EXPANDING THE TELECOMMUNICATIONS OPERATORS ECOSYSTEM:

POLICY AND REGULATORY GUIDELINES TO ENABLE LOCAL OPERATORS

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A response to the consultation for the GSR 2020 Best Practice Guidelines

This document has been drafted as a contribution to the GSR-20 Best Practice Guidelines Consultation. It was jointly developed by ITU Sector Member, the Association for Progressive Communications (APC), with authors from partner organizations Redes AC (Mexico) and Universitat Politècnica de Catalunya in an attempt to document regulations that will enable the sustainable growth of the digital economy as well as meet the social needs of citizens around the world.

The essential role that internet access plays in coping with the COVID-19 pandemic and indeed in modern life in general has become abundantly clear to all. Yet half the world remains unconnected to the internet. Recent actions by regulators around the world to cope with the additional strain on networks have brought some relief, particularly in increasing capacity for existing networks. However, rural areas with sparse populations and often lower income levels have yet to see any significant change in access.

This document makes the case that telecommunication policy and regulatory efforts need to be more deliberately focused on the issues of inclusion and affordability. Without this shift in priorities, regulatory efforts run the risk of magnifying the digital divide.

To achieve the goals of inclusivity and affordability, the focus of regulation needs to go beyond the conventional approach of focusing on a few national-scale operators towards an expanded operator ecosystem that embraces both national and local, commercial and social-purpose, operators. This transformation will lead to a regulatory framework that recognises and enables local operators and enhances the inclusiveness, agility, and overall resilience of telecommunications network infrastructure and services.

This document identifies transformative regulatory approaches from around the world where regulators have acted to prioritise inclusivity and affordability and where they have expanded their regulatory frameworks to embrace local operators, indigenous operators, and not-for-profit business models. Establishing a more diverse regulatory ecosystem will ensure that SMMEs, cooperatives, and civil-society organisations have a seat at the table in policy and regulatory deliberations, leading to more equitable outcomes.

A. Executive Summary

The COVID-19 pandemic has brought to the fore the critical importance of universal affordable access to Internet connectivity. Despite efforts from the different stakeholders, universal affordable access is far from being achieved, as existing national operators focus their efforts on using technologies and building infrastructure in more profitable areas. This means sparsely populated areas, where household incomes are low and infrastructure costs are high, remain unconnected. As a result, there is an emerging consensus regarding the need to do something different from "Business as Usual".

Based on recent changes in the telecommunications industry, this paper analyses solutions for the expansion of the telecommunication operator ecosystem. In particular it focuses on the *local operator* as the actor to fill the coverage and usage gaps left by national operators, in a complementary way. These *local operators* serve a much smaller and more distinct market, with deeper knowledge of their users, able to provide more affordable connectivity when it comes to serving a local market. Local operators can be further classified into two types: *commercial* and *social-purpose*. In the telecommunications world, the latter manifests itself in the form of cooperative self-provision of connectivity infrastructure. Examples of *local social-purpose operators* are consumer cooperatives, community-owned networks, and even municipal networks whose interest is to meet the communication needs of their communities

There are a variety of barriers that local operators face because most regulatory frameworks have been designed primarily to cater for national operators deploying their own infrastructure. This paper presents an analysis of solutions that have been implemented by regulators worldwide to address the key barriers faced by *local operators*, grouped in the following categories:

- Operator Licensing
- Spectrum Licensing and Fees
- Backbone and backhaul Infrastructure
- Financial support
- Access to network information

Regulatory interventions identified in these five areas are making it more possible for *local operators* to provide coverage in places where there was none, as well as considerably more affordable telecommunication services in areas where users do not have the disposable income to afford the data packages available from national operators.

Based on this evidence, this paper concludes with a set of recommendations for regulators wishing to create a more enabling environment for *local operators* by replicating and localizing the best practices included in this document.

B. The need for innovative approaches to closing the rural access gap

I. Mobile Network and internet uptake growth is slowing

The benefits of internet access have reached half the world's population[1], primarily driven by extension of mobile coverage from 2G to 3/4G networks worldwide, as illustrated by the chart below. However, as the chart below makes apparent, recent declines in the rate of growth of mobile networks is also increasingly being acknowledged[2].

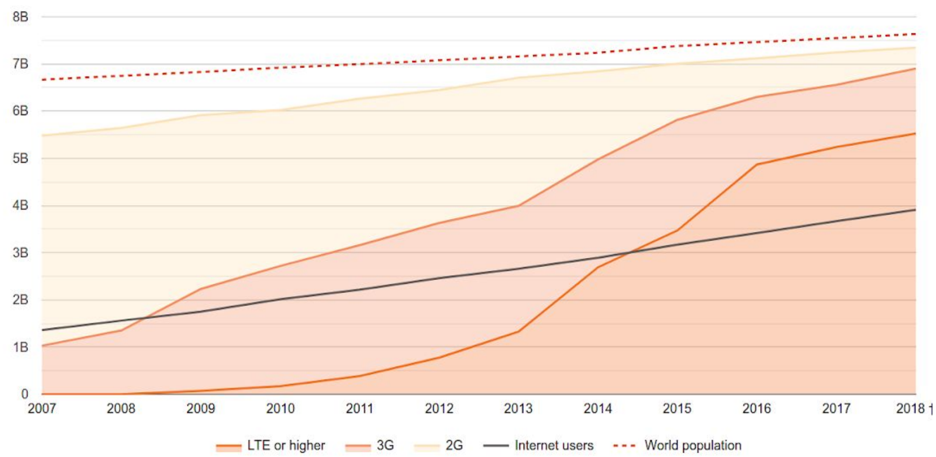

Figure 1. Number of people worldwide covered by mobile network, by technology, 2007-2018[3]

The ratio of internet users globally shows a similar decline in the rate at which it grows, suggesting that current connectivity strategies may not be as effective in connecting the remaining half of the world's population, given that they are located in more economically and geographically challenging environments.

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[1] https://news.itu.int/itu-statistics-leaving-no-one-offline/

[2] https://www.itu.int/en/mediacentre/Pages/2019-PR16.aspx

[3] https://unstats.un.org/sdgs/report/2019/goal-09/. Although there is a more updated version of this SDG report, https://unstats.un.org/sdgs/report/2020/goal-09, the graph does not maintain the same format and does not allow appreciating the decline in the growth rate, so we prefer maintaining that of 2019.

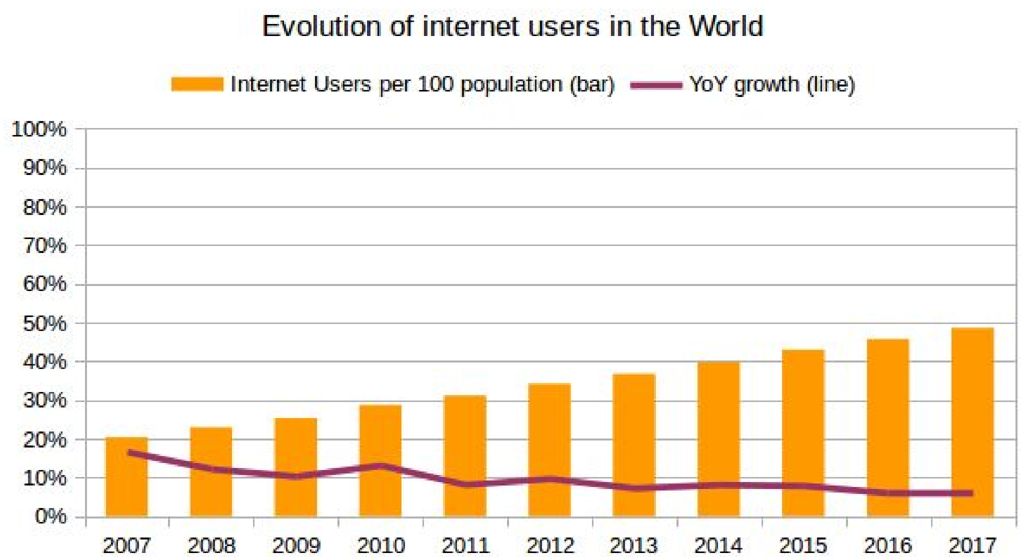

Figure 2. Growth of internet users in the world[4].

Affordability is also a key barrier to meaningful access[5]. The UN Broadband Commission's target for affordability (2% of monthly gross national income (GNI) per capita for entry-level broadband services[6]) is not being met in many income groups. In Africa, the poorest 20% of the population (roughly 200 million people) would have to spend on average 20% of their per capita income for only 500MB of data, which is insufficient to make robust use of the internet, such as for educational or entertainment purposes. In contrast, the average household data consumption in the US in 2016 was 190GB per month[7].

Coverage and affordability challenges are also compounded by demand-side barriers, such as the gender gap[8] , limited relevant available content, limited literacy (both basic and digital) and

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[4] Numbers calculated using data from ITU database 2018. The database for 2019 was consulted but did not have data for this variable for most countries.

[5] Meaningful internet access" should be construed as pervasive, affordable connection (of sufficient quality and speed) to the internet in a manner that enables individuals to benefit from internet use, including to participate in the public sphere, exercise human rights, access and create relevant content, engage with people and information for development and well-being, etc.; irrespective of the means of such access (i.e. whether via a mobile or other device; whether through private ownership of a device or using a public access facility like a library) widens the divide for those who are left out of consideration. See: www.intgovforum.org/multilingual/index.php?q=filedepot_download/3406/437

[6] https://broadbandcommission.org/Documents/publications/wef2018.pdf

[7] https://www.telecompetitor.com/igr-average-monthly-broadband-usage-is-190-gigabytes-monthly-per-household

[8] Structural, social and economic barriers hinder the ability of women and people with non-binary gender identities to access the internet. ITU suggests that there are about 250 million fewer women online than men, and that the problem is more pronounced in developing countries https://www.itu.int/en/action/gender-equality/Documents/EQUALS%20Research%20Report%202019.pdf

low ownership rates of internet-capable devices[9]. The sum of these barriers is more acute in rural areas. In Low and Middle Income (LMIC) countries in 2018, measures of the "rural mobile internet gap" indicated that those living in rural areas were 40% less likely to use the mobile internet than those in urban areas. In Sub-Saharan Africa, it is 58%[10].

II. Challenges of connecting rural areas

Providing telecommunications access to rural areas is subject to a number of constraints, including:

- Low per capita income, as local economies may be based largely on subsistence agriculture, farming, fishing, etc;
- Scarcity or absence of complementary basic infrastructure, such as electricity, water and access roads;
- Low population density and distance between population clusters;
- Underdeveloped social services, such as healthcare and education;
- Lack of adequately educated and trained technicians, and high potential for those trained to migrate to more lucrative prospects in urban areas;
- High cost of backhaul internet access (where it exists at all); and,
- Harsh environments leading to failure of electronic communication devices.

The combination of these factors, as shown in Figure 3, reveals how the revenue potential from people in sparsely inhabited rural areas may be insufficient to justify infrastructure investment by national operators to extend connectivity at an affordable price. The GSMA estimates that at least 3,000 active users are necessary to justify the cost of installing a traditional GSM base station[11].

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[9] https://broadbandcommission.org/Documents/ITU_discussion-paper_Davos2017.pdf

[10] https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/07/GSMA-State-of-Mobile-internet-Connectivity-Report-2019.pdf

[11] http://www.intgovforum.org/multilingual/index.php?q=filedepot_download/3416/412

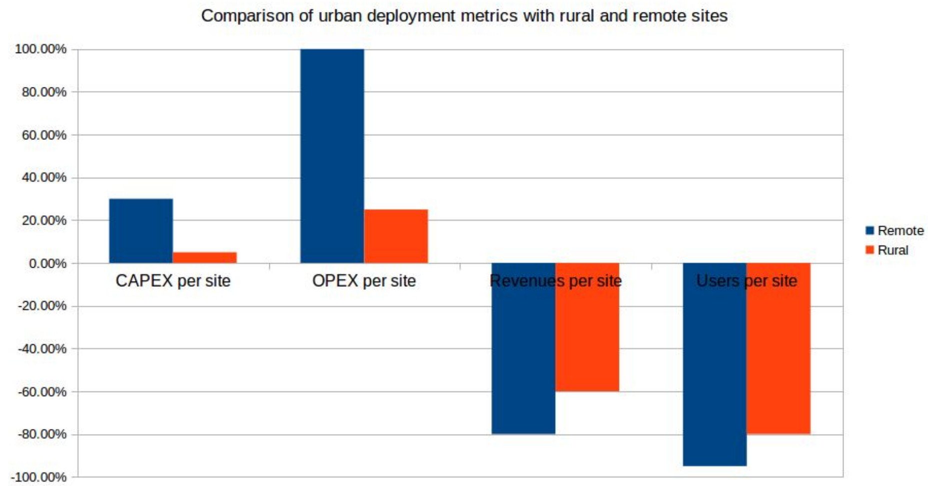

Figure 3. Economic Differences in Rural and Remote sites Vs. Urban Deployments[12]

These barriers mean that commercial telecommunication companies have considerable difficulty in justifying the costly investments for providing infrastructure to rural communities. This is typified by the observation from mobile operator MTN Nigeria's senior manager of Access Transmission Planning, Tolulope Williams[13]:

> "*Compared to our physical sites, of which we have over 13,000, our rural telephony network is less than 300 sites. In a lot of countries, it's actually the government that drives the broadband initiative to rural areas; operators need a lot of incentives in order to begin offering services. If you're going into a rural area, you're not going to make money*"

Limited private-sector interest in rural areas has resulted in various national policy strategies for addressing the usage gap, often in the form of Universal Access Funds designed to incentivize investment in rural areas. However many of these have met with limited success because they have centred around subsidising the capital costs for national commercial operators to provide coverage in these areas, while usage has not proved sufficient to sustain MNO operating costs. For example in Mozambique, the universal service fund paid for construction of 103 base stations for operators in underserved regions, yet three quarters of these are now non-operational as of 2018[14].

In conclusion, it appears that new models are likely to be necessary to ensure affordable universal coverage, as is evident from the continued usage gap resulting from the lack of

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[12] https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/07/Unlocking-Rural-Coverage-enablers-for-commercially-sustainable-mobile-network-expansion_English.pdf

[13] Developing Telecoms. (2016). Last Mile Connectivity in Emerging Markets. https://www.developingtelecoms.com/images/reports/last-mile-connectivity-dt-report-final.pdf

[14] Based on conversations with regulatory agency

affordable services, the plateau in the number of mobile subscriptions, and the low or non-existent levels of access in rural areas in most developing countries (and even in many developed ones), despite 35 years of GSM mobile network development[15]. Rural roll-outs have in fact recently slowed, or even ceased, as operators focus their investments on more profitable 4G/LTE and now 5G installations in competitive urban markets. Between 2019 and 2025, it is expected that mobile operators across the world will spend $1.1 trillion on CAPEX of which more than 75% of that will be 5G-related[16] 5G is a technology designed for high density of users and devices in urban environments, with an expected uptake of 3% of users in Sub Saharan Africa by 2025[17]. In contrast, it is estimated that only $450 billion would be required to connect the next 1.5 billion people[18], but the lack of progress towards this goal suggests that *national operators* are not able to close the rural access gap alone.

C. Leveraging change in the telecommunications industry

As a result of the current telecom market's limited progress in meeting needs for universal affordable connectivity, alternative strategies for reaching the unconnected are increasingly gaining attention. The ITU's Last Mile Connectivity Toolkit[19] describes many of these strategies that could contribute to providing universal and affordable connectivity by leveraging the available infrastructure and taking advantage of the continued evolution of the technologies combined with new market models. Key changes to the telecoms sector that are enabling these new models include:

- **Disaggregation of the value chain in the telecoms industry.** A key reason there are opportunities for new entrants is that the value chain of telecommunications networks is becoming less vertically integrated and more disaggregated. Previously, in order to enter a market, an operator needed to invest in international, national, middle mile, and last mile infrastructure. Today many countries allow competition in each of these segments.
- **The spread of fibre optic backbone infrastructure.** This is now changing access markets in many areas in developing countries, opening up possibilities for new players who can deliver targeted, localised, more affordable solutions to unserved populations.
- **Growing availability of low cost high speed satellite connectivity**. New generation High Throughput Satellites (HTS) offer broadband speeds to end-users at prices that

[15] https://www.gsma.com/aboutus/history
[16] https://data.gsmaintelligence.com/research/research/research-2020/2025-capex-outlook-2020-update-the-1-trillion-investment
[17] https://www.gsma.com/mobileeconomy/wp-content/uploads/2020/03/GSMA_MobileEconomy2020_SSA_Eng.pdf
[18] https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.16-2016-PDF-E.pdf
[19] https://www.itu.int/md/D18-SG01-C-0362/en

closer to terrestrial broadband services[20], and the emergence of Middle Earth Orbit (MEO) satellite operators such as O3B, has reduced latency times to about 150 ms round-trip, making it comparable in many cases with terrestrial internet offerings. There are also a number of companies launching LEO constellations, such as SpaceX's Starlink, which promise to further reduce the cost of connectivity in remote areas.

- **High altitude platforms.** Added to the above are a handful of initiatives that seek to deploy aerial infrastructure within the earth's atmosphere. These High-altitude platform stations/systems (HAPS), such as Alphabet's (Google) Loon project, float hundreds of 4G balloons in the upper atmosphere, essentially acting as a very tall mast. Loon is testing communications services in western Peru, and has recently entered into partnership with Telkom Kenya to deliver access in rural areas[21].
- **Commodity last mile technologies.** Innovations in low-cost electronic networking technologies have created new possibilities for affordable access. Riding on increasingly pervasive terrestrial fiber infrastructure, low-cost Wi-Fi is now provided by a wide variety of different types of providers. By 2022 about 550 million Wi-Fi hotspots worldwide are expected[22] as many have realized that wherever there are high-speed backhaul networks, the marginal cost to add Wi-Fi access points is minimal. In addition, IMT (mobile) base stations using software defined radios can now be deployed for a fraction of the cost of traditional mobile networks based on technology from a variety of startups in this space such as NuRAN, Fairwaves, Facebook's Open Cellular and others. The result is that it is now possible to put up a mobile network serving hundreds of users for less than five thousand dollars.
- **New middle-mile / backhaul technologies**. Point to point (PtP) links can be operated in many different bands, but 11 GHz band is attracting considerable interest, driven by a new generation of devices covering this band both from new microwave companies, such as Mimosa and Cambium, as well as companies historically focused on license-exempt bands such as Ubiquiti and Mikrotik. Similarly, equipment in license-exempt mmWave bands - 24GHz and 60 GHz - makes possible fiber-like wireless connections. Dynamic spectrum technology is also gaining interest, benefitting from the opportunistic use of spectrum frequencies on a secondary basis where the frequency in question may be already assigned on a primary basis to another organisation.

[20] For example, YahSat's YahClick internet service offers service in 10 countries in Africa at prices starting at $60 per month for 2Mbps.
[21] https://www.zdnet.com/article/googles-loon-launches-service-in-kenya/
[22] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-738429.html#_Toc953332

These developments suggest that it may be technically and economically possible to provide affordable access to communications, wherever there are supportive policy and regulatory environments for new and complementary access models for rural access.

D. Expanding the Operator Ecosystem

Telecommunications policy and regulatory frameworks have traditionally taken a ‘one size fits all’ approach. Conventional views of the universal access challenge treat the economy as a single entity but, in reality, the economies of the rural poor are significantly different from comparatively wealthy urban economies. In this section, we present an alternative view, and accompanying evidence, to explain how different economies complement each other in addressing the access challenge.

The economic contribution of small and medium-sized enterprises (SMEs) is already well recognised by governments around the world. Most countries have developed policies to encourage their growth. Adding to the important role of the informal sector in rural areas, the economic contribution of small business is substantial. In the United States, for example, SMEs employ 47.5%[23] of all private sector employees. In South Africa, SMEs contribute 34% towards Gross Domestic Product (GDP)[24] and provide employment to about 60% of the labour force, while in Mexico, they contribute 50% of the GDP and provide employment to 70% of the labour force.

Local SMEs serve a much smaller and more distinct market. Being in direct contact on a day-to-day basis with their customers, they typically have a much deeper knowledge of and are able to serve in a manner that a global company cannot. The economics of local SMEs are also different to those of global companies. Some elements are more expensive, but many are cheaper when it comes to serving a local market. Similarly a *local commercial operator* is not burdened by having to maintain expensive headquarters in the capital city or outlets in shopping centres and does not require costly marketing campaigns.

As yet, few communication regulators have fully recognised the potential value of *local operators*, and government policies that empower them are largely absent, with few economic or social incentives to local investment in local communications infrastructure and services.

Beyond global and local economies, there are also communal efforts to satisfy basic needs. In the telecommunications world, this manifests itself in the form of cooperative self-provision of connectivity infrastructures. These *local social-purpose operators* take a number of different forms, such as a cooperative, a not-for-profit company, or a civil society organization.

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[23] https://www.sba.gov/sites/default/files/advocacy/Frequently-Asked-Questions-Small-Business-2018.pdf
[24] https://citizen.co.za/news/south-africa/1957487/successful-economy-lies-in-small-businesses/

Examples of existing *local operators*, both *commercial* and *social-purpose*, can be found in Section F.

I. Diversity of types and sizes of operators that complement each other

We can visualise efforts to provide affordable connectivity for all as a glass jar that we are trying to fill up with stones, where the volume of the jar represents all those we would like to connect and the stones represent our efforts at connectivity[25]. Our current focus on national and multinational communications operators can be visualised as filling the jar with large uniformly shaped stones which have the virtue of each occupying a significant amount of the jar and of having a common, readily understandable shape. Yet our jar can only hold three or four of these stones and while the jar may look full at this point, these stones ultimately occupy less than half of the volume of the jar. This is analogous to the current situation in the telecommunications industry in that most countries cannot sustain more than 3-4 *national operators* yet half of the world remains unconnected to the internet.

Figure 4. Seeing the challenge of affordable access for all through the metaphor of a jar of stones.

Imagine then, that we might use smaller stones to represent *local operators* providing connectivity. Even though the jar appeared to be full, there are spaces for many of them. Yet again, the jar appears to be full, but if we fill it with water, it becomes evident that there is still a significant amount of volume that can be filled by even smaller stones of varying size and shape, symbolizing the diversity of types of *local operators*, and their capacity to adapt to the gaps left by the market.

[25] Idea originally conceived by S. Song.

Not all *local operators* are driven by the market economy. There are also *social-purpose operators* that have a significant role to play in filling the 'underserved' spaces remaining in the jar. Examples of these are consumer cooperatives, community-owned networks, and even municipal networks whose interest is to meet the communication needs of their communities in geographies where commercial services are either unavailable or unaffordable.

It is worth noting that smaller stones do not diminish the size of the larger stones, but occupy spaces that do not fit within the scope of the larger operators. Additionally, *local operators*, both *commercial* and *social-purpose*, increase traffic for large-scale operators through overall network effects.

II. Local Social-Purpose Operators

Although the business models of *national operators* and *local commercial operators* providing connectivity are fairly well understood, less is known about *local social-purpose operators* and their role in providing affordable access to communication in places where the commercial operators see no interest. Among them, a number of community-owned networks have demonstrated their ability to contribute to closing the rural access gap. This is being increasingly recognised in the outcomes of many international fora on connectivity gaps, as shown in Annex 1.

One of the recurring features of communities that have organized to produce their own services, such as connectivity, is the use of shared infrastructures, that are open and adapted to local conditions, which can enable and facilitate the development of added value and lower cost service offerings. Modern data networks typically follow a three layer model[26], and opportunities for sharing can occur in each of the different layers. These collaboratively built and operated infrastructures tend to follow a common property or common-pool resource model of governance. Another recent study which identified community-owned networks in 43 countries around the world[27] underscored the diversity in models of participation, organisation, operation, technologies used and business models. In general the guiding strategy of these networks is based on the principles of cooperation, which are often characteristic of economic activity in subsistence economies.

Aside from providing affordable access, recent research[28] highlights other additional economic and social benefits resulting from local ownership of these 'first-mile' networks. One of the

[26] https://dsg.ac.upc.edu/sites/default/files/dsg/phd_roger_20190930.pdf
[27] https://www.giswatch.org/community-networks
[28] https://www.apc.org/en/pubs/bottom-connectivity-strategies-community-led-small-scale-telecommunication-infrastructure

most evident benefits is the contribution to the local economy, creating local employment, efficiencies in local markets or helping local markets diversify.[29]

More generally, working to build and operate the network on a collaborative basis can support improved community cohesion and help to build technical self-reliance, which in turn, can reduce the cost of maintenance by minimizing transport costs and downtimes. Similarly, local ownership of the network also provides an inherent form of security against theft and vandalism. These networks hold the potential for more deliberate inclusion of women in the network, and for better local accountability, often also prioritising accessibility and digital skills to marginalised groups and the disabled. A particularly important feature is that most of these networks usually do not have traffic-based charges, which leads to more extensive use, and more local content sharing as there is little to no cost for hyperlocal on-net traffic.

In summary, access technologies have changed significantly in recent years, becoming less expensive while increasing in capabilities. This change has put powerful access technology within the reach of small organisations and community-owned operators, both non-profit and for-profit. As a result, *local operators*, and, in particular, those community-owned networks appear to have considerable potential to sustainably fill connectivity gaps while supporting local socio-economic development. However policy and regulation has yet to catch up with these developments in most countries. As a result there are as yet relatively few examples of these types of *local operators*.

E. Creating an enabling environment for local operators

This section explores the different elements of an enabling policy and regulatory framework for complementary access models so they contribute to connect the unconnected.

I. Operator Licensing

A more inclusive telecommunications ecosystem can be achieved through the creation of a tiered licensing framework that caters for the needs of operators of all sizes. Such a framework would include categories for *local commercial operators* and SMEs, which would be associated with a more modest fee structure and lower administrative burden. Additional exemptions may be extended to *local social-purpose operators* and those wishing to provide affordable access in localized geographical areas and communities and on a not-for-profit basis.

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[29] An equivalent to that is open-source software and tools, such as GNU/Linux, as an infrastructure for the development of cheaper and better internet services.

Below there is a summary of the major challenges identified, the proposed solutions, and the countries where they have been implemented.

Challenge	Solution	Example
Licenses of National/Regional Scope	More granular approach to licensing	South Africa, Brazil, Kenya
High initial and annual fees and onerous compliance requirements	License Exemptions for private networks and non-profits	Brazil, Mexico, South Africa
No specific licence for community networks	Create specific licenses for Community Networks or fitted in existing exemptions.	Argentina, Uganda
High administrative burden on regulator	Simple authorization or notification system	Canada, New Zealand, U.S.A, European Union

As a general trend, regulators are moving away from technology-specific or application-specific licenses to neutral 'unified' licenses that accommodate a range of players and services. This matches the trend toward converged communications technologies and services based on internet protocols. The most common type of unified licensing framework is a license for infrastructure (the physical assets e.g. cables, base stations, routers, earth stations, etc. that make up the network) and a different license for services (bandwidth services, packet switching, VoIP, streaming media, etc delivered over the network). Although the separation of physical infrastructure from the services that run over them is a welcome trend, it is still not the norm in most countries. Instead, technology specific licenses (e.g mobile and fixed wireless) are still widely used. In addition, where unified licenses are required, these are usually only available as national, or perhaps regional licenses. Following the analogy of the jar of stones, most licensing frameworks only allow for the biggest rocks. These licenses also come with initial financial and administrative requirements that are beyond the capabilities of even *local commercial operators*. There are some notable exceptions such as in Brazil[30], Kenya[31] and

[30] https://www.anatel.gov.br/institucional/component/content/article?id=1737
[31] https://ca.go.ke/wp-content/uploads/2018/03/New-Market-Structure-Under-The-Unified-Licensing-Framework-January-2016.pdf

South Africa, where **sub-national licensing frameworks** exist, which cater for the middle size stone in the jar analogy, but still do not fully meet the needs of the smallest, village level operators. For example the regulatory frameworks may establish lower license fees, but they maintain many of the administrative requirements that apply to larger operators. In some countries the installation and maintenance of telecommunications infrastructure can only be carried out by licensed professionals. In others, a business plan and a technical plan signed by an engineer registered by a professional association is required.

While there is merit to ensuring sufficient quality in deployments, this may need to be balanced against the barriers to entry for *local operators* in the early startup phase. In relation to license compliance, in South Africa, for instance, licensees have to follow a compliance calendar containing 22 reports, in English, throughout the year[32]. Licensing fees and administrative overheads are often accompanied by many other financial requirements which make it even more challenging to provide affordable communications to economically poor populations. For instance, it is common that operator licences include obligations to contribute to a Universal Service Access Fund. This adds additional burdens on *local social-purpose operators* which can be counterproductive given that their main goal is addressing digital exclusion.

One response to this problem is the use of **license exemptions.** This is the approach in some countries for private network operators which engage in the self-provision of services to their constituency e.g. a corporation connecting their offices nationally; a cooperative or a non-profit community network that self-provides to its members. For these situations, the designation of 'private network' exists in many regulatory frameworks and is exempted from an infrastructure license[33]. In service provision licenses there are exemptions based on specific criteria such as not-for-profit operation or providing services to underserved regions such as in South Africa and Mexico. In Nepal, there is a an exemption de facto, with the rural ISP license fee set at 1 USD[34].

-- Box - South Africa: Enabling a more granular approach in the Licensing Framework --

In South Africa there are two categories of licenses regarding electronic communications which are (i) Electronic Communications Service (ECS) (ii) Electronic Communications Network Service (ECNS) licences. Both ECS and ECNS can be either Individual or Class. Individual ECNS (IECNS) are national in scope and Class (CECNS) are regional, e.g. District

[32] https://www.ellipsis.co.za/compliance-calendar/

[33] https://www.internetsociety.org/resources/doc/2018/community-networks-in-latin-america/

[34] http://nepalpolicynet.com/images/documents/Information%20and%20Communication/Regulations/1997_Telecommunication%20Rules.pdf

Municipality[35]. The initial registration fee for a Class license is 815 USD[36]. If both CECS and CECNS are needed then the fees total 1630 USD. There is also a renewal fee of 408 USD after 10 years. If a *local operator* builds infrastructure in two different municipal districts, then two different CECNS are required.

Additionally, if any of the licenses generate revenue, the holder needs to pay an annual fee based on revenues. For the lowest group (annual turnover of 0 - 3,000,000 USD[37]), the annual fee is 0.15% of revenue. In addition, holders of class and individual licences pay 0.2% of annual turnover as a contribution to the Universal Service and Access Fund (USAF). ECS license exemption from all these fees and compliance requirements is possible for different reasons, among them "a person or company who provides ECS on a non-profit basis", as well as ECNS exemptions for Private Electronic Communications Network (PECN)[38].

-- End of the Box --

Countries with developed markets are increasingly moving toward a **simple authorization system** which permits service provision without need for a special license or an exemption. This includes the US[39], Canada[40], New Zealand[41] and the countries of the European Union, among others, where operating a wireless ISP with license-exempt (typically WiFi) spectrum is the same as starting any other business, and no specific telecommunications operator license is required.

In other countries steps have been taken to more formally recognise the role and importance of Community Networks. In Uganda and Argentina, a **new operator licence category specifically for Community Networks** has been established.

-- Box: Creating Community Networks Licence: Argentina & Uganda --

Countries which have particularly created categories for community networks in their licensing framework have followed a combination of being more granular while providing exemptions:

> ENACOM, Argentina's regulator, passed in 2018 a resolution to create a Community Networks License type. In it Community Networks are defined as those where either the

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[35] RSA. Electronic Communications Act. South African Government Gazette, 490(28743), 2006.
[36] Fee in ZAR in 2019 is 12,760:
https://www.icasa.org.za/legislation-and-regulations/fees-for-service-licences-2019
[37] The smallest bracket is from 0 - 50,000,000 ZAR:
https://www.ellipsis.co.za/wp-content/uploads/2013/03/General-Licence-Fees-Regulations-2012.pdf
[38] RSA. Regulations Regarding License Exempt Electronic Communication Networks. South African Government Gazette, (31289), 2008.
[39] https://www.fcc.gov/obtaining-license
[40] https://crtc.gc.ca/eng/comm/telecom/
[41] https://www.mbie.govt.nz/science-and-technology/it-communications-and-broadband/our-role-in-the-ict-sector/telecommunications-and-broadcasting-network-operators/register-as-a-network-operator/

users manage the infrastructure or provide services on not-for-profit basis in villages smaller than 5,000 people. Holders are exempted from licensing fees as long as they present an annual report in the regulator's site with the information requested.[42]

The Uganda Competition Commission, after a public consultation to review its Licensing framework, incorporated in January 2020 a "Communal License category". The license targets the provision of telecommunication services to specifically defined communities, i.e a "group of persons living in the same geographical location, having particular characteristics and interests in common"[43]. A holder of communal access license will be authorised to establish, operate and provide communal access to telecommunications services to a particular community for five years renewable.

-- End of Box --

II. Spectrum Licensing and Fees

Provision of affordable connectivity to the half of the world that still lacks access to the internet will mostly take place via wireless networks. As a result, the regulation of access to spectrum is a critical issue. Although there are innovations in spectrum management taking place around the world[44], adoption of these innovations has not kept pace with the growing need for affordable access solutions to create a more inclusive internet..

In terms of ensuring that all citizens are within reach of a wireless signal, regulatory challenges regarding spectrum are related to the development of innovative mechanisms to allow access to spectrum in fair terms for those operators willing to attend uncovered areas. Countries have developed different approaches summarized in the following table.

Challenge	Solution	Example
Performance of license exempt spectrum (2.4GHz and 5.8GHz) is degrading as the frequencies become more crowded	Make more license exempt spectrum available	United States: The FCC recently designated 1200MHz of spectrum in 6GHz for license exempt use

[42] Argentina: Boletin Oficial. Ente Nacional de Comunicaciones. Resolución 4958/2018 https://www.boletinoficial.gob.ar/#!DetalleNorma/190061/20180817
[43] https://uccinfo.blog/2020/01/27/approved-new-telecommunications-license-categories/
[44] https://www.internetsociety.org/resources/doc/2019/innovations-in-spectrum-management/

Assigned IMT (mobile) spectrum remains underutilised in rural areas.	Set aside IMT spectrum for rural connectivity	Mexico: Set aside 10MHz in the 850MHz band to allow the indigenous operators to connect communities below 3000 inhabitants
	Establish use-it-or-share-it mechanisms for IMT licenses	UK: Small and rural operators can apply for a license in secondary use in areas of no interest for big operators
Rural wireless backhaul requires cost effective solutions	Implement dynamic spectrum sharing regulation	U.S, U.K., Colombia[45], South Africa[46], Mozambique have implemented TVWS regulations with Nigeria[47], Kenya[48], and Uganda[49] soon to follow. The U.S. is implementing dynamic spectrum regulation in 3.5GHz[50]
	Implement light-licensing regulation for microwave	US[51] and New Zealand[52] have implemented simple authorization mechanisms for the issuing of licenses for Point to Point use in 11GHz
High recurring fees for spectrum	Consider fee exemptions for social-purpose licensees	Mexico establishes spectrum fee exemptions for indigenous operators[53]

Due to the potential for interference when two operators use the same frequency, the use of most radio spectrum requires a license. However, the rapid spread of **license-exempt spectrum**

45 https://www.rapidtvnews.com/2017083148611/colombia-sets-first-tv-white-space-regulation-in-latam.html
46 https://www.engineeringnews.co.za/article/television-white-spaces-network-operators-can-now-use-csirs-geolocation-spectrum-database-2020-05-11/rep_id:4136
47 https://africanews.space/nigerian-communications-commission-develops-draft-guidelines-for-use-of-tv-white-spaces-in-nigeria/
48 https://ca.go.ke/public-consultation-on-the-draft-dynamic-spectrum-access-framework-for-authorisation-of-the-use-of-tv-white-spaces/
49 https://www.ucc.co.ug/wp-content/uploads/2017/09/UCC-TVWS-standards.pdf
50 https://www.fiercewireless.com/wireless/fcc-approves-initial-commercial-deployments-cbrs
51 https://www.fcc.gov/wireless/bureau-divisions/broadband-division/point-point-microwave
52 https://www.rsm.govt.nz/engineers-and-examiners/how-to-become-an-approved-radio-engineer-or-certifier/
53 https://www.dof.gob.mx/nota_detalle.php?codigo=5581293&fecha=09/12/2019

use in the form of Wi-Fi, the technology of choice for many *local operators*, is an important lesson about the power of frictionless innovation and about the pent-up demand for affordable internet access. It makes sense for regulators to leverage this success by expanding access to license-exempt spectrum and further reducing costs and bureaucracy associated with its use. In addition to the traditional Wi-Fi bands in 2.4 and 5 GHz, some countries are incorporating new license-exempt bands in their Radio Frequency Plans, such as 6, 24 and 60 GHz. The Federal Communications Commission in the U.S.A. is leading the way in substantially expanding frequencies license-exempt use[54].

While demand for spectrum for International Mobile Telephony (IMT) often exceeds the pace at which regulators are able to make it available in urban areas, large amounts of licensed spectrum lie unused in sparsely-populated, economically poor regions. For example, the purple circles in Figure 5 below shows the regions in Nigeria where LTE mobile network operators are providing coverage. The map also displays population distribution data based on the High Resolution Settlement Layer (HRSL) data research by the Earth Institute[55]. As can be seen, the total coverage of the land area and populations within the **LTE signal footprint is still relatively small**. For illustration, the blue circle with the pop-up dialogue within the image, which has a radius of 10 km, contains nearly 50,000 people living where none of the LTE operators in the country are using their spectrum.

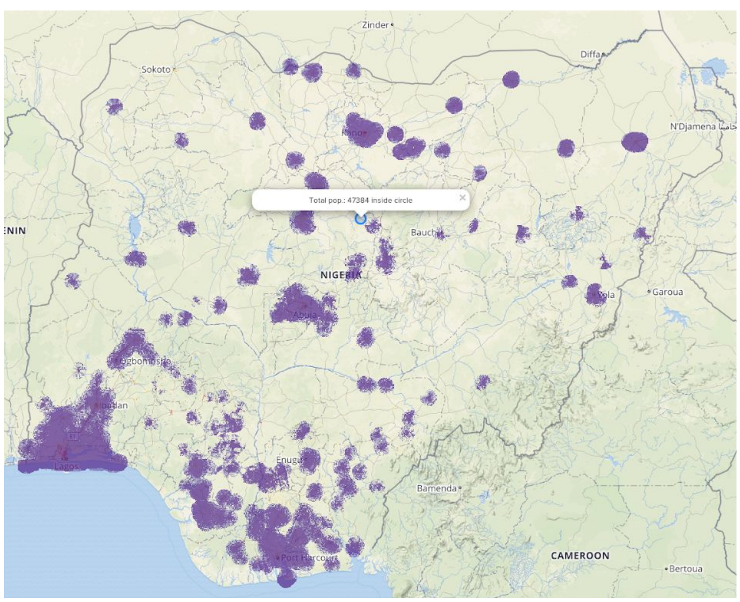

Figure 5. LTE coverage in Nigeria from all GSMA members[56].

[54] https://www.fcc.gov/document/fcc-opens-6-ghz-band-wi-fi-and-other-unlicensed-uses
[55] https://ciesin.columbia.edu/data/hrsl/
[56] https://www.mobilecoveragemaps.com

There is an opportunity for innovative approaches to reuse this spectrum to provide affordable access for all. As indicated in the section above, a variety of low-cost IMT base station manufacturers have emerged in recent years that offer the potential to dramatically change the cost model for sustainable rural mobile network deployment. Incumbent operators may not see sufficient return on investment to justify the roll-out of these new technologies. Yet, because regulation focuses on national operators, *local operators*, who do have that potential, are currently excluded from access to the radio spectrum required to deploy networks that could directly reach handsets already available in these areas. To address the under-use of assigned spectrum in rural areas, a strategy is needed to enable **sharing of unused IMT spectrum** that has already been assigned to a primary licensee. In addition to this, in many countries, there are still many blocks of IMT spectrum that remain unassigned[57]. Evidence has shown that when **IMT spectrum set-asides for social use** of this bands are created, such as the case of Mexico[58], *local social-purpose operators* provide affordable mobile services in places of little economic interest to national operators. Regulators aiming to address digital exclusion may want to consider setting aside small spectrum blocks of IMT spectrum for *local operators* wishing to provide affordable connectivity in underserviced areas. Similarly, they may consider use-it-or-share-it provisions when preparing new IMT spectrum bands for allocation and assignment. Alternatively, an effective strategy may be to allocate this new spectrum to smaller regions than nationally, or to **allocate IMT spectrum dynamically on a secondary-use shared basis** to prevent it lying unused where the need for affordable access solutions is greatest. Countries such as the United Kingdom have already pioneered these approaches[59].

The reduced interference from antennas designed for **Point to Point (PtP) links** that can focus wireless communication along very narrow beams/paths has also led some regulators to extend the use of bands traditionally assigned for satellite services, for PtP backhaul links. Additionally, powerful, low-cost microwave technology pioneered by WiFi manufacturers can be used in almost any frequency band. Some countries are benefiting from the market availability of low-cost microwave solutions in **11GHz and other frequencies**, and have adapted the regulations to encourage their uptake. This has taken the form of a light-licensing scenario such as is operated in the United States and in New Zealand for the cooperative assignment of geo-located frequency assignments.

The high cost of exclusive-use spectrum licenses, particularly through spectrum auctions, stands in stark contrast to license-exempt spectrum that is available at no cost. **Dynamic spectrum management**, which assigns spectrum on an on-demand basis, offers the

57 https://opentelecomdata.org/spectrum-chart/

58 http://www.ift.org.mx/sites/default/files/anexo_i_programa_2020.pdf

59 https://www.ofcom.org.uk/__data/assets/pdf_file/0033/157884/enabling-wireless-innovation-through-local-licensing.pdf

opportunity to establish a middle ground between both approaches. While TV White Space (TVWS) regulation has been implemented in the United States, the United Kingdom, and Singapore, its real potential may yet to be realised as an affordable access technology in developing countries where spectrum in the UHF band is largely unoccupied, especially in rural areas. In the Global South, Colombia, Mozambique, and South Africa are pioneers in this regard, having recently introduced **TVWS regulatory** frameworks aimed at exploiting the technology for addressing digital exclusion.

Spectrum usage fee calculations vary from country to country. In most cases it is determined by a formula that considers a combination of parameters, including size of the spectrum block being assigned, the center frequency (value of that particular spectrum band), and the type of application (point to point - backhaul - vs access). Some countries have come up with more innovative formulas that make more fine-grained calculations, with parameters such as the size of the area being covered, and whether the area is urban or rural or whether the spectrum is shared[60]. This allows the same formula to generate modest fees for a small, rural, local network, while, while exclusive, national use of spectrum would entail sums of the order of magnitude that national governments would like to see collected from the telecommunications industry.

Another issue for consideration is whether *local social-purpose operators* such as Community Networks should be exempted from spectrum fees. In 2019, the Mexican social-purpose operator, TIC AC, challenged attempts by the national regulator to levy spectrum fees on spectrum that has been assigned to them for social-purpose use. TIC AC were successful in their challenge with the result that spectrum fees do not apply to indigenous operators using social-purpose spectrum[61]. These provisions will further ease the provision of access in unserved areas.

III. Backbone and backhaul Infrastructure

Throughout the communication infrastructure value chain there are many cost elements that play a critical role in determining the viability of *local operators.* Access to backhaul capacity in particular is often the single biggest cost element for these operators. While this is often due to limited competition and few incentives to commercial operators to extend backbones to remote sparsely populated areas, it is also the result of the lack of enabling regulations for local operators. The table below summarises the major challenges, and regulatory responses identified.

[60] https://www.internetsociety.org/resources/doc/2019/innovations-in-spectrum-management/

[61] Article 239 - Ley Federal de Derechos 2019
https://www.dof.gob.mx/nota_detalle.php?codigo=5581293&fecha=09/12/2019

Challenge	Solution	Example
Financial infeasibility of backhaul for local operators, due lack of coverage or unaffordable capacity pricing	Deploying Wholesale open-access network (WOAN)	Public WOAN: StockAB, Sweden, NTB Uganda, GUILAB, Guinea, Private WOAN: C-Squared Uganda, Ghana, and Liberia
	Impose non-discrimination and access obligations on network elements and associated facilities for interconnection, and fair and cost-based pricing, including pricing transparency (published prices), and distance-independent pricing.	Benin, Côte d'Ivoire and Niger
	Make low cost satellite capacity to local operators	Mexico
	Allow NRENs to provide backhaul services to local social-purpose operators	Argentina, Kenya, South Africa
Barriers to deployment from private land and building owners	Rights of way for the common-good in national law and municipal ordinances to regulate deployments, including price caps on rental fees	European Rights of Way regulations [62], South Africa
	Infrastructure sharing and dig-once policies	Cost reduction directive EU, mandatory dig once rules in many European countries

[62] https://ec.europa.eu/digital-single-market/en/rights-way

	Policy for sharing by default, oriented to cost and prevent duplication. Mandate to incorporate ducts for telecom operators.	Cost-sharing directive across EU Several municipal and regional regulations in Spain.
Lack of Access to numbering and voice interconnection	Interconnection regulations ensure local operators can have access to numbering resources at cost and to asymmetric voice termination rates in their favour.	Asymmetric interconnection tariffs are well known as a means to help ensure the viability of small rural operators[63]. In South Africa for operators with less than 20% market share[64] this applies for the first four years.

Some governments have taken measures to help reduce backbone costs by establishing national **wholesale, open-access backbone networks,** usually through a parastatal company. These networks offer a business model that separates operation and ownership of the physical network from the sale of broadband services to the end-user. In these networks, the owner of the network does not supply any retail services; instead several independent service providers purchase in bulk from the wholesale operator for resale to the end-user. Similar to wholesale services in other sectors, wholesale open access networks create a shared infrastructure for many retail service providers, which provides the scale needed for cost reduction that can drive increased availability and uptake. However tariffs often reflect the premium national operators are willing to pay, instead of being priced as a public utility/enabler. In addition, minimum bandwidth purchase requirements from wholesale backbone operators are usually more than needed by small *local operators*, especially in the startup phases.

Most countries in Africa have deployed these types of backbones, usually with support from EXIM Bank of China. Typical examples include Uganda's National Transmission Backbone[65] and the dorsale à Fibre Optique nationale of Guinea[66]. Another common version of this type of networks is where the government knits together the passive and fibre infrastructure of various state companies, such as the rail line, fuel pipelines and high tension electricity distribution

[63] http://documents1.worldbank.org/curated/en/881171468780577005/pdf/284020PAPER0WBWP027.pdf
[64] https://www.icasa.org.za/uploads/files/Briefing-note-termination-rate-asymmetry.pdf
[65] https://ict.go.ug/projects-programmes/national-backbone-infrastructure-project/
[66] https://guilab.com.gn

grids. Both Brazil[67] and South Africa[68] have taken this approach. At a more local level, a well-documented[69] case is in Sweden where the municipal optic fiber company Stokab was established in 1994, and is one of the earliest wholesale-only initiatives. Through its optic fiber network, it serves more than 100 operators, having with and has key significant socio-economic influence in the region. While the aim of these projects is usually to provide a backbone where there is none (or to complement existing private infrastructure), in other cases the aim is to drive down prices on commercial infrastructure by competing with them. To address government service delivery issues, some countries have outsourced the management of the backbone to a private operator while retaining ownership of the asset. Privately-led wholesale open access networks have also been established in many countries, including in developing regions such as Liquid Telecom[70] which now operates a fibre backbone from Cape Town to Cairo, and C-Squared in Uganda, Ghana, and Liberia[71].

The wholesale-only model can be a valuable strategy to enable *local operators*. This model helps limit duplication of costly network infrastructure, and makes more efficient use of existing capacity. In addition, access to increased wholesale capacity at lower unit costs can help to ensure sustainable business cases, and can benefit diverse users and operators of any size and service type (mobile, fixed, content). To maximise the potential impact of a wholesale network, regulatory authorities may impose non-discrimination and access obligations on network elements and associated facilities for interconnection, and fair and cost-based pricing. This can also include pricing transparency (published prices), and even distance-independent pricing, to mitigate the handicap of remote areas. In West Africa, dominant operators are required to publish this type of information, in line with the ECOWAS Supplementary Act[72], and examples of the offers by dominant operators can be found in countries such as Benin[73], Côte d'Ivoire[74] and Niger[75].

As discussed earlier, *local operators* may be able to use satellite capacity to backhaul traffic. Although this is usually a more costly solution than a terrestrial one, in remote areas this may be the only option, as the cost of erecting a series of towers to connect to the nearest fiber point of presence may be beyond the financial resources of a local operator. However low cost satellite capacity may be available from governments which have their own satellites, or have

[67] https://www.telebras.com.br/
[68] https://infraco.co.za
[69] B. Felten. 'Stockholm's Stokab: A Blueprint for Ubiquitous Fiber Connectivity?' In: Diffraction Analysis report (2012).
[70] https://liquidtelecom.com
[71] https://csquared.com/
[72] https://www.ecowas.int/ecowas-sectors/ict/
[73] http://www.benintelecoms.bj/public/telecharger.php?fichier=Cat_2017-2018.pdf
[74] http://www.artci.ci/images/stories/pdf/autre_documents/catalaogue_interconnexion_mtn_ci_2016.pdf
[75] http://www.orange.ne/particuliers/1/203/catalogue%20da%C2%80%C2%98interconnexion%202018.pdf

access to capacity on commercial satellites, such as in the case of Mexico. Mexican regulations require satellite operators with a presence in the country to provide the government with 8Mhz of capacity on each satellite. The government is now providing this capacity to an indigenous community mobile *local social-purpose operator* for backhaul[76]. This has allowed the operator to bring mobile communications to areas where other types of backhaul are difficult to obtain.

As discussed elsewhere in this document, enabling *local social-purpose operators* to do so would make those benefits going beyond internet access. A similar approach is followed by many National Research and Education Networks (NRENs), which have a **utility based model** that facilitates the optimization of the unused resources by *local social-purpose operators*. In the case of South Africa's NREN, TENET, its connection policy provides for Participating Institutions to share their connections with "Non-profit entities (non-profit companies, trusts, associations not-for-gain) that the Participating Institution collaborates with or supports in educational, research and/or community engagement endeavours"[77]. Because of the currently high cost of backhaul, which has not yet been addressed by the regulatory environment, this clause was critical in the first stages of the service delivery by Zenzeleni Networks. A similar agreement has been central to the service provision of Altermundi in Argentina and Tunapanda in Kenya, where the cost of commercially available backhaul remains unaffordable for rural communities. To help address this, some regulators may be able to support these practices from NRENs, given the social-purpose nature of these agreements.

Another important element of the enabling environment is regulating access to **rights of way** (ROW). Taxes on deployments, such as usage of public ducts in streets or roads, are often seen as a source of income for authorities, including taxes that aim to charge in terms of the distance covered by the deployment.which has most impact on the rural areas most distant from the points of interconnection. An example is in Spain, where ROW are covered by the general telecom law which provides operators with the right to occupy private property and the public domain[78]. In the case of the Torelló city council (Spain), the Catalan government against Guifi.net for passing fiber through public ducts or when sharing civil works that are deploying other infrastructures (water, roads). The supporting decree was amended to minimize or not apply when used to connect citizens.[79] Fees and public prices for open-access wholesale fiber networks in Catalonia are regulated to be distance independent. This means rural and remote areas are not discriminated against to interconnect over the more wealthy central areas.

[76] https://www.tic-ac.org/
[77] https://www.tenet.ac.za/downloads/connection-policy/view
[78] Notification, negotiation or an administrative procedure for expropriation or easement https://avancedigital.gob.es/urbanismo-despliegue-redes/Paginas/derechos-paso.aspx
[79] https://fundacio.guifi.net/en_US/blog/our-blog-1/post/ressusciten-les-taxes-per-accedir-a-internet-que-discriminen-als-que-viuen-en-pobles-petits-i-allunyats-48 (Catalan)

To reduce needs for expensive negotiated rights of way regulations vary considerably between different countries. As with most of Europe, use of ROW in Spain simply depends on a notification and municipal permit, however in the UK, rights of way are subject to economic compensation. In both Spain and the UK, *local operators*, guifi.net and B4RN respectively, have also negotiated rights of way at no cost[80] in recognition of the social and economic impact to the community that a new open access deployment brings. The universal deployment model proposed by guifi.net[81], provides clear guidelines on regulating deployment in public land, and facilitates otherwise controversial authorization decisions resulting from the private ownership and use of private infrastructure in public space.

This simplification of rights of way negotiations for public interest infrastructures makes a major difference to the speed of deployment and risks, and therefore to the feasibility of open-access and community-owned network deployments. In South Africa, the government has just gazetted its Rapid Deployment Guidelines which aim to remove impediments to telecom infrastructure deployment, such as withholding of access to existing infrastructure by national, provincial and local government authorities, as well as in some instances, private property owners. This includes utilities such as road, rail, water and electricity infrastructure as well as access to high points such as tall buildings or natural peaks necessary for line-of-sight from transmitter to transmitter[82].

Similarly, **access to existing passive essential infrastructure**, such as the towers of mobile operators and the masts and poles of public broadcasters and energy distribution grids, can be shared to reduce the cost of extending access, under a cost-sharing and non-profit oriented pricing to promote the offering of added-value services. Infrastructure sharing regulations also help to leverage privately laid fibre and to reduce the cost of infrastructure duplication. For example in France, and in the European Union in general[83], if an operator digs to lay fibre then it must make space available in its ducts for other operators. This type of 'dig-once' mandate has also been extended to ensure that any new passive linear infrastructure (road, rail lines, fuel pipelines, high tension electricity grids) incorporates ducts for telecom operators.

Access to domestic transit for peering, numbering and cost-based voice interconnection for local operators remains an important constraint on their ability to operate on an equal footing with national operators. Where numbering and interconnection is available, it is often

[80] One notable conflict was a school deployment, finally resolved: http://b4rn.catonvillage.org.uk/2019/03/20/caton-is-go/

[81] Universal network deployment model for universal connectivity, https://arxiv.org/pdf/1812.11525.pdf

[82] https://www.gov.za/documents/electronic-communications-act-proposed-policy-and-policy-direction-rapid-deployment

[83] The Broadband Cost Reduction Directive, that aims at incentivising cooperation across sectors and exploiting synergies (e.g. with energy, water, transport) to the benefit of the citizens by creating the conditions for more efficient deployment of new physical infrastructure so that the networks can be rolled out at lower cost. See https://ec.europa.eu/digital-single-market/en/cost-reduction-measures

dimensioned, and priced, for large operators with volume and cost commitments that are beyond the scope of most local operators.

IV. Financial Support

Usually *local operators* scale in three phases, pilot, consolidation and expansion. In some locations, even *local social-purpose operators* 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 or to commit to being anchor tenants (ideally with an upfront payment for services). However, in most rural areas in the developing world, the resident population is unlikely to have the financial or human capacity to be able to provide the needed resources, and external fundraising will be required[84] for each of these phases of development.

Below there is a summary of the major challenges identified, the proposed solutions, and the countries where they have been implemented.

Challenge	Solution	Example
Public financing	Non-recoverable subsidies, non-repayable contributions by public administrations	Universal Service Funds (USFs), Least Cost Subsidy Auction
Public incentives to promote private investment	Tax deductions for economic donations to public interest infrastructure	Infrastructure (CAPEX) donation to the guifi.net Foundation results in 35-75% tax deduction from the Spanish government (tax office).
Financial risks in infrastructure deployment	Public administrations financing initial deployments	Xafogar fibre deployment in Spain
Investment from public banks	Global, regional, national wholesale and public banks	National development banks, World Bank and IFC, combined with retail banks such as ethical banking,

[84] https://www.giswatch.org/en/infrastructure/towards-financial-sustainability-community-based-networks

		private lenders, interested in impact investment

Based on the extensive experience of guifi.net[85] over the last 15 years, the two main sources of finance for new infrastructure are external resources and reinvestment. In this document we focus mainly on the former, where public policies can create tax incentives for private and public investment and donations for shared infrastructures, as well as providing direct financial support to local operators. Public funding should ideally cover or incentivise the three different phases of scalability of these types of projects: pilot, consolidation and expansion.

Tax benefits or deductions for donations from members of a *local social-purpose operator* provided to infrastructure for the public good. In the case of guifi.net, donation of infrastructure (CAPEX) to the guifi.net Foundation results in 35-75% tax deduction to the donor[86]. That tax deduction and the fact the infrastructure is shared at cost, on a non-profit basis, results in efficient infrastructure deployments. For example, B4RN is owned by its members through community shares[87] to raise the investment to cover the work and materials required for installation in a new area. An effective fundraising strategy for helping to address digital exclusion is for administrations to offer tax breaks for contributions to the deployment of network infrastructures for underserved communities.

Non-recoverable subsidies, non-repayable contributions by public administrations, such as Universal Service Funds (USFs). Many countries have established a USF from the contributions from licensed operators, however many have already accumulated large amounts of unspent funds, partly because of the limited capacity of regulators to evaluate and disburse funds to the right projects[88], and also because of the paucity of appropriate projects to support. In this scenario, some countries are restructuring their USF to support *local operators*[89]. Apart from financial support, prospective stakeholders could help with the proper legal and regulatory establishment of such funds. Aside from simple direct grant or loan funding, another vehicle is the **Least Cost Subsidy Auction** where the government calls for expressions of interest in serving a location and accepts the one with the lowest proposed subsidy. Additionally, most countries have programs to develop rural enterprises as well as SMEs, but currently these usually do not cover the field of telecommunications, despite the potential impact of rural

[85] http://dsg.ac.upc.edu/rogerb-phd

[86] http://intranet.fundaciones.org/EPORTAL_DOCS/GENERAL/AEF/DOC-cw5565970265664/InformaciOnfiscalparadonantesdeduccionesnuevas.pdf

[87] https://b4rn.org.uk/community/investors/

[88] http://webfoundation.org/docs/2018/03/Using-USAFs-to-Close-the-Gender-Digital-Divide-in-Africa.pdf

[89] https://www.enacom.gob.ar/institucional/avanzamos-hacia-una-mayor-conectividad-y-reduccion-de-la-brecha-digital_n2444

telecommunication microenterprises presented throughout this report. The problem with this situation is exemplified by the following case: Telecomunicaciones Indígenas Comunitarias, an Indigenous (TIC-AC) GSM network in Mexico, was one of the winners of the Prize Innovatis, the National Prize for Social Innovation Research[90]. Apart from this recognition, the different government entities responsible for the prize were supposed to support the winners through its different programs. From the three winners, TIC-AC was the only one that did not receive any support, as none of the programs of the entities covered telecommunications.

Public administrations financing initial deployments to be repaid by customers or operators at term or when reaching thresholds of usage levels to reduce risk. In the Xafogar fiber deployment project in a rural area of Spain by Guifi.net[91], the county's agency is contributing to the implementation of fiber in the area where the Guifi.net foundation receives funds from the municipalities under the commitment to deliver connectivity in commons model to the municipal buildings. The public administration contributes in lending an initial amount to be returned as new investors join, and coordinating and disseminating the initiative but not in grant funding. In less than 4 years the initial amount loaned by the county's agency, used to create a backbone and show feasibility, has been returned to the public agency, and fiber connectivity has become widespread in previously unconnected rural areas.

Traditional **bilateral and multilateral development institutions such as national development banks** or UN agencies and organisations such as the World Bank and the IFC have financed the deployment of telecommunications infrastructure. However, these agencies face three challenges when their funds are to be used by small operators and community-owned networks: small scale, high real and perceived levels of risk, and low surplus revenues[92] with which to repay the loan. Another source is impact investment from ethical banking[93]. For example B4RN carried out a successful regulated crowdfunding campaign offered in coordination with the Triodos ethical bank in the UK for 3.3 million GBP. Their experience combined with being a community business owned by its members, offers a key competitive advantage.

V. Access to network information

More granular, publicly accessible information on the location, ownership, and operation of telecommunications networks is essential to enabling a more diverse operator ecosystem. *Local operators* require access to information on backhaul networks, towers, and spectrum assignments to be able to design and plan sustainable networks to address access gaps.

[90] https://www.youtube.com/watch?v=VcdDlscl7qY
[91] https://fundacio.guifi.net/en_US/page/xafogar
[92] https://www.giswatch.org/en/infrastructure/towards-financial-sustainability-community-based-networks
[93] https://www.triodoscrowdfunding.co.uk/invest/broadband-for-the-rural-north

Adopting Open Data[94] policies and approaches in telecommunications ensures that a more constructive debate on access among civil society organisations, the broader internet technical community, government, and industry takes place.

Challenge	Solution	Example
Local operators and digital advocacy organisations are unable to discover the extent to which IMT frequencies have been assigned.	Standardise good practice of making all IMT spectrum assignments and details of license fees and obligations publicly available on regulator websites.	Nigeria, UK.[95]
Coverage maps from mobile operators are not subject to any independent verification. Coverage gaps and opportunities may be understated.	Standardise the good practice of making data on all tower and radio operation publicly available	Canada, Netherlands[96]
Absence of public data on all national fibre networks hampers strategic planning by operators national and local.	Obligate all fibre operators to publish publicly available network maps including points of presence.	France, Ireland[97] Dark Fibre Africa, South Africa

A simple first step would be to normalise transparency regarding the assignment of spectrum frequencies. It is not fruitful to have a public debate on innovations in spectrum management without a clear understanding of current spectrum assignments and their terms and conditions.

[94] What is Open Data http://opendatahandbook.org/guide/en/what-is-open-data/
[95] https://www.ofcom.org.uk/spectrum/information/spectrum-information-system-sis/spectrum-information-portal
[96] https://wetten.overheid.nl/BWBR0027031/2013-03-15
[97] https://fibrerollout.ie/rollout-map/

Several country regulators offer examples of good practice in this regard, including the UK[98], Mexico[99], and Nigeria[100].

Another important step in transparency is public information regarding network towers and their occupancy. As ensuring affordable access to all of the population becomes an increasingly important strategic priority, having a rigorous understanding of the limits of existing coverage becomes essential. Network operator coverage maps are useful tools, but require a mechanism for independent corroboration. Public access to information on tower location and occupancy is the simplest route to achieving that. As with spectrum assignments, good practice already exists. The Canadian regulator publishes a downloadable database[101] of all towers and associated radios. In India, commercial operator Airtel has published a map[102] of their entire tower infrastructure network under the slogan "Because you have a lot to say. And we have nothing to hide."

Transparency in the deployment of terrestrial fibre-optic infrastructure is important too. Fibre-optic points of presence are the "deep water ports" of the internet, meaning they have very high capacity, low-latency connections to the global internet. Access to fibre for backhaul is often essential to fully take advantage of the innovations in spectrum management mentioned in this paper. Yet it is surprisingly rare for commercial operators to publish detailed fibre maps. With few exceptions[103], governments and regulators have been slow to push for transparency in this area. Good practice in this area can be seen in operators like Dark Fibre Africa in South Africa who have published a detailed fibre map[vi] of their network since their formation over 10 years ago.[104]

ITU-D publishes interactive transmission maps[105] of backbone broadband connections worldwide, of core transmission networks including optical fibres, microwaves, submarine cables and satellite links. A missed opportunity in the ITU transmission map is the ability to download the underlying data for the map in an open format. This would allow it to be used by

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98 OFCOM Radiocommunications licences.
https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences

99 Instituto Federal de Telecomunicaciones: Registro Público de Concesiones http://ucsweb.ift.org.mx/vrpc/

100 Nigerian Communication Commission - Frequency Assignment Tables
https://ncc.gov.ng/technical-regulation/spectrum/frequency-assignments

101 Government of Canada: Spectrum Management System Data
http://sms-sgs.ic.gc.ca/eic/site/sms-sgs-prod.nsf/eng/h_00010.html

102 Airtel Open Network https://www.airtel.in/opennetwork/

103 The French regulatory agency, ARCEP, publishes public maps of fibre, towers, and mobile coverage. They have a published Open Data policy regarding the collection and publication of telecommunications infrastructure data. https://www.arcep.fr/cartes-et-donnees/new-deal-mobile.html

104 Dark Fibre Africa Coverage http://www.dfafrica.co.za/network/coverage/

105 https://www.itu.int/itu-d/tnd-map-public/

researchers in combination with other socio-economic datasets in order to produce new insights. In contrast, the AfTerFibre[106] map maintained the Network Startup Resource Center (NSRC) allows maps of network fibre infrastructure to be downloaded in a variety of open data formats. This has allowed researchers to carry out an econometric investigation of the relationship of terrestrial fibre networks in African countries to employment levels[107]. This is the tip of the iceberg in terms of research opportunities linking telecommunications infrastructure data to other publicly available socio-economic data sets. The benefits are of course not limited to researchers. The ability to combine socio-economic datasets and telecommunications infrastructure data will benefit entrepreneurs seeking investment opportunities as well as regulators and policy-makers seeking to validate the impact of their interventions.

F. Impact of a more diverse operator ecosystem

A number of countries have demonstrated leadership in the implementation of a more enabling environment for *local operators,* including nations with large populations and relatively industrialised economies in the Global South, such as Brazil, Argentina, Mexico and South Africa. Although a global survey has not yet been carried out, it is apparent that the number of these *local operators* are growing significantly, complementing and extending the services provided by the national fixed and mobile operators.

In South Africa, examples of these *local operators* include over 500 hundred local commercial operators, mainly in the form of Wireless ISPs. The Wireless Access Service Providers Association (WAPA) has observed the number of customers of its members had grown 2000% to 164,000 in the last 11 years. *Local social-purpose operators*, in particular community networks, are also expanding, with Zenzeleni Networks having incubated a new cooperative in the Eastern Cape[108], and several other community networks appearing elsewhere in the country [109] [110] [111].

This trend has been evident for some time in other countries that have adopted similar policies, such as in Brazil where there are now more than 12,000 *local commercial operators*, with 200 new ones registering each month. Of them, more than 3,650 small/community/non-profit operators have obtained license exemption from Anatel to provide internet access. According to Anatel's indicators, *local commercial operators* represented 17% of overall internet access in

[106] African Terrestrial Fibre Map at NSRC - https://afterfibre.nsrc.org
[107] Moonshot Africa and jobs. https://blogs.worldbank.org/developmenttalk/moonshot-africa-and-jobs
[108] https://www.giswatch.org/en/country-report/infrastructure/south-africa
[109] https://www.news24.com/SouthAfrica/Local/Peoples-Post/connecting-ocean-view-20190805
[110] https://www.internetsociety.org/blog/2019/01/south-africa-gauteng-community-outreach-why-community-networks-matter/
[111] http://vpuu.org.za/ict4d/digital-divide-south-africa/

2017, and today they represent 23%[112]. In Argentina the ecosystem of *local operators* is also vibrant, with approximately 2,000 cooperatives that provide communication services which emerged as a result of the history of self reliance in the provision of public services in the many sparsely populated areas scattered across the territory. This helped stimulate the growth of local cooperatives providing cable TV, and then internet access[113]. The directive from ENACOM to include community networks as part of its licencing framework, is now helping to consolidate the association of local social-purpose operators, with CARC having representatives from 20 organizations[114]. In Mexico, following recent provision of social purpose mobile spectrum in 2016, about 20 *local social-purpose* community-based IMT operators have rapidly emerged, and now cover about 70 villages in the state of Oaxaca[115].

These types of *local operators* are also present in the Global North. In the USA, rural telecommunication co-operatives have existed since the early part of the last century. The NTCA–The Rural Broadband Association currently represents about 850 of these independent community-based telecommunications companies that operate in rural and small-town America. In addition about 750 municipalities spread across the USA have established their own fibre and wireless networks for use by their residents. [116] Many of these networks also exist in larger urbanised areas in the USA, including New York City, Oakland, California, and Detroit, Michigan. In Spain, guifi.net - which received the European Broadband Award for the best innovative model of financing, business and investment in 2015[117] - supports thousands of individual participants and 26 local for-profit and non-profit telecom operators sharing infrastructure in commons, with a fiber/wireless backbone and multihoming internet links, with Wi-Fi and FTTH access. B4RN, a community-owned fibre operator near Lancaster UK serves 74 rural communities with 1 and 10 Gbps. In Greece, another *local social-purpose operator*, Sarantaporo.gr, received the European Broadband Award in the category for “Demand generation and take-up of connectivity” in 2019[118].

However the emergence of *local operators* has so far only been seen in the few countries with conducive policies, often combined with supportive historical conditions or traditions of self sufficiency. In general, however, most countries have much fewer numbers of ISPs and private network operators, and in many of them there has been a marked decline. For example, in West Africa, one of the regions with the lowest levels of indicators related to coverage and internet

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[112] Contribution by the Federative Republic of Brazil - Topic for the public consultation of the CWG-internet: https://www.itu.int/md/meetingdoc.asp?lang=en&parent=S19-RCLINTPOL13-C&source=Brazil%20%28Federative%20Republic%20of%29

[113] See for example: http://altermundi.net http://www.telpin.com.ar and the co-operatives association: http://catel.org.ar

[114] http://carc.libre.org.ar/

[115] See TIC AC https://www.tic-ac.org/ https://www.rhizomatica.org/resources/ https://www.redesac.org.mx

[116] See https://muninetworks.org/communitymap https://www.ntca.org/ https://muninetworks.org/sites/www.muninetworks.org/files/2017-01-UW-Co-ops-RuralBroadband-report.pdf

[117] https://ec.europa.eu/digital-single-market/en/news/five-projects-got-first-ever-european-broadband-award

[118] https://ec.europa.eu/digital-single-market/en/news/winners-european-broadband-awards-2019

usage, and year-on-year growth declining, there is an average of three ISPs per country in the ECOWAS states, with the exception of Ghana and Nigeria[119]. In Pakistan the number of ISPs has dropped from 120 to 4 in recent times, while Pakistan's internet penetration rates are below 20%[120]. Similarly, in India, where mobile operators have been engaged in aggressive mobile data pricing that is seeing small ISPs exit the market, internet services still only reach half of the population.

A more vibrant and inclusive economy (as illustrated by the 'jar of stones' metaphor) is possible, given the wide range of customer bases and value propositions, but regulation to enable a wider range of economic levels is needed to achieve this. For instance, Vodacom, a national mobile network operator, has over 43 million customers in South Africa, while the 250+ WAPA members, mostly local commercial operators, each have between 100 and 20,000 paying customers (who might each be providing access to between 1 and 100 individuals). Zenzeleni Networks, a *local social-purpose operator* and WAPA member, fits into these ranges as well. At the same time, Vodacom, which has seen its net profit grow more than 11 times over the last 15 years, with a net profit above 1 billion USD in the last year only[121]) sells 1GB data bundles valid for one month at 149 ZAR[122]. Simultaneously, Too Much Wifi[123], a *local commercial operator* serving urban townships in Cape Town, is providing similar data packages about 7 to 8 times cheaper than Vodacom. At the other end of the spectrum, Zenzeleni Networks, which operates on a cost recovery basis for its members, provides unlimited internet for 25 ZAR/month.

G. Conclusion

The ongoing global pandemic has shown how important internet connectivity is to preserve life as well as to support economic activity. Yet, almost half of the world remains unconnected. With current trends showing how the growth rate of internet users is declining and with national operators turning their attention to new technologies mainly designed to improve the user experience of those already connected, it is imperative that regulators take action to expand the operators' ecosystem to enable complementary access models.

Recent changes in the telecommunications industry have made it technically and economically possible for *local operators*, both *commercial* and *social-purpose*, to fill the coverage and usage gaps left by *national operators*, in a complementary way. Despite barriers inherent to the majority of regulatory frameworks that are designed for *national operators*, evidence shows

[119] Progressus report 2018.
[120] Data from the ITU Database 2018.
[121] Numbers calculated using Vodacom's Financial Results 2003 -2018
[122] These pricing structures has been considered "anti-poor" by the Competition Commission of South Africa: http://www.compcom.co.za/wp-content/uploads/2019/12/DSMI-Non-Confidential-Report-002.pdf
[123] https://toomuchwifi.co.za/

that in countries where regulatory interventions to enable *local operators* have been implemented, users in areas previously unconnected or with unaffordable services have developed their own ways to be connected.

Regulators can create a more enabling environment for *local operators* by replicating the best practices from regulatory frameworks worldwide included in this document. Below we list a summary of the recommendation along the five categories identified where regulatory intervention is required to enable *local operators*:

Cluster of regulatory interventions	**Good practice identified**
Operators Licensing	More granular approach to licensing
	License Exemptions for private networks and non-profits
	Create specific licenses for Community Networks or fitted in existing exemptions.
	Simple authorization or notification system
Spectrum Licensing and Fees	Make more license exempt spectrum available
	Set aside IMT spectrum for rural connectivity && Establish use-it-or-share-it mechanisms for IMT licenses
	Implement dynamic spectrum sharing regulation && Implement light-licensing regulation for microwave
Backbone and backhaul Infrastructure	Ensure the viability of *local operators* through open mechanisms for affordable and predictable and affordable access to backbones, backhaul and interconnection
Financial support	Non-recoverable subsidies, non-repayable contributions by public administrations
	Tax deductions for economic donations to public interest infrastructure

	Public administrations financing initial deployments
	Global, regional, national wholesale and public banks
Access to network information	Standardise good practice of making all IMT spectrum assignments and details of license fees and obligations publicly available on regulator websites
	Standardise the good practice of making data on all tower and radio operation publicly available
	Obligate all fibre operators to publish publicly available network maps including points of presence

Annex 1 - Recognition and Awareness

One of the main barriers to the adoption of an enabling regulatory framework for *local operators* is that few people know they even exist. This applies not only to the rural communities that are most likely to benefit, but also to policy makers and regulators, and development organisations. Lack of awareness is compounded by the view among most policy makers and funders that access markets can be sufficiently well-served by a handful of large (multi)national operators competing to provide services of sufficient coverage and quality, and at an affordable price. However, there is an increasing body of experience that indicates that support expanding the telecommunications operator ecosystem to include local operators. A number of global policy positions have now reached similar conclusions. Among them:

> Recommendation 19 ITU-D: Telecommunications for rural and remote areas - The World Telecommunication Development Conference (Dubai, 2014)[124]:

10. that it is important to consider small and non-profit community operators, through appropriate regulatory measures that allow them to access basic infrastructure on fair terms, in order to provide broadband connectivity to users in rural and remote areas, taking advantage of technological advances;

11. that it is also important that administrations, in their radio-spectrum planning and licensing activities, consider mechanisms to facilitate the deployment of broadband services in rural and remote areas by small and non-profit community operators;

> The Report of the United Nations Secretary General's High Level Panel on Digital Co-operation[125], in its recommendations for An Inclusive Digital Economy and society includes:

"*Second, investments should be made in both human capacity and physical infrastructure. Creating the foundation of universal, affordable access to electricity and the internet will often require innovative approaches, such as community groups operating rural networks, or incentives such as public sector support.*"

> The Annual Deliverable 2019-2020 from ITU-D Study Groups Question 5/1: Telecommunications/ICTs for rural and remote areas includes[126]:

"the following recommendations can be made for now:

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[124] https://www.itu.int/en/ITU-D/Conferences/WTDC/WTDC17/Documents/WTDC17_final_report_en.pdf
[125] https://www.un.org/en/pdfs/DigitalCooperation-report-for%20web.pdf
[126] ITU-D Study Groups: "Broadband development and connectivity solutions for rural and remote areas". Available at: https://www.itu.int/dms_pub/itu-d/oth/07/23/D07230000020001PDFE.pdf

- *Ease regulatory requirements for community network operators."*

In Africa, the Specialized Technical Committee on Communications and Information Technologies (STC-CICT) from the Africa Union included, in its 2019 Sharm El Sheikh Declaration (STC –CICT-3) the following text directing the African Union Commission to:

"29. PROMOTE the formulation of strategy and pilot projects for Unlocking Access to Basic Infrastructure and Services for Rural and Remote Areas including Indigenous Community Networks, and develop guidelines on legislation on deployment of technologies and ICT applications, to accelerate infrastructure role out in collaboration with ATU and other regional institutions;"

Additionally, the Broadband Commission "Connecting Africa Through Broadband: A strategy for doubling connectivity by 2021 and reaching universal access by 2030" recognizes the role of community networks in 3 of the 7 Objectives of its Action Plan. Of particular interest is Objective 5: "Provide direct funding support for extending affordable broadband access to commercially challenging rural and remote areas, to women, and low-income users", and the recommendations under Objective 1: "Ensure that the commercial broadband ICT market is open and structurally prepared for competitive private investment:

"Adopt open wholesale and retail telecommunications market entry policies, especially competitive and unified licensing regimes, and liberal, dynamic spectrum policies. Such policies should also accommodate community and nonprofit focused network operators who offer services in underserved areas."

In addition some countries include in their policy documents references to community networks, small operators and co-operatives as a vehicle for digital inclusion. Among them, Kenya and South Africa. Kenya highlights the need to provide for enabling policy and regulatory framework for community-based operators in their National Broadband Strategy[127]. South Africa not only mentions them in their National Broadband Plan[128], and includes them as part of the Telecommunications Value Chain in their SMME Strategy[129], but the development and promotion of "SMMEs and cooperatives" is part of the objects of the Electronic Communications Act, the main act of the telecommunications sector in the country[130]. In the particular case of community networks, specific support for their development was articulated in the Budget Speech 2018 from the Department of Telecommunications and Postal Services[131]. Unsurprisingly, South Africa is the country in Africa with the most local operators in Africa.

[127] https://ca.go.ke/wp-content/uploads/2018/02/National-Broadband-Strategy.pdf
[128] https://www.ellipsis.co.za/wp-content/uploads/2013/10/NBP-2013.pdf
[129] https://www.dtps.gov.za/images/phocagallery/Popular_Topic_Pictures/40756_31-3_TeleComPostServ.pdf
[130] Electronic Communications Act, 2005 (Act No. 36 of 2005): https://www.dtps.gov.za/index.php?option=com_phocadownload&view=category&download=34:electronic-communications-act-2005&id=2:legislation&Itemid=142&start=20
[131] https://africanewswire.za.com/deputy-minister-stella-ndabeni-abrahams-telecommunications-and-postal-services-dept-budget-vote-2018-19/

In the Americas region, during the last few years, Brazil has implemented a strong policy and regulatory strategy for facilitating the participation of small operators in serving rural and remote areas[132], including a recent note on how to regulate community networks[133]. In Mexico, community and indigenous operators are specifically recognized in the Telecommunications Act, and it specifies that spectrum planning activities should always take into consideration the specific needs of these operators. Mexico's new Social Coverage Program specifically refers to them as an important allies in addressing unconnected areas[134]. At the regional level, the Interamerican Telecommunications Commission tracks the implementation of resolution ITU D-19 regarding small, not for profit and community operators, through resolution 268-PCC1. The report, presented in 2018, shows the development of inclusive regulation for small and community operators in each of the countries[135].

The ITU has its own SME program which aims at integrating the participation of SMEs in ITU processes, such as study groups and other ITU events[136], which is a step toward the recognition of the contribution that small enterprises bring to the ecosystem, although as yet it does not include explicit recognition of *local operators* found in other policy documents.

[132] Expansion of Brasilian Broadband Network Document presented by the Brasilian Delegation at the 35th Meeting of the PCC-1 Citel 2019.

[133] https://www.anatel.gov.br/setorregulado/component/content/article/2-uncategorised/528-redes-comunitarias

[134] https://www.gob.mx/sct/acciones-y-programas/programa-de-cobertura-social

[135] The details of the study can be found at https://www.redesac.org.mx/regulacion

[136] https://www.itu.int/en/join/smes/Pages/default.aspx