Development of Channel Models for Low-power and Lossy Wireless Networks in Urban Environments

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To date, most insights concerning the performance of Low-power and Lossy wireless mesh Networks (LLNs) deployed in urban environments have been obtained through simulations based upon simplified channel models and tests conducted using testbeds of limited size and extent. We sought to overcome the limitations of previous work and develop better insights into the factors that affect network performance through analysis of network performance data collected from BC Hydro's 1.9-million-node Multi-Service Grid Network which includes both meter-to-meter (device-to-device (D2D)) and meter-to-pole-top collector (device-to-infrastructure (D2I)) links. We have previously shown how path loss models that are representative of the entire network can be developed using appropriate data analytics and demonstrated that the results compare well to results previously shared by others. Here, we show how the richness of the data set allows us to develop far richer channel models than has previously been practical and thereby provide the basis for far more sophisticated system simulations than have previously been attempted.

One aspect of the path loss modelling issue concerns the wider range of scenarios that are captured including building density, terrain morphology and foliage height and density. Another aspect includes the larger number of samples which allows to compensate for various types of measurement uncertainty in our data. Of particular interest is the manner in which our measurement database allows to assess the performance of individual links day by day for an extended period. Our data reveals that a significant fraction of links experience variability from day to day and allows us to capture this behaviour is in a form suitable for use in system simulations. Such behaviour must be accounted for in development and assessment of techniques for network tuning through addition of relay nodes and/or transmit power adjustment. The final result of our work is a power law model that captures the behaviour of wireless links in urban-scale low-power and lossy mesh networks, including dependence of model parameters on the environment and link variability, with unprecedented accuracy.