**5G networks: Open network architecture and densification strategies for beyond 1000x network capacity increase**

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Abstract:

The key advantages of the 5G network include among other things a 1000x capacity increase in the available network capacity. This increase will support the Internet of things and also the Device to Device communication architecture. However, the increased network capacity provided by the 5G communications standards comes with the high cost of infrastructure. The high attenuation faced by mmWaves in the proposed 5G spectrum restricts the 5G network deployments to femto cells. This cell size, increases the densification of the network resulting in very high infrastructure cost for the operators. This paper presents a network topology capable of minimizing the deployment costs of the 5G networks and at the same time increasing the network capacity by several factors beyond the 1000x capacity increase currently being proposed by the 5G network. This architecture relies on the use of collocation strategies, centralized system network planning and a cloud based MSC and HLR/VLR database system. With this approach a single third party provides the MSC and database service while each operator controls their dedicated BSC and BTS. The traffic from users of a given operator is transmitted using the operator's infrastructure and bandwidth. When the operator's capacity is exhausted, the traffic is routed through the infrastructure of the next operator and the revenue from the traffic is shared between the operators. This system however gives priority to the original customers of the operator and only transmit traffic from other customers if the second operator has excess unused capacity. The centralized network planning makes the channels from each operator available at each cell. This increases the available capacity of the network to greater than 1000x and improves user experience and spectrum utilization.

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I. Introduction

The gradual progression of the communications technology and standards towards the 5G is driven largely by the possibility of higher data rates to support the ever increasing demand from devices, applications and users. This demand is to be met by a migration to the mmWaves which has a larger capacity and the use of densification which reduces the cell sizes to pico and femto cells and increases the frequency reuse while reducing the distance related attenuation and increasing the datarates [1]–[4]. This system topology being proposed for the 5G networks however has a key disadvantage and this is the high infrastructure requirement for the technology. The densification of the cells leads to the requirement of several base stations, a tremendous increase in the number of base stations required to cover a given geographical area. This hardware increase presents a major challenge especially for developing countries where the availability of public power supply is not guaranteed and most operators run their networks on diesel powered generators. The use of smaller cells also provides an opportunity for the development of green infrastructure as the small cell sizes mean small transmit power and thus the base stations can be designed to run on solar power. This also presents another set of challenges as it brings to the fore the need for backup battery installation and replacement. This work presents the development of an open network architecture with a cloud based MSC and a configuration which allows operators to share channels and also share cell sites. The key advantages of this architecture are that it increases spectrum utilization for all the operators and also minimizes their CAPEX and OPEX costs. The subscriber experience is also improved as their calls can be transmitted seamlessly through any available operator infrastructure without any additional cost increase. The operator, whose network has reached its limit will instead of dropping the incoming call, have that call transmitted through the infrastructure of the next available operator with idle capacity. The revenue from the call is then shared between the operators with the second operator having the greater percentage of the revenue. This way, the owner operator gets to keep his customer satisfied and gets revenue even when he is not able to carry the traffic while the second operator with idle capacity gets revenue even when his subscribers are not using his infrastructure. This system presents a win-win situation for all the operators and the subscribers in that cell. The system will reduce the cost of deployment borne by the operators, increase the spectrum and infrastructure utilization and increase the datarate available at that cell to beyond the 1000x currently being proposed for the 5G standard.