Development of Path Loss Models for Low-power and Lossy Wireless Networks in Urban Environments using Data Analytics

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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. Our immediate goal was to develop path loss models that are representative of the entire network using appropriate data analytics.

Because the links are non-line-of-sight, power law path loss models generally apply. We first show how distance errors or finite distance spans may degrade estimates of the parameters of such models in typical environments and should be accounted for in the development of path loss models for LLNs. After developing procedures for managing and preparing network data for analysis, we reduced the path loss data collected in three representative areas with hilly terrain and light vegetation, hilly terrain and heavy foliage, and flat terrain and light foliage and compare the results to previous work. The results show that: 1) modelling path loss using data collected over short distance spans and with substantial distance errors is challenging but can be accomplished with appropriate care, 2) the path loss experienced over such short D2D and D2I links is fairly independent of terrain and foliage density, and 3) the slightly lower accuracy of the network data compared to data collected using purpose built channel measurement equipment is more than compensated for by the vastly greater amounts of data that are available.