

# Analysis of EMC between Equipment of Wireless Systems and Medical NB IoT Devices

Aliaksandr Svistunou  
EMC R&D Laboratory  
Belarusian State University of  
Informatics and Radioelectronics  
Minsk, Belarus  
emc@bsuir.by

Vladimir Mordachev  
EMC R&D Laboratory  
Belarusian State University of  
Informatics and Radioelectronics  
Minsk, Belarus  
mordachev@bsuir.by

Eugene Sinkevich  
EMC R&D Laboratory  
Belarusian State University of  
Informatics and Radioelectronics  
Minsk, Belarus  
esinkevich@bsuir.by

Ming Ye  
R&D engineering Lab  
Huawei Technologies Sweden AB  
Stockholm, Sweden  
ming.ye@huawei.com

Arthur Dubovik  
EMC R&D Laboratory  
Belarusian State University of  
Informatics and Radioelectronics  
Minsk, Belarus  
emc@bsuir.by

**Abstract**—The analysis of EMC between equipment of wireless systems (4G/5G user equipment of cellular communications as well as access points of radio local area network) and medical narrowband Internet-of-things (NB IoT) devices (utilizing LTE carrier in 452.5–457.5 MHz range for uplink and 462.5–467.5 MHz range for downlink) operating inside a hospital building is made. Computer simulation with the use of multipath radiowave propagation model and a 3D model of hospital premises is performed. The integrated interference margin involved as a criterion of EMC is calculated as a result of the analysis. It was concluded that the equipment of considered wireless systems can interfere with medical NB IoT devices (as well as NB IoT devices can interfere with receivers of these wireless systems) if emitters and receptors are located within the same room or in contiguous rooms. In order to reduce the levels of electromagnetic interference, recommendations are given.

**Keywords**—EMC, medical narrowband Internet of things, 4G/5G cellular communications, radio local area network

## I. INTRODUCTION

Narrowband Internet-of-things (NB IoT) is a low-power wide area network technology for wireless communications. This technology is widely used to provide different services (smart metering, smart cities, smart buildings, agriculture) as well as for medical applications [1], [2], [3]. In the case of medical purpose, NB IoT is aimed to use for remote monitoring of patients' health parameters (e.g., blood pressure, heart beat, respiratory rate, glucose level), for elderly healthcare services (e.g., to automatically communicate the occurrence of a fall of a patient outside the patient's home in order to make treatment earlier [4]). NB IoT can also be useful to improve healthcare service during pandemic in smart hospitals especially for high-risk patients [5]. During operation of medical NB IoT system, the data (health information) is transmitted by NB IoT device to a base station of cellular communications and then can be accessible to medical staff for making decisions and treatment, as well as the patient's NB IoT device receives the data from the base station for remote adjustment and controlling of the user device.

According to [1], [6], [7], NB IoT technology is more suitable for healthcare applications (in respect to licensing policy, long-range data transmission, and energy-efficiency)

---

The research project is upon the sponsor by Huawei technologies Sweden AB in the Agreement No: YBN2019095135 / 19-1101K.

than other wireless technologies. Taking into account the other advantages of NB IoT technology (ability to operate within current LTE network, supporting up to 100000 IoT devices per a base station, high quality of service, high reliability [1], [4], [8]), this technology is promising for healthcare industry in the future. According to forecast [10], IoT connections will grow rapidly in near 10 years.

Mass use of 4G/5G wireless systems in hospitals can create a challenge of electromagnetic compatibility (EMC) between NB IoT and equipment of wireless systems, because medical staff and patients can use mobile devices of 4G/5G cellular communications and radio local area network (RLAN) near to NB IoT devices operating in active mode. Previous researches of EMC between NB IoT systems and wireless systems gave the alarming results: medical short-range devices can interfere with receivers of NB IoT devices (because the standards do not guarantee the absence of interference) [11], LTE signal creates a strong interference to the receiver of NB IoT user equipment [12], NB IoT cell coverage is affected due to radar interference [13].

The objective of this paper is to analyze EMC between wireless equipment (user equipment of LTE and 5G cellular communications and RLAN access points) and medical NB IoT devices used inside buildings of medical facilities.

## II. DESCRIPTION OF EQUIPMENT

### A. Considered NB IoT devices

NB IoT devices [14] utilizing LTE carrier in 452.5–457.5 MHz frequency range for uplink and 462.5–467.5 MHz frequency range for downlink [15] (band 31) is considered in EMC analysis. According to [16], band 31 can be used for NB IoT operating. The decision [17] introduced the use of LTE land mobile system in this frequency band in frequency division duplex (FDD) mode.

### B. Equipment of wireless systems under consideration

Equipment of wireless systems involved in EMC analysis is as follows.

1) LTE mobile station which operates in the following frequency ranges: 1920–1980 MHz for uplink and 2110–2170 MHz for downlink in FDD mode, and 2570–2620 MHz in time division duplex (TDD) mode [15].