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BRIDGING THE COVERAGE GAP IN NIGERIA VIA SMALL CELLS AND HTS BACKHAUL SOLUTION

Abstract

Nigeria, the most populous country in Africa has a relatively huge online presence compared to other African countries with about 112 million users, 37.8% broadband penetration and also 36 million smartphone users according to industry reports. However, half of Nigeria's 190 million population reside in rural areas, which are usually un-served or underserved by broadband connectivity due to various challenges such as inadequate power supply, huge cost of building/maintaining macro base stations, right-of-way issues, fibre deployment costs, backhaul limitations, perceived low return on investment, multiple taxation, insecurity etc. To help overcome this coverage gap, governments, operators and regulators must find innovative ways of reaching the unreachable in a sustainable and effective manner especially in developing countries such as Nigeria. Studies have shown that the use of small cells in conjunction with macro-cells is quite effective in increasing capacity and coverage of mobile networks. These small cells - Femtocells, Picocells or Metrocells, can provide flexible alternatives to macro cell networks and also extend 3G/4G networks from urban areas to remote areas. They are usually less expensive, consume less power (can use solar panel), are easy to install and also provide the coverage and capacity required. However, even with such small cell deployments, other technical challenges are constraints of backhaul and power, which seriously impede rural mobile coverage in Nigeria. With recent developments in High Throughput Satellite (HTS) technology, satellite backhaul has become quite attractive for certain use cases. The use of HTS brings about backhaul solutions with techniques that exploit frequency reuse scheme, spot beam technology, Time Division Multiple Access (TDMA), Adaptive Coding and Modulation (ACM), Frequency Diversity (FD), Satellite Diversity (SatD), TCP acceleration etc. to improve the link reliability, availability, latency performance and spectral efficiency. This paper proposes an effective and sustainable means of providing rural mobile coverage via small cells and HTS in developing countries such

as Nigeria, taking into consideration the unique technical, socio-economic and regulatory complexities in these countries. The Matlab/Simulink tool is used to model typical end-to-end link performance of such a system. The paper further describes the architecture and design consideration of small cells with satellite backhaul, highlighting some typical examples, real-life use cases and possible future trends.

Keywords: Small Cells, Satellite Backhaul, HTS, ACM, Frequency Reuse, Spot Beam.