Fiber-based Small Celling Backhauling: Network Planning

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1. Extended Abstract

With the wireless networks migrating towards fifth generation (5G) that promises seamless wireless connectivity with 1000x increase in capacity, 10x increase in data rate and 1ms latency [1], wireless networks have to evolve towards dense deployment with significantly more small cell base stations with higher backhaul capacity to meet the 5G requirements. Despite the elegance of small cells to overcome the capacity crunch, the cost associated with backhauling and real estate can deter the uptake of this solution. Therefore, small cells and backhaul infrastructure need to be planned simultaneously to achieve cost optimality. Optical fiber with its inherent large bandwidth, low loss and immunity to electromagnetic interference characteristics stands out as the most suitable backhaul for wireless networks. In addition, with the fast roll-out of optical fiber infrastructure in the next decade, the wireless network is able to leverage off the existing and planned fiber infrastructure for backhauling to maximize return of investment.

We have previously investigated a framework to simultaneously plan both the location of small cells and the optical fiber backhaul networks to achieve cost optimally solution while guaranteeing coverage and capacity requirements of the network [2,3]. Our optimization framework also explores how to plan a cost-optimal and energy-efficient network under different deployment scenarios where fiber resources are sparsely located and where there is availability of renewable energy resources. We have evaluated our proposed framework by using it to plan a fiber-based small-cell network for a suburban area of Victoria in Australia under diverse coverage requirements and cell radii.

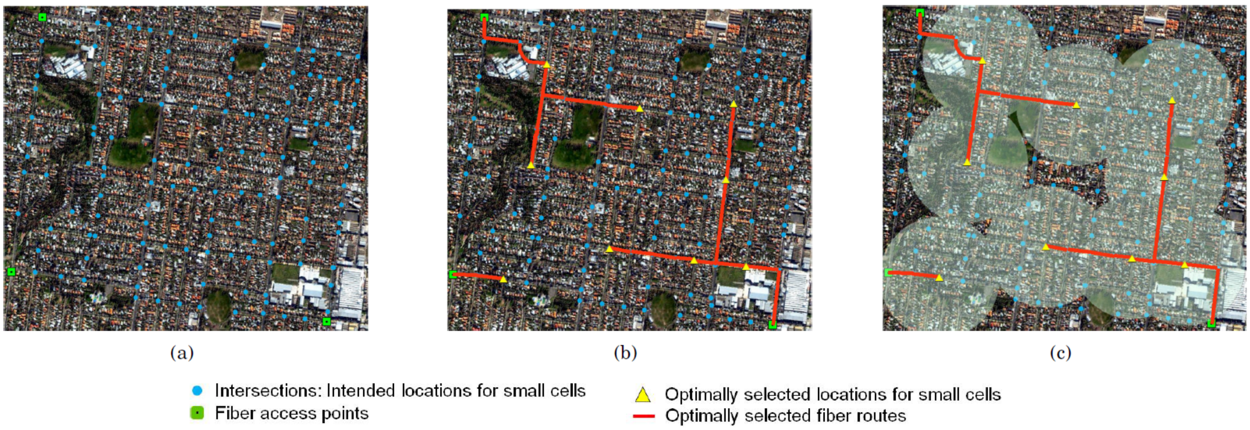

Figure 1. (a) Data set of investigated area (b) Optimal solution for 300m small cell deployment with 90% coverage (c) Achieved geographic area coverage

Our results show that 200m cell radius incurred the largest cost regardless of the coverage requirements and the total network cost does not increase linearly with the percentage of population coverage. The largest cost contributor is the backhaul due to installation of new fiber routes while the contribution of energy cost is < 5% of the cases studied. Our proposed framework can be used to provide guidelines for simultaneously designing fiber-based small cell networks in a cost-optical manner whilst achieving diverse network requirements.

2. References

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