TV White Spaces to bring affordable internet to rural communities

To connect the rural unconnected to affordable internet is not so much a technical problem but more one of economics. For the large mobile operators, it is of no economic value to connect people who live away from the main rural highways in sparsely populated areas, even as a loss-leader project. TV WhiteSpace technology is the way forward.

Technologically speaking, internet connectivity on TV White Spaces is not much of a challenge. Using TV space (TVWS) in the 470-694 MHz frequency band on a secondary basis, (excluding radio astronomy sub-band 606 MHz to 610MHz) has proved to be an excellent technical solution.

While technical trials have been carried out in the Western Cape and Limpopo, the commercial and economic aspects were not investigated until two years ago, when the Wireless Access Providers Association (WAPA) embarked on a large-scale commercial trial in association with a consortium consisting of the following: South African and US partners including Stadia Capital, Adaptrum, International Data Corporation (IDC), Microsoft, Project Isizwe and the United States Trade Development Agency (USTDA). The project, which aimed to demonstrate the technical, socio-economic and commercial benefits of TVWS, will end this month with the publication of the TVWS GSLD by ICASA and a paper by the IDC a few months later. "The trial was very successful and has attracted wide interest from wireless internet service providers", WAPA executive member and project manager, Paul Colmer told EngineerIT in an exclusive interview.

The U.S. Trade and Development Agency (USTDA) provided $1 million to kick-start the project. The purpose of the study was to demonstrate TVWS as a commercially relevant and optimal solution for connecting rural South Africa. The end result of the feasibility study will be documented into a technical analysis, a financial feasibility study and an executive paper which will show the following findings of the main elements of the commercial trial and study:

- the population density TVWS is best suited to serve.
- the topology best suited to using TVWS.
- the average revenue per user which can be safely assumed once connectivity is in place.
- the predicted return on investment periods.

"The IDC paper is expected to be published by the end of July 2021 and will be made available to all members of WAPA," Colmer said.

TVWS have many advantages over the 2 and 5 GHZ bands

The key advantage of TVWS deployment is that the signal coverage can reach up to a 10 km radius from the base station without the requirement of line-of-sight. This makes it ideal for connecting people living in the rural undulating hills of KwaZulu-Natal and the Eastern Cape, as well as areas in other provinces where there is poor existing backhaul infrastructure. Each TVWS base station was connected at a bandwidth of 20 Mbps with a total of 30 WiFi hotspots. The hotspots are scattered within walking distance of each citizen of the trial area.

After the trial, WSIPS in South Africa will have the opportunity to deploy as many as 1600 such base stations, reaching 50 000 hot spots servicing a potential 13 million rural citizens.

Paul Colmer, WAPA executive and project manger

Expected development impacts

The impact would be to provide at least 1 GB of data per person per month or uncapped access at a very affordable charge.

"We live in an unjust and unfair society," Colmer said. "Low income groups pay the highest price for data because they can only afford to buy small pay-as-you-go packages, yet they need it most. Their average cost of data is between R400 and R600 per Gig, while higher income groups pay as little as R2 — R3 per Gig.

We are a long way off the ITU call for bridging the digital divide and the creation of a digitally inclusive society. I believe that with the implementation of TVWS, rural communities will get access to affordable internet within walking distance of their homes.

The expected coverage of the network will reach 13 million people currently living in 3,5 million dwellings in these areas. Thirty five percent of these dwellings have access to the internet using a smart phone. The expected number of new subscribers is 1,7-million, including some coverage in the hardest to reach, most dispersed areas and rurally unconnected people of the Northern Cape.

Extended feasibility study

The initial feasibility study included a network build as well as the development of a business plan, including financing aspects to help ISPs and their investors understand and take advantage of the commercial opportunity. The study was planned for one year by the Covid-19 pandemic, and the various stages of lockdown required an extension.

Multi-faceted project consortium

WAPA, representing 250 members, as well as Microsoft and Adaptrum, are members of the Dynamic Spectrum Alliance (DSA), a global association that develops policy for, and mechanism in bands such as TVWS.

Project Isizwe is a South African business. It has been operating for many years and has successfully managed free WiFi projects.

DSA is the only global organisation focused on promoting spectrum sharing innovation to get the most out of wireless resources. Its team is made up of worldwide technology experts, making it the shared spectrum go-to organisation for regulators and policymakers all over the world.

DSA advocates for policies that promote unlicensed and dynamic access to spectrum to unleash economic growth and innovation. Additionally, it advocates for a variety of technologies that allow dynamic access to spectrum. Its focus is ensuring that the regulatory framework to support that diversity of technologies is adopted. Some examples of its advocacy actions include:

- 5.9 GHz and 6 GHz – it advocates for more unlicensed spectrum access in these bands for wireless devices and the new Wi-Fi generation, Wi-Fi 6. WLAN/RLAN will carry offload from cellular 5G technologies.
- TV Space – provides long range and area coverage. It boasts great obstacle penetration in difficult terrain areas, in addition to building penetration. mmWave – unlicensed and shared use are ideal for mmWave spectrum because poor distance propagation and building penetration can enable massive frequency re-use.

Adaptrum is a Silicon Valley based company with TVWS equipment, engineering training and installation expertise for optimal deployment of the technical part of the project.

The International Data Corporation (IDC), a market research and analysis company, will provide an executive paper and overall assessment of the technical and economic aspects of the TVWS solution.

Microsoft's Airband team provided the underlying support on TVWS policy, project management, technical architecture capabilities and services on cloud-based CRM, billing systems, education solutions, and on the spectrum data base.

The initial commercial feasibility study used leased and loaned equipment from

Typical Spaza shop installation

Adaptrum, Isizwe and Microsoft. Three WAPA WISPS who supported the project are Airband (part of Herotel), Letaba and Mia Voice and Data.

Promoting entrepreneurships

During the trial, many of the hotspots were installed in spaza shops creating additional income by selling airtime. "We see this as a great opportunity to empower more people to become hotspot hosts as another revenue stream.

The story of TVWS in SA

South Africa has been a driving force in TVWS since its early stages and is the first country in Africa to have published a TVWS regulatory framework. Encompassing an unreached population of over 20 million people in hard-to-reach terrain makes SA an ideal test location for a solution that scales affordably.

The September 2016 issue of *IEEE Spectrum* carried an article entitled "*Bridging Africa's Broadband Divide*", in which authors David Johnson and Chomora Mikeka outlined trials in Cape Town and Malawi.

The trial in Cape Town broke new ground by using channels adjacent to those being used for live broadcasts, something that ran contrary to practice in most countries. Nevertheless, no reported interference to existing services resulted. The trial was mostly conducted by the Council for Scientific and Industrial Research (CSIR), using manual analysis because the Geolocation Spectrum Database (GLSD) was not ready at the time.

Since about 2010, the CSIR Meraka Institute had been working with ICASA, Sentech and others, punting the merits of space systems. The Meraka Institute developed a sensing technology demonstrator to show the feasibility of the approach. In 2011, Google approached ICASA about implementing space systems. ICASA introduced them to the Meraka Institute, knowing that the required capability was available locally.

The Cape Town trial was the culmination of this process, in which the Meraka Institute cooperated with Google and other partners to develop and demonstrate the TVWS technology. The results of the trial were sufficiently successful and it was cited by the USA's regulator, the FCC, as proof that adjacent-channel operations were feasible, contrary to what had previously been thought.

In 2014, the Meraka Institute conducted another trial in cooperation with Microsoft, the Department of Science and Technology, the University of Limpopo and Multisource. Other African trials have since been run in Botswana, Ghana, Kenya, Malawi, Namibia and Tanzania.

A CSIR Meraka Institute team developed a Geolocation Spectrum Database (GLSD) based on the Protocol to Access Space. The GLSD will be managed by ICASA and is expected to be available from1 April 2021. The CISR has agreed to manage the secondary GLSD which is from where WSIPS that have the necessary licences will be allocated their channels.

Using this open standard and a comprehensive database of existing licensed transmitters, the GLSD is able to accurately forecast the presence of commercial signals at specific locations, thereby avoiding much of the potential for interference.

From left: Jacob Flewelling (USTDA), Hala Rharrit (US Durban Consulate), Paul Colmer (WAPA) and Timothy Driessel, (Mia Voice and Data).

WAPA, established in 2006, is a non-profit trade association acting as a collective voice for the wireless industry. Its primary objective is to promote the growth of the wireless industry by facilitating self-regulation, promoting best practice and educating both members and the market about new wireless technologies and business models. WAPA offers its members regulatory advice, technical training, a code of conduct, a forum for knowledge sharing and business enablement opportunities.

WAPA is positioned to be an interface between the government regulator (ICASA), network operators, service providers, and consumers. It regularly makes submissions and presentations to the government on regulations affecting the wireless industry. WAPA is tirelessly lobbying for more progressive and efficient spectrum management in South Africa and is focusing on the possibilities of TVWS spectrum for interference-free access.

For more information point your browser to www.wapa.org.za