Impact of Electromagnetic Radiation of 4G/5G Base Stations on Medical Short-Range Devices in Urban Area

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***Abstract*—The impact of electromagnetic radiation created by micro base stations of 4G/5G cellular networks on receivers of medical short-range devices of different systems (capsule endoscopy system, body area network system, and active implant system) located inside buildings is analyzed for urban area. The analysis is made by the use of computer simulation involving the multipath radiowave propagation model which takes into account outdoor-to-indoor propagation. To perform the simulation, a 3D model of a fragment of urban area containing buildings of a height from 6 m to 60 m is developed. The integrated interference margin is used as a criterion of electromagnetic compatibility. Results of the analysis show that 4G/5G base stations can create the interference to all considered types of medical short-range devices in cases when emitters are located outside buildings and receptors are located inside buildings. In order to achieve electromagnetic compatibility between these base stations and considered medical systems, recommendations on reducing of levels of electromagnetic interference are given. Results of this research can be used to ensure safe operation of 4G/5G base stations with respect to vital medical devices.**

Keywords—EMC, medical short-range device, 4G/5G cellular communications, base station

I. INTRODUCTION

Reliable operation of medical equipment is very important, especially for vital medical devices. In recent years, medical short-range devices (MD SRD) are used in modern hospitals for measuring and transmitting of vital health information (e.g., temperature, pulse, blood glucose level, blood pressure level, electrocardiogram, respiratory function readings) at short distances of several meters. Due to intensive expansion of 4G/5G mobile communications, its radiofrequency electromagnetic (EM) radiation may be dangerous for MD SRD operation. And taking into consideration essential asymmetry of downlink and uplink traffic volumes, EM fields created by base stations (BS) may be no less dangerous than EM fields created by 4G/5G user equipment operating in hospital buildings [1]. Terrestrial density of BS is increased in cities on areas with high density of subscribers; in many situations, BS of cellular communications can be located near hospital buildings. In these cases, the risk of interference created by BS to operation of MD SRD is increased, especially during business-hours of cellular communications. Therefore, the analysis of electromagnetic compatibility (EMC) between BS and MD SRD should be performed.

The objective of this paper is to analyze the impact of EM radiation of BS (LTE and 5G) located outdoor on MD SRD of different systems (medical body area network system, capsule endoscopy system, and active medical implant system) operating inside a hospital building.

II. CONSIDERED BASE STATIONS AND MD SRD

The following types of BS are considered in the analysis of EMC.

1) LTE BS operating in the frequency range of 2110-2170 MHz for downlink in frequency division duplex (FDD) mode [2].

2) LTE BS operating in the frequency range of 2570-2620 MHz in time division duplex (TDD) mode [2].

3) 5G BS (type 1-O) operating in the frequency range of 3400-3800 MHz [3].

The following types of MD SRD are considered in the analysis of EMC.

1) Peripheral (wearable) receiver of ultra low power wireless medical capsule endoscopy system operating in the frequency range of 430-440 MHz [4] (SRD 1).

2) Peripheral (wearable) receiver of medical body area network system operating in the frequency range of 2483.5-2500 MHz [5] (SRD 2).

3) Peripheral (fixed) receiver of low power active medical implant system operating in the frequency range of 2483.5-2500 MHz [6] (SRD 3).

4) Peripheral (fixed) receiver of ultra low power active medical implant system operating in the frequency range of 402-405 MHz [7] (SRD 4).

5) Peripheral (fixed) receiver of ultra low power medical data service system operating in the frequency range of 401-402 MHz [8] (SRD 5).

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