Social ISPs for reducing digital inequality

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***Abstract*— In developing economies digitalization projects related to governance, education and other vital areas of public life tend to fail because in the targeted population only very few have Internet access. This is holding back economic and social development. This document outlines the regulatory and market dynamics related obstacles that prevent rapid improvement. A new approach coined Social Internet Service Provider is introduced. The business model and rough business case of a Social ISP, as well as the regulatory requirements and constraints, are outlined. The conclusions of this paper constitute a call for action for governments, regulators and investors. This paper shows how to make the Internet accessible to the next billion people.**

Keywords—digital inequality, digitalization, digital divide, connecting the unconnected

I. Introduction

Digitalization is globally high on the agenda. According to the UN position statement in [6], "Digital advances can support and accelerate achievement of each of the 17 Sustainable Development Goals – from ending extreme poverty to reducing maternal and infant mortality, promoting sustainable farming and decent work, and achieving universal literacy". Generally, making healthcare, education and government services available online is improving efficiency of these services.

In countries where a large portion of the population does not have Internet access, these services are only available to few. Furthermore, even in countries where Internet access is available in the most populated regions, a substantial number of people are excluded from digital services due to technical ("unconnected") or commercial ("underconnected") reasons.

During the COVID lockdown in Namibia schools switched to remote education. Authorities sent a survey to find out which content and learning activities to be sent to the learners. It was discovered that only 2% of the pupils were able to access the Internet. [1]

In low and middle income countries mHealth services including virtual consultations, diagnostic tests, and prescriptions of drugs widens the health inequality in the community as a large population group will consistently lack access to the services while the smaller population benefits from it [2].

COVID and E-Governance lessons from South Africa [3] include the finding that relatively low Internet penetration, combined with low social media penetration, means that e-government services offered via social media do not reach a wide proportion of the population. South Africa has an Internet penetration rate of 68% while the average in Africa is 39%.

These examples illustrate the difficulties of introducing efficient digital services in areas with limited Internet penetration. Clearly Internet access is a prerequisite for modern life as we know it.

What needs to be done to enable affordable Internet access now? The questions should be high on the agenda for any state or organization working on sustainable development in low and middle income countries. The topics to be addressed are:

1. Regulation
2. Business model
3. Access to capital

One could argue that technology or technology development should be a fourth topic, but as we are addressing the needs of low income populations and time is of the essence the focus is on existing widely used and proven technical solutions.

This paper proposes a new approach to reach digital equality. The examples and statistics in this document are from Africa but the approach taken applies to other parts of the world as well.

II. Key concepts

Unconnected: people not connected to the Internet. This includes populations of areas that lack connectivity services as well as those who either cannot afford or physically master getting connected. The latter group includes e.g. handicapped, elderly and illiterate people.

Underconnected: people who either have intermittent connectivity because of technical reasons such as poor coverage or network congestion or who do not have financial means to either pay for connectivity or user equipment that allows them adequate service levels. Use cases such as eLearning, mHealth or eGovernance are generally not available to these people.

III. What needs to be connected

In 2022 92% of the 5.0 billion people using the Internet use a mobile phone to go online [4].

2022 the global sales of 5G smartphones for the first time outpaced the sales of 4G phones [7], but it will take many years before 5G becomes an option for the mass market in Africa. According to [8] in Sub-Saharan Africa 4G penetration is growing from 17% in 2021 to 33% in 2025 and 5G to grow to 4.5% in the same timeframe.

While the growth of 4G and 5G is significant, a Social ISP that wants to target the currently unserved or underserved low income population in Africa needs to consider ways to provide some connectivity to the legacy user equipment as well. The simplest way to do this is to use mifi devices or other 4G/5G user equipment capable of offering Wifi connectivity. This approach allows the Social ISP to select between building on 4G or standalone 5G. The technology

choice depends on a number of factors, including the availability of frequencies, the need or desire to use existing user equipment and the price. For still some time the slow progress of the standalone 5G ecosystem and the very low 5G UE penetration in Africa leads to 4G being the technology of choice in most cases.

IV. Current Internet Connectivity services and their limitations

A. Public services

Consumer Internet access is generally available from three sources:

1. Public service
2. Private Internet service provider (ISP)
3. Mobile network operator (MNO)

Apart from libraries where you may find computers available to the public, free Internet is almost exclusively offered using Wifi. If the service is offered by authorities, it is limited to central locations and institutions, e.g. schools. Private restaurants and shops may also offer free Internet for attracting data hungry customers.

A private ISP operates using a fiber, cable and microwave radio infrastructure. A customer orders a connection. The ISP either uses existing infrastructure or builds the last mile connection for being able to offer the service. ISPs also offer public Wifi service in selected locations.

Mobile network operators have become the dominant providers of Internet connectivity. In addition to smartphones mobile routers (especially Mifi devices) are used to access the service.

B. Private networks

Today private networks are predominantly built using Wifi. Mines, harbors and other business sites that extend over a large area benefit greatly from private mobile networks. Today this means private LTE. Over time private 5G will become the dominant technology. The success of private mobile networks in a given market depends to quite some extent on the availability of useful spectrum that can be licensed for local use at a reasonable cost and effort.

The high penetration of 2G and 3G phones in Africa might suggest the use of these legacy technologies for private networks as well, but the limited data rates and scarcity of frequencies for which 2G and 3G have been specified make these options impractical. Besides it would be very difficult to find funding for projects that build on outdated technical platforms that are being sunset in other parts of the world.

C. Community hosted networks

In areas where commercial networks are not available, access networks can be set up as a community effort. The leader for this activity may be an entrepreneurial person or a local institution, e.g. a school. Hosting base station sites for larger telecom operators is also an option.

So far setting up these systems and operating them has required networking expertise. Like snowflakes, all mobile network deployments are different. With the emergence of private LTE it becomes easier to cover larger areas with a relatively simple system that is easily replicable.

In community hosted networks the topic of cost sharing or a fair usage policy is more important than in networks where a commercial entity operates the network for profit.

V. Obstacles to digital equality

In this section fundamental reasons leading to the current digital inequality in Africa are discussed. Note that the challenges are predominantly rooted in regulation and established practices. Technology is not the blocker.

A. Mobile network operator business model

Mobile network traffic has been growing at over 50% each year throughout the 4G era. At the same time the average revenue per user for a mobile operator has grown only very little. This means that mobile operators are constantly busy upgrading their networks just in order to keep their existing business. One of the side effects of this is that especially in those countries where rural coverage is poor or missing it is very difficult for operators to find a business justification for network expansion. Capacity extension in existing areas provides a better business case as towers and other infrastructure is in place and existing customers are easy to address. An equally important topic is customer retention as generally all operators follow a similar strategy when upgrading their networks.

B. Conservative telecom regulation

Telecom regulation varies per country, but basic concepts are inherited from the times of telecom liberalization. Especially in Africa obtaining a new mobile operator license is possible without a prohibitive cost, the requirements for fast population coverage, service quality, consumer protection etc. makes it very difficult for newcomers to compete against entrenched big MNOs with recognized brands and networks with massive amounts of users.

The current regulation essentially assumes that when using 3GPP technology the primary service is retail SIMs and subscriptions.

C. Poor access to capital

Over time many attempts to create new mobile operators in Africa or to vitalize ailing license holders have failed. This has made investors cautious. With the current license requirements securing the capital for a project that builds a mobile network from scratch and builds a sustainable customer base is not available. Another finding is that even in wealthier countries the typical number of strong nationwide carriers has not grown beyond three.

VI. Emerging enablers

A. Proliferation of private mobile networks

Private mobile networks, i.e. initially private 4G and over time private 5G can be built using a minimal subset of the features available for public mobile networks. This has several important implications on the cost of the network investment and operation.

1) It allows the construction of preconfigured systems that work out-of-the-box that do not require special skills when the network is set up or operated. This eradicates the implementation and operation service cost as known by the public network operators.

2) Streamlined products including base stations optimized for private networks and small mobile core software that can be run on any PC are gradually emerging.
3) A private mobile network is built for fulfilling the needs of an existing user base. This means the network can immediately provide utility (and revenue with charging). When building a new public network, the network usage is in the initial years typically very low as upfront customer acquisition is very difficult.

B. *Availability of public 4G networks for connecting private networks*

At the outskirts of the public mobile networks an outdoor LTE modem with a directional antenna placed on the roof may be the most cost efficient and easy way to connect a site or community to the Internet.

C. *Evolution of satellite services*

Satellite data connections have traditionally been used in places where no other communication infrastructure is available, e.g. ships.

New generations of satellites and the emergence of low orbit earth satellite constellations has led to price reductions that make satellite services a viable option also for carrying the traffic of a community. Current pricing is discussed in [6].

Pricing plans with data caps may require some enforcement of user traffic, as one or a few heavy users of video easily deplete the available data quota. Before ordering a low orbit satellite service it is advisable to make sure that the satellite receiver can be placed so that it has 180' sky view. Hills, trees or buildings block the signal and may lead to a poor or completely dysfunctional service.

D. *Improvements in usability of networks*

With the emergence of private mobile network products and systems optimized for use by people without significant telecom expertise are appearing on the market. This means that also the hurdle for communities to install and operate their own mobile access networks are becoming smaller.

VII. THE CONCEPT OF A SOCIAL ISP

The social ISP is a new approach to connect the unconnected and the underconnected. For a social ISP to be sustainable, it has to operate using a different business model than traditional mobile operators and ISPs. Instead of the full telecom service portfolio the focus is on providing Internet access.

Instead of building the network according to a pre-approved plan to areas with the highest population density and/or purchasing power the social ISP shall help communities and enterprises to build coverage where they need it. This has three benefits. First of all the planning process with site surveys, site acquisition etc. can be skipped. Secondly the network can be taken into use immediately when built without any significant marketing effort. The third benefit is that the cost of deployment is lower if the community participates in the effort.

When operating the network another benefit of community hosting becomes visible. First line maintenance tasks can be handled by the community. In the traditional model, where an operator service expert travels to the site, a large amount of cost is caused by travel. Also the experienced downtime is shortened significantly as fixing issues is not subject to task lists, where rural issues tend to have low priority.

The social ISP allows communities and enterprises to run some of their software applications locally in the village, school or campus. This means some of the traffic is handled locally and does not burden the Internet connection, which is a finite and costly resource.

The technology used by a social ISP taps into products from the optimal price/performance category, the 3GPP base station and UE ecosystem as well as reliable off-grid solar or other local renewable energy sources. With little extra cost the solar power system can be dimensioned to serve the hosting community with surplus power.

Using the above recipe the social ISP can provide lower cost data service than any other type of player on the market. At the same time the low cost approach allows a social ISP to be reasonably profitable. This allows growth and attracts investors.

In order to keep the network simple and to avoid accusations of unfair competition the social ISP should not offer telephony or SMS services. Neither should subscribers get telephone numbers. Mobility can be limited. In many jurisdictions these limitations allow the social ISP to operate without a telecom operator license, which typically brings along a long list of detailed requirements.

The social ISP should not compete for SIM resellers as this sales channel is expensive and well represented in areas where mobile operators do have reasonable coverage. Instead the social ISP should work primarily with authorities, enterprises and communities that need many subscriptions at a time.

The social ISP offers data services only. Reasonable Internet access over LTE and Wifi is the killer application. The wifi service is available by Mifi boxes and LTE routers. In most cases Mifi devices that are battery operated are the most suitable option as availability of power is limited, and Mifi boxes can be charged using the off-grid solar system that is deployed with the community hosted network

A limited set of local services that help reduce the load on the Internet link should be considered. These include SIP based messaging and calls as well as content caching. Local services provide value to the community even when the Internet connection is broken or poor.

The access network of the social ISP can be efficiently implemented using a community hosted LTE small cell deployment. Technically this equals a small private LTE deployment. The community hosted network can be connected to the Internet using any available Internet service. As an alternative the social ISP can also establish a simple LTE macro network to act as a backbone for communities. Note that this approach requires additional spectrum assets.

From a network architecture perspective the Social ISP builds many small independent access networks that are

capable of providing some local services. This is outlined in the figure below.

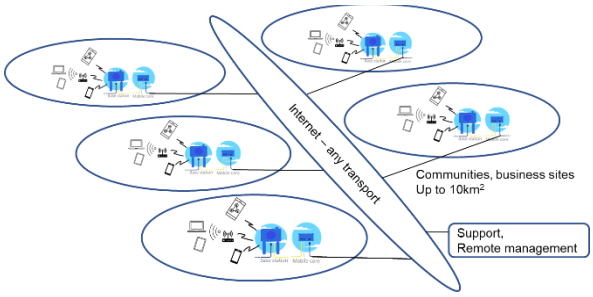

Fig. 1. Example Social ISP network architecture

Note that it depends on the local requirements and regulation if the user of a particular access network will be served by other access networks of the Social ISP. Technically this is easily doable.

The structure with independent access networks with some local services improves both availability and security of the system, as there are no central components and the local services will continue to operate even if the connection to the Internet is unavailable.

VIII. The Social ISP Business Case

A. *Reasonably priced data services*

In Africa the dominant pricing model for mobile data is prepaid data blocks. A fixed amount of data is sold at a given price. There may be other constraints such as a limitation of the data speed or the time in which the data has to be consumed.

Usage based pricing is not very user friendly as buyers need to decide in advance how much data the services they want to use are consuming. Especially for less experienced users this is far from trivial. For digitalization efforts this is a challenge.

As an alternative the Social ISP should make time based subscriptions available. *Internet hours* or *Internet days* with limitations on the connection speed are easier to understand than megabytes or gigabytes.

An important aspect of affordability is the investment needed in new user equipment. The use of battery powered Mifi devices that offer local Wifi allows extending the Social ISP addressable markets to those having phones that do not support LTE. In environments where women and children are likely to use second hand devices the availability of a local wifi service improves digital equality. Note that the Mifi devices can be operated by prosumers, e.g. local shopkeepers who offer Wifi access in addition to other goods and services.

B. *Cost structure*

When compared to the cost structure of a traditional mobile network operator the Social ISP capital expenditure is smaller and more focused. Instead of building radio coverage for a large area it is enough to cover places where people live or work. As seamless mobility is not high on the agenda, simpler and lower cost small cell deployments can be used instead of traditional massive macro sites with high towers. Another key difference is the absence of a massive service core needed for telephony, SMS and other services. This also greatly simplifies the requirements of the business support system. The result is reduced complexity and upfront integration work. Also the need for skilled experts is significantly reduced.

The reduced capital expenditure is directly reflected in reduced operating expenses as less equipment and software needs to be maintained. Another cost saving topic is the community hosting of the systems deployed close to the customers. Tier one maintenance can be done by the community. Another significant difference is marketing and sales. Instead of a nationwide launch campaign with significant investments in brand awareness and a broad retail coverage the Social ISP can do marketing and sales locally in the places it is covering potentially using the communities as sales channels.

IX. Regulation for Enabling Social ISPs

The simplest and most straightforward regulative solution for enabling Social ISPs is to offer local frequency licenses that can be used for private networks and making these available for anyone who wishes to build a local access network. The practices introduced in the UK by Ofcom or in Finland by Traficom can be used as a basis. Topics to be agreed locally include the level of the recurring cost needed for maintaining the license and potentially a use-it-or-lose-it scheme that may be needed for discouraging speculative frequency reservations.

As an alternative the social ISP can be operated as a public service with a nationwide 20 or 40MHz frequency license. Such frequency assets are too limited for competing with the mobile operators and should not distort competition.

For protecting the mobile network operators the regulator can (and often do) also require specific licenses for telephone numbers that are needed for telephony services and SMS. reservations.

X. Conclusions

This document discussed the current challenges that make it difficult to provide connectivity and Internet access to a large portion of the African population. Lack of connectivity spoils many digitalization efforts and is an obstacle to sustainable development. This paper proposes to resolve the problem by introducing Social ISPs. Essentially these are Internet Service Providers using components of the mobile networking ecosystem for the last mile as well as community hosting that allows a more efficient cost structure than traditional approaches.

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