# THE ROLE OF TV WHITE SPACES AND DYNAMIC SPECTRUM IN HELPING TO IMPROVE INTERNET ACCESS IN AFRICA AND OTHER DEVELOPING REGIONS

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Many people may ask, why do we need new connectivity technologies in Africa? Isn't WiFi, DSL and mobile Internet enough? However we still have a long way to go in providing ubiquitous affordable and reliable Internet access in Africa and other developing countries. At the household level Internet penetration is estimated at 77% in Europe by the ITU, compared with 7% in Africa. With regard to broadband access, the divide follows similar patterns, but inequalities are even more accentuated, with less than 10% of the world's population having broadband access. Average broadband speeds vary by a factor of more than 40, from 256 kbps to more than 10 Mbps. Access inequalities are even more visible when disaggregated by disadvantaged groups, especially in developing countries - particularly the rural population, women, oppressed cultural groups, people living in remote small island nations, and in the least developed countries generally.

The two major reasons for these inequalities are the limited distribution in many areas of basic Internet infrastructure (international and national backbones and last mile/local networks), and the high cost of access, which makes services largely unaffordable in regions such as Africa, where the price of a computer-based broadband plan with 1 GB of data volume represents on average more than 50% of GNI per capita (by comparison the figure is 2% in Europe) [1].

The impact of this is that without affordable Internet, the high proportion of people who have low incomes in developing countries will not be able to participate fully in the digital revolution - to find new ways of making a living, to make more efficient use of available resources, to

1. http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2013.pdf

access online learning materials, gain knowledge of health issues and use online government services, and to maintain regular contact with friends, peers and family.

Without ubiquitous Internet, those in more isolated and rural areas (the majority of people in Africa and other developing regions) will continue to remain cut-off from the benefits described above. People living in rural areas are particularly disadvantaged because they cannot take advantage of the 'death of distance' that the Internet provides, spending much time and their limited incomes travelling to urban centres for simple transactions. Outside main centres throughout Africa, schools, small businesses, local government offices, NGOs, libraries, clinics, colleges and many institutions that are fundamental to day to day social and economic development, still don't have affordable, reliable and fast internet access.

Without dependable access, the institutions and the public will not be confident about relying on the services provided over the Internet - as we come to depend more on connectivity for carrying out many day-to-day activities, service interruptions need to be minimised through having at least two physically independent connections to the Internet.

Use of TVWS and other innovative uses of spectrum for fixed wireless access can help meet these goals in the following ways:

1. **Reducing Internet access costs** - Internet service providers able to make innovative use of radio spectrum can help to create more competition in markets for Internet access. This will put pressure on the existing/incumbent carriers which rely on their market dominance to maintain high profit margins or inefficient business practices. Mobile operators in particular, have become the 'new incumbents', often operating in cartel-like fashion even if there is nominal competition. These 'monopolistic' practices do not only keep prices high, they also limit network neutrality and innovation.

2. **Providing more ubiquitous access** - the lower radio frequencies used by TVWS can help by reaching greater distances than higher frequency systems which are less cost-effective. In addition, greater competitive pressure provided by new fixed wireless providers will also increase the incentive for carriers to make more infrastructure investments in unserved areas.

3. **Providing more reliable access** - in the developed world 'permanent' connectivity would most often be provided by a DSL or cable-TV service, complemented by a mobile broadband service. In Africa and other developing regions, a fixed wireless solution such as TVWS could be complemented by a WiFi or mobile broadband connection. In this way TVWS can provide an alternative physical path to the Internet, ensuring that vital services continue in the event of a service interruption on one of the links.

## 8.1 THE POTENTIAL FOR INNOVATIVE SPECTRUM USE

With the growth in use of wireless technologies generally, radio spectrum has become a particularly vital part of the Internet ecosystem. The use of TVWS and other dynamic spectrum-uses are particularly appropriate for developing countries - where there is plenty of unused broadcast spectrum, bitrate expectations are lower and there are large numbers of people living in areas unserved by existing infrastructure. The explosive growth of mobile access has tended to draw attention away from the provision of fixed access (which offers higher speeds and lower subscription costs), and as a result fixed last-mile infrastructure has tended to take a lower priority in public policy, and current policy and regulatory practice has not responded to the problem with much creativity.

Rural communities are especially vulnerable to poorly managed spectrum because they are less likely to have any fixed line alternatives. But although there is also more spectrum available in rural areas because there are much fewer existing spectrum users, this has not translated into better spectrum access.

Lack of awareness by national policy makers of the need for low cost spectrum for wireless operators is a key factor, along with lack of capacity to update spectrum plans as new technologies emerge, as well as resource constraints in spectrum regulation enforcement. Among the most visible of these problems is linked to the slow move from analogue to digital TV in developing regions, delaying the availability of the important 700-800 MHz wavebands [2], which are particularly suitable for high-speed wireless broadband services. Allocation of the 2.6 GHz waveband is important for broadband in urban areas and is also subject to allocation delays in many countries. Use of dynamic shared and unlicensed spectrum technologies such as TVWS and WiFi could have a major role to play in meeting connectivity needs immediately, without having to wait for the analogue to digital switchover, which now appears that it will not take place in many developed countries before the 2015 deadline proposed by the ITU.

2. Often called the 'Digital Dividend'.

Currently the high cost of spectrum licenses is a major constraint on deploying new wireless services, limiting the deployment of wireless Internet services, and increasing end-user costs. High spectrum prices are also linked to the continued dominance of the mobile operators. Having paid millions of dollars to the state for these licenses, the mobile operators are able to convince governments to limit the entry of other new wireless players in the market. Many mobile operators have claimed that the license fees were paid on the basis of a limited number of market players and that the market size is insufficient to support more operators. This has been reinforced by the fact that different approaches to spectrum management for increasing access are usually overlooked

by most regulators and smaller and local ISPs.

Of particular importance is that the dynamic spectrum-use model can also be applied to other frequencies to increase efficiency of spectrum-use more generally, and help reduce the burden on regulators for spectrum management. The few TVWS trials that have taken place have already demonstrated that very large portions of the allocated spectrum bands are not actually in use, and this has thrown into question the whole premise of 'spectrum scarcity', upon which current allocation models are based. Hopefully, as more on the ground spectrum-use information becomes available from more developing countries, and from more sources than just the (often poorly resourced) national ICT regulator, such as through crowd sourcing, there will be better awareness of the increased potential of the radio spectrum resource.

In this respect TVWS is a point of entry for highlighting issues of spectrum management generally, and can bring together a wide range of stakeholders to work together on solutions to the access problem. As highlighted by the history of TVWS support in the US where NGOs first pushed for its use, civil society has an important role to play in bringing attention to dynamic spectrum use. With a technology-neutral agenda, civil society groups are not biased toward a particular access solution and can be a trusted partner in helping to guide the adoption of the most effective mix of technologies.

## 8.2 MAXIMISING THE IMPACT OF INNOVATIVE SPECTRUM USE

It is important to note that TVWS and other dynamic spectrum technologies are part of a larger 'connectivity ecosystem' and will not reach their full potential unless other needs for the access ecosystem are also addressed at the same time. In developing countries these needs are many but the most important of these are:

- **Low barriers to entry for new Internet providers (licensing)** - as noted above, aside from the existing ISM/WiFi spectrum bands, high licensing costs for spectrum usually exclude smaller players who may wish to enter the market, and mobile operators are often resistant to any new applicants. Even more of a constraint in some countries is that new licenses to operate Internet services are simply not available, leaving the market to the incumbent and the existing mobile operators.

- **Efficient Interconnection** - without good interconnection with existing networks, the level of service that smaller dynamic spectrum providers can offer their customers will not be on par with those of the existing larger players. At a minimum this requires efficient exchange of local traffic with other Internet providers &

Content Distribution Networks (CDNs) by ensuring the presence of well run Internet Exchange Points (IXPs) with participation from all the major Internet providers. Ideally this should also include interconnection mechanisms with the traditional voice operators for carrying out Voice over IP (VoIP) calls. In some countries VoIP and voice services generally are not sanctioned except for use by the existing incumbent fixed and mobile networks.

- **National fibre backbones** - without good national fibre backbone infrastructure, the more remote areas which are most likely to benefit from TVWS and other wireless technologies will not be able to connect affordably and with sufficient capacity. Governments need to encourage more investment in this infrastructure by encouraging competition and also ensuring cost-based access to existing fibre optic cabling, ducts and rights of way of energy, transport, water and sanitation networks. This may need the adoption of new regulations to allow third party access to this infrastructure and to limit prices charged. Some good examples include: West African Power Pool (WAPP), Tanzania water distribution control network, the Brazilian public national fibre backbone (Telebras), Broadband Infraco public national backbone in South Africa. At the same time this also requires implementing infrastructure sharing regulation for existing providers. This usually applies to provisioning of ducts or conduit for optic fibre in new transport or energy networks, but also applies to water and sanitation pipes in municipal areas, and to wireless base-station masts. Up to 80% of the cost of laying fibre lies in the civil works - the trenching, ducting, permitting and obtaining the rights-of-way. These costs are avoided by using the energy grids, thereby making it much more economic to deploy fibre. In addition, many electricity distribution grids already have fibre installed on them (to control power distribution sub-stations) and can provide excess fibre pairs at very little cost. Unfortunately, the level of awareness of the potential of this 'alternative infrastructure' is low in most developing countries and where it exists, the energy operator often does not understand the market dynamics for telecom capacity and wishes to charge excessive amounts for access.

- **Low cost access devices.** Low income groups are particularly constrained in being able to afford the necessary equipment to access the full potential. To support better access for these communities, public financing schemes may need to be adopted with low interest loans or guarantees, and by minimising import duties on equipment.

- **Public support for extension of connectivity** to remote and rural areas. The use of universal service funds which take a proportion of revenues from existing operators to support network deploy-

ment in underserved areas has become a well accepted vehicle for this. However, few examples of good practice in this area have emerged. One good example is in a developed country, France, where operators must provide a quote in response to a request for service in any part of the country. The regulator deducts the national average cost of providing a connection (determined by the regulator's own benchmarks) and gives the difference to the operator who must install the connection within a specified time period. A reverse auction for provision of service in under-serviced areas is another such mechanism.

- **Public access facilities are needed** for those who cannot afford access in the home or at work. This can often be achieved by equipping libraries and community centres with the necessary equipment.

- **Online payment systems.** Without widely available electronic payment systems for the unbanked, those in rural areas will not be able to take advantage of one of the most desirable features of the Internet - e-commerce. Unfortunately most of the payment systems adopted to date rely on mobile networks - other alternatives need to be made available.

- **Local content development** - support is needed for building relevant local applications in order to maximise the demand for networks, such as for e-Governance and civil-service networking.

- **Effective consumer protection** - to reduce the risks of accessing the Internet, effective protection will be needed against such as aspects as spam, fraud, and hate speech, especially against women and minority groups.

- **Improved electricity distribution and renewable energy policies.** Energy dynamics are becoming increasingly linked with Internet connectivity at many different levels. The impact of energy supply and energy costs on Internet access is a well-recognised issue for disadvantaged communities, most of which suffer from high energy prices and lack of, or unreliable and/or poor quality grid power. This even includes capital cities and other major urban areas in many developing countries. These energy constraints not only affect end-users needing to provide power to their access devices and run them reliably, but they also have a deep impact on operator costs to deploy and maintain their networks. One of the reasons why mobile access charges are higher in many developing countries is the need to install generators for base stations, and to operate an entire supply chain to replenish them with diesel, often over difficult and remote terrain. Even when power is there but is unreliable, operators have much higher capital costs for

network deployment just to install backup power facilities which may be only infrequently used. Fortunately, renewable energy options for powering network operator and end-user equipment are beginning to see greater use, most especially where countries have adopted Independent Power Producer Policies (IPPPs) which allow the cost of renewable power generation facilities to be defrayed by selling any excess power generated back to the grid. New models for supplying energy in disadvantaged communities are also emerging. In many developing countries, energy kiosks are now available where people pay to have their phones recharged with an adapted car battery or solar panel. Energy distribution grids (high voltage pylons, local electricity distribution poles, and oil/gas pipelines) are a vital resource for minimising the cost of backbone optic fibre deployment.