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Optimizing the African VLBI Network for Astronomy and Geodesy

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Currently SKA-SA and HartRAO are converting the redundant 34-m telecommunications antenna in Ghana to a radio telescope. The Ghanaian radio telescope will be the second element, HartRAO the first, of what will become the African VLBI Network (AVN). There are 29 documented 30-m class telecommunications antennas in 19 African countries (though some have been destroyed). It is proposed that more of these can be converted and added to the AVN. Each addition will improve the present global VLBI networks; some will have greater impact than others. Currently there are plans, and limited funding, to convert two more antennas in Kenya and Zambia. It is presently proposed that each of these new AVN stations will be equipped with the same receivers as Ghana, a 5 and 6.7 GHz receivers and later a 1.4 - 1.7 GHz receiver. New radio telescopes may also be built. However, no significant evaluation of the optimization of the AVN has been completed. Such an analysis will inform which to convert first, where to build new stations and what next-generation instruments and receivers they should have.

In this presentation we re-visit the scientific justifications for the AVN including both astronomical and geodetic science. We analyse weather station, GPS and satellite weather data for each telecommunications antenna in Africa to determine the frequency limitations at each. A Google-based assessment of the possible radio frequency interference environment is made. We also generate UV-coverage plots for existing VLBI networks together with potential AVN locations to get an idea of the density and distribution of the UV tracks and the imaging quality that may be obtained. In addition we simulate some geodetic observations to asses the contribution of AVN antennas to geodetic VLBI products in current and future networks. With this data we attempt to optimize the AVN for each science case, both astronomical and geodetic. We discuss the potential contributions the AVN might make to current global geodetic and astronomical experiments, as well as what a stand-alone AVN can do. We also discuss possible stations of interest for high-frequency radio astronomy and astrometry, possible sites for future VGOS antennas and where collocation of other geodetic instruments can be implemented.

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