Analysis and Prediction of Canadian Electromagnetic Environment

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During recent years, significant changes in electronic and telecommunication technologies have been occurring, new communication modes such as ultra wideband (UWB) and power line communications (PLC) have been introduced and applied in practice, and the usage of spectrum has been increasing extensively. Meanwhile, urban development has been giving rise to a high density of residences and construction of residences in close vicinity of high power transmitters, thus diversifying and complicating radio environments in urban and suburban regions. Furthermore, the variety and number of devices using very low signal levels have also increased dramatically and these devices can be prone to malfunction when they are exposed to the electromagnetic (EM) field strength of some level. The combination of these circumstances has brought about serious concerns and increased awareness of the immunity problem among public. To resolve or alleviate the problem, the following three tasks need to be fulfilled: (1) Quantify the EM environment with a reflection of the most recent urban development; (2) Identify the concerns arisen from the changes in both the EM environment and electronic and telecommunication technologies; (3) Provide consultative service and advisory information on the intended plan of action on immunity problem. Hence, one key issue is how to more accurately analyse and predict the ambient levels of the EM field strength in the current urban and suburban environments.

In this work, the analysis and predication of the Canadian electromagnetic (EM) environment are implemented through the Integrated Spectrum Observation Centers (ISOC), which have been deployed throughout the country to provide the infrastructure required for an efficient and effective spectrum monitoring program. Starting with the exploitation of ISOC Smartview – Terrain (Predict) software, the simulated radio coverage areas are generated for the antennas installed at a monitoring site. Based on these simulation results, an empirical path loss model is developed that provides a good balance between accuracy and complexity and is able to characterize EM field strengths in macrocells no matter whether a monitoring site is located there. With this path loss model, an investigation is carried out to characterize and quantify the cumulative effects of a multitude of radio devices operating in urban and suburban areas, and a definite connection is established between the transmitter density, the resulting effect on the ambient levels of the EM environment and the probability that this resulting effect occurs. By comparing our predicted results with the measured data collected from some monitoring sites, the appropriateness and effectiveness of our approach are validated, and some important findings are given and meaningful conclusions are drawn, which forms the bases and provides the directions for a resolution of immunity of electronic equipment intended to operate in the Canadian radio environment.