Radio Channel Modeling in Body Area Networks

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1 Project description

A body area network (BAN) is a network of bodyworn or implanted electronic devices, including wireless sensors which can monitor body parameters or to detect movements. One of the big challenges in BANs is the propagation channel modeling. Channel models can be used to understand wave propagation in and around the human body and they are essential for antenna design, protocol design and the design of front-end RF hardware and modulation. Consequently, the channel modeling is the starting point of effective, efficient body-centric communications. In our project, we will investigate the propagation characteristics around the human body and propose accurate channel models in various user cases.

2 State of the art

We foresee that in a few years the number of people using a BAN will increase significantly in the areas of medical healthcare, personal monitoring, etc. The most popular frequency bands for on-body propagation are the 2.4–2.5 GHz industrial, scientific and medical (ISM) band and the European 868-MHz band. These bands have been adopted in some standards. More generally, measurements have been done in the frequency range of 3–11 GHz [1]. The results of this paper highlight the importance to carry out a comprehensive study of the nature of the signal propagation when it takes place close to the human body. It was found that for certain scenarios the channel characteristics are different, depending on the gender or the medical condition of the subject. This finding introduces further complexity to derive a generic model for on-body propagation. Statistical characterization for different frequency bands has been addressed in many papers. In [2], measurement results for a narrowband wireless BAN at 868 MHz have been presented. It was observed that the Nakagami-m [3] distribution provided the optimum fit for the majority of on-body propagation channels in both anechoic and open office area environments. Furthermore, the level crossing rate (LCR) and average fading duration (AFD) were also accurately described by Nakagami second order statistics. In [4], the time-series analysis was adopted to examine and model signal characteristics for on-body radio channels at 2.45 GHz in stationary and mobile user scenarios in different locations. Autocorrelation and cross-correlation functions were shown to be dependent on body state and surroundings.

3 Our contribution

Based on the previous work, we examined various scenarios and possibilities for potential research. In our project we will investigate the statistic models which are suitable for describing the on-body propagation. Existing models for propagation modeling have been investigated and up to the authors' knowledge not an accurate or generic model has been concluded for on-body propagation. For instance, Nakagami distribution was claimed to best describe the measured channels in[2], whereas in [1] it is said the lognormal distribution best fit the channel measurements. Furthermore, both the stationary and mobile scenarios were defined in specific ways that they were not able to represent the complexity of the real-life BAN application cases. The state-of-art BAN proposals only adopt one transmitter and several receivers thus the communication possibilities among the nodes are limited. Due to those limitations, we will focus on proposing mixed models or even new models based on realistic user cases in order to have thorough insight in on-body propagation mechanisms. Moreover, we are designing a new BAN which consists more than one transmitters and several receivers to form a network that is capable to handle the information via different paths in order to cater to the fading effects, interference or power consumption issues. The project is now in the initial phase with the possible adjustments for the approach in the future.

4 Future interest

We will continue focusing on channel modeling towards more accurate models which cater to the real-life scenarios. The impact of interference and the interference mitigation techniques will be investigated. Furthermore, study in communication and multiple access techniques will be carried out to establish the link between the individual nodes in BANs.

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