Abstract

In the dissertation IEEE 802.11 standard WLAN networks were modelled and analysed, operating within ISM 2.4 GHz radio bands. For those networks an array of patterns and relationships enabling calculation of maximal throughput were presented. These included both simple models (such as TUL - Throughput Upper Limit), as well as more complex and exact ones, based upon Markov chains in particular, involving, for instance, static selection of operation modes (multi-rate) of ST.

So as to limit the impact of traffic and retransmission management techniques onto the network throughput in the dissertation only UDP protocol based data transmission has been taken into consideration. Thus the WLAN throughput values obtained were the highest possible for such types on networks.

The selected propagation models applied in this dissertation, as well as mathematical throughput model, packets generator, operation system or type of data transmission were intended to facilitate devising and construction of mathematical model of WLAN IEEE 802.11 network with infrastructure which would approximate reality to the highest degree, and whose solutions to planning and optimisation problems of the studied Wi-Fi network would subsequently be confirmed empirically in tests of an operational network.

In the dissertation for the purpose of finding the best solution of optimisation problem and WLAN network planning along with its infrastructure multi-objective optimisation (MOO) was used, which allows for including many objective functions in the optimisation problem, as well as obtaining a set of non-dominated solutions. The difficulty in using MOO is lack of known Pareto frontier (P) as well as large number of Pareto-optimal solutions which have to undergo thorough analysis before one of them can be selected.

Two MOO functions sets which underwent analysis were compared with results obtained via single objective optimisation (SOO) based upon various selected objective functions. The obtained results allowed for creation of Pareto frontier, and, after application of zero unitarisation method (MUZ), the best results were further analysed with performance metric

(PM). Additionally, the results obtained were verified empirically, and a ranking GQ_i^{best} was constructed upon $\overline{S^E}$, $\overline{PM^E}$, $\overline{JFI^E}$, estimated number of AP and assumed number of ST stations. (Chapter 9).

In the dissertation a number of comparative analyses of selected, known from scientific publications, and the most important optimisation algorithms (OPA) was conducted. The algorithms allow for choice of number of AP in WLAN with infrastructure, and their optimal placement within indoor area covered by radio reach of the network, but also allow establishing of initial power of transmitter, and radio frequencies in its particular access points. Using thus formulated set of rules and methods of optimal (from the objective function perspective) planning of WLAN network with infrastructure and using selected optimisation algorithms a test local wireless network with infrastructure, compliant with IEEE 802.11 standard was implemented in indoor environment. The network was subsequently analysed, and assessed empirically, with priorly designed measurement experiments.

All of the above mentioned problems, and questions were formulated as thesis of the dissertation:

Inclusion of objective function, upon which planning of IEEE 802.11 network infrastructure, characteristics of radio channel multi access protocols, CSMA/CA protocol, were based should allow for optimal placement - both from the point of view of particular ST stations, as well as of entire network - and configuration of access points in a chosen indoor radio environment.