"Frugal" 5G: Next Generation Wireless Systems for Connecting the Unconnected

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In the recent years, there has been a significant growth of cellular wireless communications. Despite this growth, a large part of the world is still deprived of broadband connectivity. For example, in India, while the number of cellular subscribers is 1 Billion, the broadband penetration is mere 150 million. Moreover, the broadband penetration in rural areas is even marginal. It is estimated that 3-4 Billion population of the world still do not have access to Internet. Using existing cellular wireless systems including Third Generation (3G) and Fourth Generation (4G) technology, there are significant challenges in providing broadband access. These include- High capital and operations expenditure with low Average Revenue Per User (ARPU), lack of affordable backhaul, energy cost which is worsened by lack of reliable power supply and geographic accessibility including issues such as right of way.

These challenges require a re-thinking on developing next generation wireless system for connecting the unconnected world. Mobility is not a major driver for designing such systems, rather fixed primary broadband access is the most important requirement. A simplified IP based network architecture with dynamic spectrum sharing and a low cost wireless backhaul can set the vision of what we call "Frugal" 5G for connecting the unconnected.

While affordable fixed access can be provided using a dense deployment of IEEE 802.11 based WiFi Hotspots, one of the major impediments for widespread deployment of such Hotspots is the lack of connectivity to WiFi access points. Fiber connectivity in terms of backhaul is limited in such countries and may currently reach only at designated points in a town or city. In such a scenario, the problem of connecting the core network to the access network can be addressed using wireless middle-mile network. Such a middle-mile backhaul can be provided using various solutions. One such solution could be based on TV UHF spectrum which is largely unutilized in many developing countries. Moreover, in order to reach these distances, sub-GHz spectrum provides excellent propagation characteristics, and at the same time will not require expensive infrastructure such as high towers and strict line-of-sight. Alternate solutions can be based on mesh network in mmWave.

This paradigm opens up several directions for technology solutions. These include dynamic spectrum sharing for multi-operator co-existence, scalable control and management of such access and middle mile network through software defined network controller among others.