to demand for even basic voice connectivity, this is clearly not a simple problem to solve.

Due to their generally small size, there are limited economies of scale in community networks, which often means more costly services to operate the network, resulting in higher per-user overhead costs than in larger networks. Since community-based networks often operate or plan to set up in remote, sparsely populated areas, costs are higher than in urban areas for providing internet connectivity and energy, as well as for transport and sourcing of the business and technical skills, which are usually scarce in these areas. And although there may be many important social and economic benefits that can be derived from a community network, it is often difficult to translate these benefits into the cash needed to pay for the network and its operations.

On the positive side, in contrast to traditional commercial operators, community-based networks are able to start at a very small scale and have a more diverse range of models for achieving financial sustainability. In addition, they are less likely to need an expensive marketing and public relations budget. While some community networks may operate much like a traditional commercial network (where users pay a monthly fee to cover all costs), others may draw to varying levels on volunteer labour, donations of equipment, donated upstream bandwidth and the use of high sites to erect towers and antennas, or subsidies from government and commercial sources.

Primarily focusing on remote or rural areas where connectivity is not available, this report looks at the different aspects that may be considered in maximising the potential for small-scale networks to achieve financial sustainability by leveraging opportunities to minimise costs and access start-up funds.

Starting small

At the outset, it should be noted that many community-based networks have started on an informal basis from very small beginnings, which require almost no initial external financial support. Considering that the high cost of internet access is a major barrier to increased connectivity, it is not surprising that the most common example is the Wi-Fi broadband network, where the cost of a link to the internet is shared among a number of users via Wi-Fi. Households and offices do this routinely, but this can easily extend to providing links to neighbours. If the users are close enough and they install their own routers, the only cost is for each user to pay their share of the monthly fee for the upstream connection to the internet, and perhaps add a small contribution for router power consumption at the location of the shared upstream connection.

Bandwidth costs and network scaling

Ensuring the lowest possible cost for upstream connectivity to the internet is often a top priority with community networks, as this usually has the single largest impact on overall operating costs, and ultimately, on the financial sustainability of the network.

Some communities have been able to negotiate with their upstream internet provider to reduce the fees for the bandwidth leased – often a university, a government infrastructure provider or perhaps a

1 GSMA. (2018). *The Mobile Economy 2018*. https://www.gsma.com/mobileeconomy

sympathetic local internet service provider (ISP). Even if a discount cannot be arranged from an ISP, and there are no other nearby supporting organisations with capacity to spare, commercial ISPs still usually charge less per Mbps for higher capacity commitments. This means the larger the initial network deployment (in terms of numbers of users), the lower the monthly cost per user. And if cheaper additional bandwidth is available to respond to demand as the network grows, the cost savings can be passed on to the users. This lower cost of participation further adds to the network effect in attracting new members.

It is also worth taking into consideration that as the network grows, bandwidth costs per user are further reduced, because usage is more evenly spread over time with a larger user base. So, for example, doubling the number of users does not require doubling the upstream capacity in order for each user to have the same network experience. As a result, even if extra capacity costs the same on a per-Mbps basis, the cost of upstream bandwidth per user reduces as the number of users grows. If this can be translated into reduced charges for cost recovery from users, this will further incentivise participation in the network.

In networks providing voice services, the economies of scale are smaller, because each voice channel requires symmetric, dedicated capacity with low latency and high quality of service. As a result, service fee increases are more linearly linked to traffic increases. Balancing the number of channels required in peak and off-peak periods can involve compromises and requires experience. In addition, there may be recurring costs associated with allocation of numbering resources. Furthermore, unless there is a favourable regulatory regime, small voice networks can struggle to meet the minimum interconnection requirements of the larger national operators, let alone gain any volume discounts from them.

Once a broadband network has grown to a sufficient size, upstream bandwidth costs are often significantly reduced by installing a caching server on the network. The server stores copies of content requested by users, thereby reducing duplication of traffic on the link whenever that content is requested again by the same or another user. Pre-fetching content and refreshing mirror servers (such as software and operating system updates, Wikipedia, etc.) during off-peak periods can further optimise the use of the link for peak traffic during the day. Some community networks have also taken additional steps to manage their expensive upstream capacity by setting up their routers to filter access to high-bandwidth websites, especially during peak periods.

Exploiting the availability of the excess internet capacity of nearby larger institutions during off-peak periods has also proved an effective strategy in cutting upstream bandwidth operating costs. For example, AlterMundi in Argentina has an agreement with the National University of Córdoba[2] for free capacity of up to about 10 Mbps during the day, but in off-peak periods the community network can access as much capacity as is available to the university, in practice about 250 Mbps. Members of the network adapt their usage accordingly, knowing that access at peak time is likely to be less efficient.

Where low-cost off-peak capacity is not available from a larger nearby institution, some community networks, such as Pamoja in the Democratic Republic of Congo (DRC), have leveraged the peak/off-peak dynamic by leasing capacity during office hours to local businesses at commercial rates (and higher service levels), while making the service available at a much lower cost (or free) to the public during the rest of the day/night. This strategy can also be adopted more generally by charging all users a differential rate for peak versus off-peak usage, or even making usage free during off-peak periods.

Finally, it should also be noted that many community networks have not aimed to provide access to the upstream internet, focusing instead on linking the community directly with each other and to locally hosted servers and content. Naturally these networks are unburdened with upstream connectivity costs, although in some cases it is assumed that the participants have their own internet connections (mainly in urban environments). In others, the networks are "islands" completely unconnected with the "rest" of the internet, such as Mesh Bukavu,[3] which hosts a large amount of content online locally.

Gaining independence

If the community network's upstream connection is provided on a purely commercial basis by a single operator, the network is essentially reselling the service in smaller chunks on their behalf and absorbing the cost of collecting the fees. In this situation the community network is also dependent on the prices for capacity charged by the operator, and must pay for all the upstream traffic, even when it is destined for other local networks nearby.

2 See the Argentina country report in this edition of GISWatch.

3 See the DRC country report in this edition of GISWatch.

If other ISPs are present, then it makes sense for community networks to establish additional direct links to at least one of the other operators as well. Although this requires greater technical knowledge and a more capable router (to be able to route traffic efficiently between multiple networks), this not only gives the network a better negotiating position on the price of upstream capacity, but also makes the network faster for the users of the interconnected networks, and reduces capacity needs on the original link. Ideally, if it is possible to establish a link to a local internet exchange point (IXP), then more networks can be reached directly, and it should normally be possible to "peer away" even more traffic, further reducing the costs for transit capacity purchased from upstream providers.

As importantly, a single link to one upstream provider also creates a vulnerable point of failure, while a network with multiple upstream connections will be more reliable, because one of the providers can go down and the network will continue to function.

Reliability quickly becomes an important concern once an affordable service has proven itself and as the community becomes more dependant on it, especially for economic activities, such as remote work. Long periods of downtime can quickly sap confidence in the network, and generally chill the level of use when connectivity returns. If there is only one source of cost-effective capacity in the area, it can still make sense to set up a 3/4G backup link for urgent traffic if a mobile network is accessible (perhaps through a long distance Yagi antenna).[4] Alternatively, a tower or high site, or even a satellite link, may be needed to reach other more distant options for obtaining backup connectivity.

Minimising the cost of additional resource needs

At the next level up in terms of costs and infrastructure required for the network, there may be a need for a tower and/or network equipment to provide mobile voice and data services, or to relay the signal to a distant community, a larger institution or a sub-set of users. In some cases, this might also involve site rental for a high site on which to locate the relay equipment, and tower insurance. Along with upstream capacity, these costs are usually the other major cost component of a community network, especially if a large tower is needed, and/or solar power and protection against lightning is required.

Sometimes the owner of the high site will accept the provision of free connectivity in return for installation of a tower on the location. If there is already a telecom tower of some form on the site or nearby, it may be cheaper to lease space on the tower than construct another. However, this may require some hard negotiating or bringing in the telecom regulator to ensure that infrastructure-sharing regulations (which should include price caps for space rental) are being adhered to. These regulations are unfortunately not widely adopted in many developing countries – for example, Airtel still charges USD 1,300/month for space on one of its towers in Rwanda, a country which prides itself on having one of the more advanced regulatory environments on the African continent.

Tower costs can often be reduced by having them locally constructed, and by mounting shorter towers on existing tall buildings, or even trees, if available. In addition, use of non-line-of-sight frequencies (most often those lower than 800 Mhz) means that towers do not have to be high enough to reach over trees, buildings and other obstacles, which considerably reduces tower deployment costs. This was noted in the Gram Marg network in India,[5] where the initial TV white space (TVWS) deployment used relatively low towers. When the network had to switch to line-of-sight 5 Ghz links due to regulatory issues, the towers required needed to be much higher. As a result, although 5 Ghz radio equipment for the links is much cheaper than the TVWS equipment, the overall deployment costs were significantly higher because the tower costs were a much larger component of the total cost.

Similarly, with mobile voice and data services, choice of lower frequencies (e.g. 700 Mhz rather than 1800 Mhz) means that towers can be shorter and/or farther apart because lower frequencies travel farther, providing greater coverage. Voice (2G) deployments in the lower frequency bands can also take advantage of the much longer distance that these signals cover relative to 3G/4G data connections.

Fortunately, the cost of equipment for generating electricity from solar power continues to drop, but the batteries, electronics and solar panels for off-grid sites can often still cost as much as the tower itself, especially when the power system needs to support mobile networks, for which the base stations consume significantly more energy than Wi-Fi. However, for off-grid locations, it should be noted that energy needs in a mobile network are concentrated at the tower and overall energy consumption

4 https://en.wikipedia.org/wiki/Yagi%E2%80%93Uda_antenna

5 See the India country report by Gram Marg in this edition of GISWatch.

in a mobile network is lower, because the end-user devices use less power than the user's router and access equipment in a Wi-Fi network.

In general, because of the reliability concerns described above, it is important to dimension the power system sufficiently to ensure that occasional long periods of cloudy weather do not cause a system outage. In addition, availability of backup equipment, ideally stored on-site, for quick replacement of broken parts also needs to be considered, as well as the lightning protection and security for the tower equipment if necessary – some community networks need to employ full-time patrols to guard against theft.

The community network may be required to pay licence, spectrum, business and other fees, for which there is often no way to reduce costs, except by spreading them across a larger user base. However, as the importance of these networks is being increasingly recognised, it is hoped that more countries will follow the example of Mexico in recognising the social purpose of these networks,[6] and making appropriate dispensations to support them by providing access to licensed spectrum and limiting bureaucratic burdens and unnecessary fees and taxes.

Aside from spectrum and licence fees, import duties should not be ignored, as these can often double the cost of the network equipment, and also often add significantly to the cost of end-user access devices. If waivers on import duties cannot be obtained from the government for community networks, it may be possible to avoid some of these taxes through partnerships with charities which have special status, or through informal import channels.

Use of open source hardware and software also helps to bring down equipment costs and provides many other advantages. This is already a relatively common strategy among community networks where proprietary Wi-Fi hardware is often modified with open source routing software (e.g. Open-Wrt). This trend is similarly found now for mobile network infrastructure thanks to projects like Osmocom for 2G/GSM and OpenAirInterface and NextEPC for 4G/LTE.

There are now also an increasing number of open hardware platforms, in particular the much-anticipated LibreRouter initiative by AlterMundi, a number of 2G base stations such as those from Fairwaves and Sysmocom, and the OpenCellular LTE base station currently under development. These new devices generally offer cost advantages over the traditional equipment commonly being used – in particular, the presence of three radios in the LibreRouter increases the available capacity on the mesh, and obviates the need for duplicate devices when acting as a relay or mesh node, while simultaneously performing hotspot functions to provide end-user access.

Buying network equipment in bulk or organising group purchases with other community networks can also help to bring down equipment costs. Community network collaboration is particularly important for helping reduce prices in small community-driven hardware projects such as the LibreRouter, which does not benefit from the same economies of scale as consumer devices mass produced by the large companies operating in this market.

In relation to the administrative and human resource aspects of a community network, the involvement of community members is usually essential to minimising costs of deployment and operations. While technical and business skills often need to be initially sourced from outside the community, with fairly minimal training, local volunteers can be used for many tasks, such as erecting towers and installing equipment on roofs, or even day-to-day technical and administrative tasks (troubleshooting, adding users, collecting fees, etc.).

Nevertheless, once the network grows beyond a certain size, the most cost-effective solution is likely to involve part-time or even permanent staff from within the community. In some cases, especially where there are multiple similar networks operating in the country with licence compliance needs and shared use of other resources (such as higher level technical expertise, a satellite link or DID numbers),[7] it can make sense to establish a national or regional organisation that can take on the burden of many of these common administrative tasks. This has been done in Mexico with TIC A.C. to support its member villages operating community networks.

Fundraising

In some locations, the members of the community may be able to fundraise internally to cover the costs of the network, especially if there are some potential businesses or other organisational users willing to contribute. In cases where telecom

6 See the discussion on TIC A.C. in the Mexico country report in this edition of GISWatch.

7 https://en.wikipedia.org/wiki/Direct_inward_dial

infrastructure is managed as a common-pool resource, finance is crowdsourced by those benefiting from the infrastructure. See for example the country report on guifi.net in Catalonia, which won a European Commission Broadband Award with this approach.

However, in most rural areas in the developing world, the resident population is unlikely to be able to provide the needed resources, and external fundraising will be required. In choosing targets for fundraising, it is worth noting that there are three intrinsic difficulties in raising funds for networks focused on remote and rural areas from traditional lenders, investors and soft funders (banks, venture funds, development institutions, etc.):

- Scale: Rural networks are likely to have far fewer customers than urban networks, rendering them less attractive to traditional investors or lenders, be they commercial or soft (development) funders. This is because the overheads for due diligence and administering smaller disbursements are not so different from those for larger-scale projects, resulting in a relatively high cost of finance, especially if they are in remote and isolated locations which may be unfamiliar to the funder. Also, many of these networks may be purely focused on provision of connectivity in a particular location, and may have little or no interest in scaling and replicating in ways that would create the larger projects that are more attractive to traditional funders.
- Real and perceived levels of risk: There may be higher actual or perceived levels of risk by potential funders because the initiatives are based on novel business models, may be run by people with limited management skills, or use new technologies in unfamiliar contexts. These initiatives may also lack land collateral or other asset sureties needed to provide guarantees for loans. Even if collateral is available, in many developing countries the cost of commercial bank loan finance is exceedingly high to reflect the high level of perceived risk, so this option is unlikely to be cost effective for a community network.
- Low surplus revenues: Networks serving remote and rural areas usually operate in locations with low income levels, and where operating costs are substantially higher in comparison to urban areas. Therefore, the ability to service a loan or provide a return on an investment may be quite limited. Furthermore, there are many networks which a) do not aim to make a profit and/or b) try to ensure that fees for service are as low as possible. This may disincentivise traditional investors in the telecommunication sector looking for higher returns.

Given these considerations, community networking initiatives are likely to find raising the needed startup funds from commercial or other traditional lenders difficult. Even soft loans from development funds are still currently more focused on large-scale national initiatives, and as conservative lenders or grant makers, they need to be convinced of the potential for the novel strategies and innovative business models of community networks. Ideally, local intermediaries acting for many networks could play a key role in this area, as they may be more familiar with the landscape and can better evaluate potential initiatives, aggregate needs, as well as manage the disbursement of funds received from large funding sources.

To meet the funding gap, a variety of other fundraising strategies can be considered:

- Universal service funds: National governments usually have universal service funds to support the provision of access in rural and underserved areas. Many of these have already accumulated large amounts of unspent funds, partly because of the limited capacity of regulators to evaluate and disburse funds, and also because of the paucity of effective projects to support. Given the recent response of regulators and policy makers who have been sensitised to the potential of community networks, it would appear that this avenue of support is likely to become increasingly fertile in future.
- Grants and awards from Regional Internet Registries (RIRs), ccTLD operators, the Internet Society, APC and other international NGOs and commercial tech organisations such as Facebook, Microsoft and Mozilla: While the funds available from these organisations are relatively small, these institutions have been the most common source of financial support for community networks to date.
- Provision of in-kind services: These can reduce the startup and operating costs of the network by tapping into the corporate social responsibility (CSR) programmes of businesses, forming partnerships with local and international NGOs operating in the area and local government offices. Examples include donation of equipment, skills/training, tech volunteers and bandwidth.
- Cross-subsidisation: As discussed earlier, in some cases, community networks may be financially sustainable by charging businesses a

monthly fee and giving discounts to the general public. Funds for the cross-subsidy can also come from other services provided, which may be unrelated to the provision of connectivity to the end-user – for example, hosting remote sensing equipment (weather, air quality, etc.) for a government or research agency, as is being experimented with at TakNet/Net2Home in Thailand.[8]

- External crowdsourced funding: Crowdsourcing funds from outside the community offers significant though untested potential. However, there may be interest from the diaspora and people in developed countries who have visited the area as volunteers or tourists, among others, in funding a local initiative.

Conclusion

This report aims to familiarise the reader with the most common strategies for minimising and sharing costs in community networks, and in raising the necessary financial and other resources to help support their long-term financial sustainability. Given the relatively short time frame and difficult conditions in which community-based networks have emerged, the extent to which these strategies will help ensure a place for community networks in meeting the needs of connecting the unconnected is still unclear. However, given the diversity of strategies that have already emerged and the level of interest in supporting community networking initiatives, the prognosis is good.

8 See the Thailand country report in this edition of GISWatch.

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.

GLOBAL INFORMATION SOCIETY WATCH
2018 Report
www.GISWatch.org

ISBN 978-92-95102-07-1

IDRC | CRDI
International Development Research Centre
Centre de recherches pour le développement international

Canada