Green Mobile Backhaul in Heterogeneous Wireless Deployments

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Abstract: This tutorial first introduces and describes different backhaul technological and architectural options (i.e., fiber-, microwave-, and copper-based), then it discusses their impact on the energy consumption of current and future heterogeneous mobile wireless access deployments.
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1. Summary

One way of reducing the power consumption in mobile access networks is to use *heterogeneous* network deployment strategies. The key rationale behind such techniques is to tailor the network deployment to the expected traffic demand, i.e., to provide *coverage* via *macro* base stations and to guarantee high *capacity* only where it is needed via *pico*, *micro*, and/or *femto* cells. Thereby the number of required power hungry macro base stations will be reduced, and consequently the overall energy consumption can be lowered. This topic has already been targeted by a large number of research studies [1,2].

However, most of the works about power consumption in mobile access networks neglect to consider the contribution of the backhaul segment, i.e., the portion of the network used to aggregate the traffic coming from the various base stations. In terms of total network power consumption the backhaul contribution is not necessarily the same for all mobile network deployment scenarios. It has been shown that the relative effect of the backhaul power consumption is non-negligible for scenarios with an increasing number of small (low power) base stations [3]. This means that the total power consumption of a heterogeneous network deployment to a larger degree is affected by the backhaul technology and architecture.

The focus of this tutorial is on how different backhaul architectures may affect the total backhaul power consumption. With this objective in mind, various backhaul technologies and architectures will be presented and their power consumption assessed. Currently backhaul is to a large extent based on *microwave, copper* and *fiber* [4]. These technologies are complementary and offer different advantages/disadvantages for different deployment scenarios. Fiber-based alternatives come at a relatively high deployment cost (CAPEX) but offers long-term support with respect to increasing capacity requirements. Microwave-based backhaul is attractive in terms of short time-to-market, low investment in infrastructure and relatively simple deployment [5,6]. Digital Subscriber Line (DSL) might be still appealing in the presence of an existing copper infrastructure, bearing in mind its capacity limitations [7].

In summary it can be concluded that the “best” backhaul architecture may not necessarily have to rely on one single technology, but may as well be the result of a mix of microwave, fiber, and eventually copper. This depends on several factors, such as existing infrastructure, spectrum and license costs, availability of equipment, operator business situation, and required QoS levels.

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4. References

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