Twisted-wire pairs (TWPs) are used as one of the primary communication channels in digital subscriber line (DSL) networks. In typical DSL system environments, TWPs are susceptible to many different kinds of noise. The most common are crosstalk noise, radio noise (see Fig. 1) and impulse noise. A practical way of modeling the behavior of TWP structures is to use multi-conductor transmission-line (MTL) theory. However, MTL models that include the effects of radio noise interference have not been used before in the analysis of DSL systems. As a step forward in this direction, a MTL model for predicting the terminal response of a bundle of TWPs to an illuminating plane-wave electromagnetic field is presented. In the past, crosstalk noise in TWP bundles has been successfully characterized by modeling TWPs as a cascade of short uniform MTL sections rotated continuously. The presented model is an extension of this approach capable of including the effects of radio noise interference.

Previously proposed radio noise interference models often assume that, when a TWP is inside a tightly packed bundle of wires, the power coupled by an interfering radio signal will be either the same or lower than the power that would be coupled when the same TWP is in free space. In order to test this assumption, computed results for two different TWP configurations (a single pair and a bundle of seven pairs) are presented. By comparing the model predictions for both configurations it can be established that a TWP can be much more susceptible to radio noise when it is placed inside a tightly packed bundle of wires than when it is in isolation. Such finding contradicts the aforementioned assumption, and it demonstrates the need of using a radio noise modeling approach where the field interactions between neighboring pairs are taken into consideration.

Fig. 1. Diagram of the radio noise interference problem in DSL systems: an interfering radio source launches a plane-wave that induces a noise signal across the terminals of the TWPs in a DSL network link.