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Spectrum Considerations for 5G Mobile Communication Systems

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Abstract

Increased demand of consumers on services in the mobile environment with high data rate and technologically developed mobile broadband communication systems will require more spectrum to be available in the future. The new technologies require frequencies for their development and usage. One of the main objectives of fifth generation (5G) mobile communication systems, known also as IMT-2020, is to increase the current data rates up to several gigabits per second (Gbit/s) with even more than 10 Gbit/s. One possibility is to consider the use of higher frequencies in order to increase the available bandwidth, which is necessary to achieve such data rates. Main idea of the research is to investigate the available International Mobile Telecommunications (IMT) frequency bands and possible new one – above 6 GHz for possible identification worldwide and in Europe for IMT by the 2019 World Radiocommunication Conference (WRC-19). Main characteristics and requirements of IMT-2020 are also provided in this paper.

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Keywords: 4G mobile communication; 5G; IMT; Mobile service; Spectrum planning

1. Introduction

Mobile broadband traffic is ever increasing, driven by consumer demand for mobile data, improved performance and quality of mobile networks, new technologies, devices, applications and services e.g. machine type communications that introduce advanced ways of using mobile service frequencies. In this paper authors continue

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their previous study[1] updating the list of International Mobile Telecommunications (IMT) bands and supplementing the study with considered frequency bands for 5G mobile communication systems.

Authors found that investigation on millimeter wave spectrum for 5G was performed in study[2] where different frequency bands were considered in comparison with our study, referring to several ongoing 5G research and development (R&D) projects and considering the spectrum allocation status of Japan, United States of America, and European Union (EU). Consequently, five candidate frequency bands there were selected.

The second study is the one in study[3] where national situation of China is discussed in regard to the 5G vision, spectrum demands, and potential candidate bands. Unlike the above mentioned studies this paper presents results of consideration of existing and potential IMT frequency bands including for 5G mobile communication systems.

This paper is organized as follows. The second chapter is devoted to the mobile spectrum estimate for terrestrial IMT. The third chapter dedicated to the current IMT frequency bands. The fourth chapter is devoted to the future possible IMT frequency bands, mainly for 5G. The fifth chapter describes main characteristics and requirements of IMT-2020, and in the last one conclusion are derived.

2. Mobile spectrum estimate for terrestrial IMT

The ITU terms for 3G and 4G are IMT-2000 and IMT-Advanced accordingly. The term IMT-2020 is adopted for 5G. Collectively they are known as IMT. The capabilities of IMT systems are being continuously enhanced in line with user needs and technology trends[4]. IMT systems have contributed to global economic and social development.

With the mobile data traffic increasing more spectrum resources will be necessary for the future mobile broadband communication systems. The Report ITU-R M.2290-0 provides a global perspective on the future spectrum requirement estimate for terrestrial IMT in the year 2020. The predicted total spectrum requirement for both low and high user density scenarios was calculated to be 1340 MHz and 1960 MHz (including the spectrum already in use, or planned to be used) at least by the year 2020[5]. In some countries, national spectrum requirement can be lower than the estimate derived by lower user density settings and in some other countries, national spectrum requirement can be higher than the estimate derived by higher user density settings. The mobile traffic forecast presented in Fig. 1.

It is assumed that for the year 2020, the median traffic growth will fall in between the lowest and highest growths, anticipating at least 25-fold traffic growth ratio in 2020 compared to 2010[5]. Other estimates[6] anticipate that global IMT traffic will grow in the range of 10–100 times from 2020 to 2030.

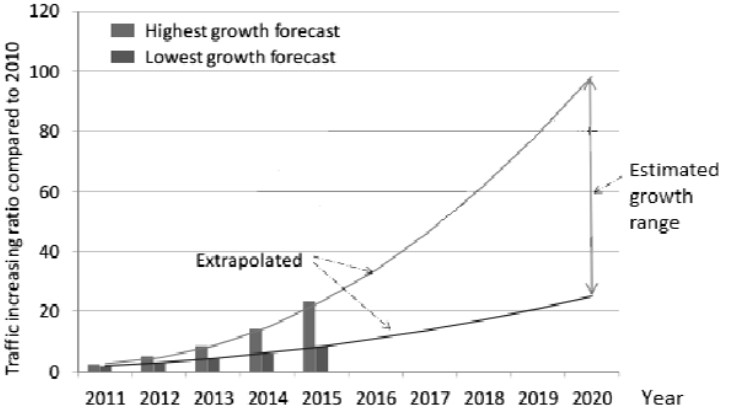

Fig. 1. Mobile traffic forecasts toward 2020 by extrapolation according to the Report ITU-R M.2290-0.

An option for increasing data rates, already envisaged for fourth generation (4G) mobile communication systems, is the development of small cells and the combination of the capacity of unlicensed bands (e.g. 2.4 GHz, 5 GHz) with the capacity of a licensed frequency block. This will require smart networking for handover and switching between various technologies and frequency bands in heterogeneous networks[7]. Another option is carrier