Adjacent channel co-existence study between 5G NR and Wi-Fi in the 6 GHz band for indoor scenario

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***Abstract*—This study presents indoor compatibility between Wi-Fi operating in the 5925-6425 MHz band and 5G NR operating in the 6425-7125 MHz band. The study estimates interference levels between 5G NR and Wi-Fi equipment and presents the results as a performance degradation of the 5G NR. The analysis considers two scenarios, the first is a Rician channel between 5G NR and Wi-Fi equipment, and the second is when there is a Rayleigh channel.**

Keywords—5G, 6 GHz, Wi-Fi, co-existence, adjacent channel, Monte-Carlo simulations

I. Introduction

The 6 GHz band became one of the most attractive bands for broadband technology's expansion. The lower part of the band (5925-6425 MHz) today is enabled to be used on an unlicensed basis by Wi-Fi technologies for indoor applications in most countries, whereas the higher part of the band (6425-7125 MHz) is planned to be used by 5G NR in many countries and currently studies within the Radiocommunication sector of the International Telecommunication Union (ITU-R) and is planned to be identified for IMT on World Radiocommunication Conference 2023 (WRC-23). Given that 5G NR operates on a licensed basis and requires a high signal-to-noise ratio (SINR) to provide high-speed data for such applications as enhanced mobile broadband (eMBB) and ultra-reliable low-latency communication (URLLC) it is important to avoid interference with 5G NR systems so that operators would fulfill the required QoS to the users. It should be noted that 70-80% of the cellular technologies traffic is generated indoors, therefore there is a possible adjacent channel interference cases when 5G NR user equipment is located inside the same indoor premises as Wi-Fi equipment [1][2].

Today ITU-R studies the compatibility of 5G NR with incumbent services in the 6425-7125 MHz band with satellite systems and radio relay links. Many of these studies were published by the authors [3][4][5][6][7]. At the same time, the question of possible interference of Wi-Fi to 5G in the adjacent channel scenario wasn't studied yet and so far, no administration estimated how these two systems will co-existence in case of close vicinity deployment. This study intends to show how indoor deployment of Wi-Fi in the 5925-6425 MHz band may affect 5G NR user equipment that is located in the same buildings with Wi-Fi and operate in the frequency band 6425-7125 MHz. The results of this research may help administrations and operators that intend to use Wi-Fi and 5G NR in the 6 GHz bands and understand how some of the services of 5G NR may degrade in case of Wi-Fi interference. Figure 1 presents a schematic situation of interference from Wi-Fi equipment to the 5G NR user equipment located inside one building.

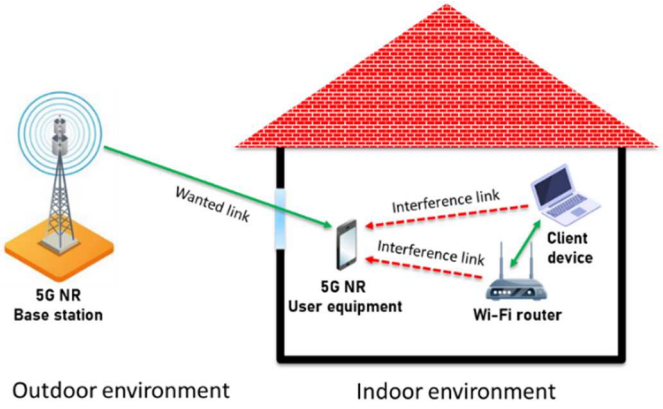

Fig. 1. Interference scenario of Wi-Fi devices to 5G NR user equipment

For indoor cases, two types of interference scenarios from Wi-Fi to 5G NR are possible, the first is when 5G NR user equipment and Wi-Fi router and/or client device are located inside the same space indoors and have close distances between each other, such a case would be the worst-case scenario since it would have the highest impact. Typical examples where such scenarios are possible include airports, railway stations, shopping malls, restaurants, and other places where 5G NR user equipment may be in the same space as Wi-Fi equipment. The second indoor scenario includes the scenario when Wi-Fi and 5G NR are located in different rooms, and there is a wall between 5G NR equipment and Wi-Fi equipment, such cases are common for residential buildings, offices, or hotels where 5G NR and Wi-Fi may be used in the neighboring rooms, this case is more interference friendly since 5G NR would be shielded by the walls from the Wi-Fi transmissions.

By analyzing possible propagation situations between the Wi-Fi transmitter and 5G NR receiver, two different path categories can be identified: paths with a strong LoS component, and obstructed paths – non-line-of-sight (NLoS).

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