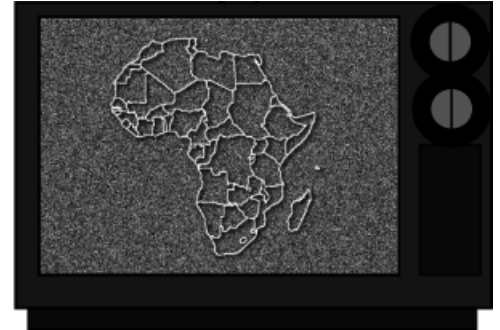


Television White Spaces Spectrum in Africa The Story So Far in 2013

Last week I attended an event in Dakar entitled the [TV White Spaces Africa Forum 2013](#). It was an event organised and largely sponsored by Google in partnership with a number of other organisations including [Microsoft](#), [Internet Society Senegal](#), [Afrinic](#), [APC](#), and the [Senegalese Ministry of Communication](#),

[Telecommunications and the Digital Economy](#). TV White Spaces (TVWS) refer to an alternative approach to radio spectrum management that allows for the dynamic re-use of unused spectrum, particularly but not exclusively television spectrum. In a subsequent post, I will attempt a plain-English explanation of why this is an important technical and regulatory innovation, particularly for countries that are struggling to provide comprehensive, affordable access to their people.



Google and Microsoft

After a welcome by Minister Cheikh Abiboulaye Dieye, I moderated the first session giving first a [brief introduction](#) to TVWS. Much more interesting though were the two key presenters for the first session: Kai Wulff of Google and Paul Mitchell of Microsoft. To have Google and Microsoft on the same stage making common cause for affordable access through TV White Spaces spectrum is a bit of a dream come true for me. For Microsoft and Google this is very much a case of the enemy of my enemy is my friend. They compete in search, mapping, mobiles and just about everything else but in this case Google and Microsoft share an enemy in the high cost of access in Africa. Both stand to benefit from having more Africans affordably online and in this particular case, their corporate goals are fairly well-aligned with a development goal. And on that front, standby for news in June of a new industry association on dynamic spectrum supported by both Google and Microsoft.

What stuck in my mind from this session was an interesting analogy shared by Kai Wulff who pointed out that in Africa, taxi drivers generally don't fill up their tank completely but just enough to get where they need to go. Similarly, pay-as-you-go

airtime has allows for dynamic management of phone charges. This is common knowledge but it was a nice insight that this conceptual framework might be applied to spectrum management.

Pilots and Trials

So what's going on in Africa with TVWS? A lot. Both Google and Microsoft are sponsors of significant of trials in Africa; Google in South Africa and Microsoft in Kenya. There are also independent efforts going on in Malawi. Here's an update on them.

South Africa

The Google-sponsored trial in the Western Cape of South Africa is a small success story in collaboration. TVWS technology was initially instigated by an active civil society and by the Wireless Access Providers Association (WAPA). After gaining the attention and then support of Google, other key players came on board.

- TENET, the South African National Research and Education Network (NREN), offered to be the project manager for a TVWS trial;
- ICASA, the South African communications regulator, expressed its support for the trial;
- CSIR, the Council for Scientific and Industrial Research, a parastatal research agency, offered to carry out the necessary spectrum measurements to provide the necessary evidence of non-interference that would pave the way towards regulation; and,
- the e-Schools Network provided a local network of schools in need of affordable access to be connected through the trial.

Arno Hart, TENET's project manager for the trial, [presented the work of the trial](#) so far. So far 10 schools have been connected representing more than 6400 students. So far the technology has met its most important goal which is demonstrating non-interference with television broadcasts. Cape Town has more active terrestrial television broadcast channels than most place in South Africa so it was ideal for a trial of TVWS. The throughput and latency of the connectivity is not quite the 10mbps over 8km that has been advertised but it was still respectable. It is evident that TVWS technology is still evolving and performance improvements can be expected.

Arno's talk had lots of interesting insights into TVWS such as the fact that the frequencies below an in-use television channel are more sensitive to interference in the frequency directly above the channel. This is because the lower end of the television channel is a marker that helps define the wave form for the channel. Interfering with this marker has a bigger impact on the television broadcast than interference at the top end of the channel. Critical information like this will help shape the spectrum authentication database that will determine what television spectrum can be used for TVWS access and where. You can read more about the trial on [TENET's website](#).

Kenya

The genesis of the TVWS pilot in Kenya is a little different. It was inspired by one of the true pioneers of connectivity in Africa, Malcolm Brew. Years ago Malcolm was the CTO of Bushnet Uganda, a company building HF radio links into rural Uganda and the DRC to deliver email into areas previously considered inaccessible except by satellite. Having since moved back to the Isle of Bute in his native Scotland, Malcolm convinced British Telecom to run a TV White Spaces trial on the Isle. Paul Henderson, chair of Indigo Telecom, a Kenya satellite services provider, happened to call Malcolm and was amazed by the quality of their Skype call over the TVWS connection. He immediately saw the potential of TVWS for rural Kenya and, with the support of Microsoft and USAID, has rolled out a pilot in Nanyuki, Kenya. You can read more about the pilot on [Microsoft's website](#).

While this pilot has gone ahead with a lot of international support, its internal support is a little more complex. The pilot enjoys support from the Ministry of Information and Communications but it doesn't appear that the communication regulator (CCK) are particularly involved in the trial. I was disappointed not to see someone from CCK at the Dakar event. Moving forward it will be essential to engage more closely with the regulator as they are crucial to the success of TVWS.

Malawi

Another very interesting trial is [getting underway in Malawi](#). Championed by Dr. Chomora Mikeka of the University of Malawi and Jonathan Pinifolo of the Malawi communications regulator ([MACRA](#)), they are carrying out background research

in anticipation of setting up a pilot in a few months. They have partnered with the International Centre for Theoretical Physics ([ICTP](#)) in Trieste who have a long history of supporting wireless research in African universities.

What I found interesting about their story so far was their innovative approach. Among other things, they have developed a very low-cost spectrum analyser based on Open Hardware which has allowed them to carry out a spectrum survey at a fraction of the typical cost. In listening to Dr. Mikeka, it was evident to me that Africa has the potential not just to be a leader in regulatory innovation around TVWS but a technology leader as well.

Others

And of course there is more going on. Microsoft is supporting other pilots in [Tanzania](#) and soon in the [Limpopo](#) province in South Africa. In Nigeria, a company called [WaveTek](#) has secured the West African distribution rights for Carlson Wireless and is on the verge of carrying out a trial.

Manufacturers and Wireless Standards

There are an array of competing standards around TVWS technology. First there is the [802.22 standard](#) also known as Wi-Far which has evolved out of the WiMax standards group. Next there is the [802.11af standard](#) also known as White-Fi which has evolved out of the WiFi standards group. Then there is also the [Weightless standard](#) which has been put forward by [Neul](#), one of the earliest developers of TVWS technology. Neul developed its own Weightless standard because they originally designed their TVWS technology for machine to machine (M2M) communication. As the demand for TVWS in rural broadband applications became more apparent, they adapted their Weightless standard for broadband use. Finally there is the wild card in the mix, the TD-LTE standard for White Spaces being developed by Huawei.

Neul have licensed their technology to [Carlson Wireless](#) so currently all Carlson equipment also uses the Weightless standard. Interesting to note that Neul are also releasing their own equipment shortly which will perhaps end up competing with Carlson. The South African TVWS trial is using Carlson equipment as is the Malawi trial. In Kenya, the TVWS pilot is being carried out with [Adaptrum](#) equipment. Adaptrum currently use the 802.22 standard or something fairly close

to that standard.

So which standard is likely to dominate? That was what I hoped to find out more about at the event but I was disappointed. Manufacturers were pretty vague on the topic. When I asked the question, I didn't get much more than "the market will decide". On the one hand letting the market decide is a good thing but on the other hand, the balkanisation of the standards community makes it hard to build momentum.

From what I can make out so far, 802.22 is designed for rural broadband but is not that well-loved by manufacturers because it is a complex standard to implement. 802.11af is simpler and easier to get to market but suffers some of the limitations of its WiFi parentage. Weightless appears to have an early advantage but will other manufacturers really buy into a standard so closely associated with one company? Finally, TD-LTE doesn't currently feature in any trials and is targeted at the mobile industry not the rural broadband industry but it would be a mistake to discount Huawei from any calculations in this arena. I found it a bit hard to understand the presenter from Huawei but I believe a typical use case for TD-LTE White Spaces would be something like backhaul and coordination among [femtocells](#). While an interesting and possibly very efficient use of TVWS, the TD-LTE approach holds much less interest for me because it puts TVWS directly into the mobile operator supply chain as opposed to enabling entrepreneurship that could lead to more competition in the broadband marketplace.

White Spaces and the Authentication Database

Although it didn't start out that way, TVWS technology is now inextricably connected with the concept of an authentication database. Early proponents of TVWS argued for a spectrum-sensing approach to regulation where TVWS devices would regularly "sniff" the spectrum to see if it was in-use by the primary spectrum holder and dynamically switch out of any occupied spectrum. There was sufficient push-back from broadcasters on viability of spectrum sensing that an alternative had to be devised. This alternative came in form of an authentication database that all TVWS devices are obliged to connect to in order to receive information about available spectrum in their area.

Andy Lee of Google gave a [great presentation](#) explaining the basics of how the

authentication database works. In short, the database combines information about spectrum in use with information about the geography of the region and performs a calculation to determine where current broadcasts reach and on what frequencies. It then uses the inverse of that to establish what spectrum is free for use and where.

In Africa, even in urban areas, it is clear that there is a lot of unused television spectrum that could be re-purposed for TVWS rural broadband applications.

A lot of work has been done in the US and elsewhere to establish an open standard for TVWS databases. The Internet Engineering Task Force have developed the [PAWS standard](#) for accessing TVWS databases. While different companies have developed TVWS database applications, Google and Telcordia among them, they all operate according to a common standard. Thus it is possible to have more than one authentication database in a country.

In terms of regulation and TVWS databases, it is worth noting that there is one significant difference between US and UK regulation of TVWS. In the UK, the power output of the TVWS device is not pre-determined but can be dynamically set via the database. Thus if the database knows that the device is in a remote areas with few or no terrestrial television broadcasters, it can permit the TVWS to operate at a higher power output offering better range and throughput.

There was some discussion among the participants as to whether an authentication database was the best approach to TVWS for Africa. Some people argued that this was importing unnecessary limitations from the US. It is an interesting question. On the one hand, I would like to see TVWS achieve the same kind of success that WiFi has through an unlicensed environment. I fear that constraints such as an authentication database might limit the uptake of the technology. On the other hand, variable power output (described above) which a database enables is a significant advantage. In addition, an authentication database also offers a big security blanket to regulators who need not worry that they are opening Pandora's Box because they ultimately are still in complete control of the spectrum. This may prove to be a critical ingredient to speed adoption.

The Regulators

Most interesting of all was what the African communication regulators had to say.

Speaking at the event were representatives from the communication regulators in Senegal, Niger, Malawi, and South Africa. In the audience, there was representation from communication regulators of Benin, Cameroon, Cape Verde, Ivory Coast, Nigeria, and Togo. What was most striking for me was the wide range of perspectives on TVWS. Some regulators clearly saw the potential and were working to integrate TVWS into their strategic planning and others were frankly sceptical. Of those who were doubtful of TVWS technology, a lot of the concern centred around the fact that television spectrum was already a subject of heated debate related to the Digital Switchover and the potential release of one or more IMT bands for mobile use. The spectrum bands in question, 700MHz and 800MHz, form the upper block of the UHF television band. I have my own opinions about [how this could be handled](#) but it is clear that there is a lot of interest in television spectrum and, as a result, a lot of concern that it be handled appropriately. It was proposed by some that TVWS should wait until the Digital Switchover was complete and firm agreements had been made on new IMT bands such as the 700MHz band. In my opinion, making these issues dependent on each other robs TVWS technology of its primary innovation, the ability to continuously and dynamically adapt to a changing spectrum regulatory landscape. One thing is clear to me and that is that more awareness raising and healthy debate of TVWS needed.

No discussion of regulators would be complete without mentioning the [stand-out presentation](#) from the UK regulator (OFCOM)'s head of spectrum, Prof H Nwana.

Prof Nwana's roots are in Cameroon but at OFCOM he leads what is arguably the most progressive approach to dynamic spectrum regulation in the world. His vision of the evolution of dynamic spectrum management is inspiring.

Summary

This is a watershed moment for Television White Spaces in Africa. There is a lot going on. With the backing of companies like Microsoft and Google, TVWS are getting recognition as a key part of the regulatory toolbox. Manufacturing is starting to come on board but the process is a little slower than anyone had hoped. TVWS equipment has yet to achieve its full mass market potential.

Equally the standards for TVWS are still evolving. Expect to see one of these standards leap forwards in the next 24 months. The tide of TVWS is at the flood and it is up to African governments, regulators, and entrepreneurs to decide whether to seize it or not.

All the presentations from the TV White Spaces Africa Forum 2013 are [available online](#). Kudos to Google and all the other partners for making this extremely worthwhile event happen. Finally, if I have missed nuances or missed the mark entirely on any of the above, please do correct me.

However things turn out, it is clear to me that we need a better understanding of the choices and their implications. While most of my time is still taken up with [Village Telco](#), I am very happy to say that I am now also affiliated with the Network Startup Resource Centre ([NSRC](#)), an organisation that has dedicated itself to building the capacity of Internet network operators around the globe . My role with them is to build understanding of the opportunity that shared spectrum technologies and policies represent.