Work in Television White Spaces (TVWS) and Dynamic Spectrum and a bit on Antennas

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There is a need for work around improving frequency spectrum utilization efficiency to support the South African government targets of 100% broadband by 2020, with tough specifications stated by the National Broadband Policy "South Africa Connect" (2014), e.g. each school needs Internet connectivity of at least 10 Mbps. The research and development in our research group at CSIR includes work on smarter antennas for wireless networking as well as advancing the spectrum management to move from its current static approach towards dynamic spectrum management.

The work on smart antennas covers both physical beamswitching antenna design and development of algorithms to control the direction of the beam in a wireless mesh network. Several prototypes have been developed and demonstrated an increase in the throughput and reduction in latency 2-3 times on average, in a busy network scenario.

The work on dynamic spectrum management (DSM) allows for sharing spectrum, where the sharing depends on spectrum availability at a specific location and interval of time, permitting reuse of unused spectrum bands. This approach moves away from the approach used in the past, where the spectrum was usually allocated and assigned on exclusive basis for decades.

We started with this work through compatibility studies and trials of television white space (TVWS) technology. The TVWS refers to the reuse of ultra-high frequency (UHF) portion of TV broadcasting spectrum to provide wireless communications without causing interference to reception of TV. The reason for selecting this frequency band is because it is widely underused worldwide, and even less used in rural Africa. For example, Sub Saharan Africa has 63% rural areas with almost entire UHF TV band open. The CSIR has executed two large trials of TVWS technology, one in Cape Town in 2013 and another in Limpopo in 2014, and assisted in preparing and running a TVWS trial in Ghana in 2015. Overall, these trials provided fast speed Internet to over 20,000 users, with speeds as high as 12 Mbps, at distances up to 8 km. As per recent outdoor tests done in Pretoria in 2015, the latest TVWS equipment permits 86 Mbps. Even faster speeds equipment is being introduced. At present, CSIR is also working with the BITRI (Botswana Institute for Technology Research and Innovation), Botswana in setting up TVWS research and development and a TVWS trial in Botswana.

There are two recent developments deserving special attention. South African spectrum regulator ICASA (Independent Communications Authority of South Africa) has started official processes to implement dynamic spectrum management. In November 2015, a document with a call for public inputs was released, now followed by collection of the inputs and publication of a findings document. Based on these, the DSM in South Africa may get commercial grounds within 1-2 years from now. The second recent development is about a geolocation spectrum database (GLSD) developed by the CSIR, which permits to automatically estimate and assign unused TV channels in UHF spectrum nationally. This database has passed testing and recently been certified by the UK spectrum regulator Ofcom and is among a dozen such databases in the world. At present, we are investigating the application of the GLSD on sharing the spectrum between the TV broadcasting and LTE.