Causality of COVID-19 on EMF Radiation in Campus Area of University of Novi Sad

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Abstract. The mobile telephony became one of the worldwide most important technology, allowing wireless communication at any moment and virtually at any place. It is based on electromagnetic field (EMF) radiation from its network base stations, which inevitable cause EMF expansion in surrounding. However, the new base stations are followed by strong controversy, increasing concerns of the public, regarding potentially dangerous health effects of the EMFs. Thus, there is a constant demand for overall investigation and supervision of existing EMF exposure. In last decade, the wireless sensors networks emerged as an innovative solution for effective monitoring of EMFs in the environment. The latest established is the Serbian EMF RATEL network, which offers a sophisticated approach of telecommunication service-based EMF monitoring. This network performs wideband monitoring, taking into account the contribution of all active EMF sources in the vicinity of specific location. In this paper, the new role of the EMF RATEL system is considered, analyzing it as a smart solution for an emergency management. The perceptible causality of the COVID-19 on EMF radiation in campus area of University of Novi Sad is investigated, regarding the extensive activities of students in this part of the city of Novi Sad.

Keywords: EMF monitoring · Wireless sensors network · COVID-19

1 Introduction

The mobile telephony has rapidly been implemented throughout the world, where the newest 5G technology records the significant expansion: "*The number of 5G devices understood to be commercially available has likewise grown, by 29.9% over the last quarter.*", concluding with August 2021 [1].

Even the mobile phone technology is already significantly present, the controversy and negative public campaigns still exist, particularly regarding installation of their new base stations (BS). Those negative campaigns propagate dangerous health effects of the high-frequency electromagnetic fields (EMF) radiated from BSs, regardless the fact that existing scientific researches demonstrate no evidence for such influence [2].

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Unfortunately, the anticipated realization of the newest 5G network raises uneasiness of the general public, related to the potential exceeding of admissible EMF limits [4], since 5G BSs will have to work in parallel with existing BSs of 2G/3G/4G BSs.

The general public will naturally always insist on lowering the radiation power and consequent EMF strength from BSs. However, this will trigger requirements of mobile operators for dense installation of BSs, in order to provide high quality communication links. The compromise has to be made and consequently EMF measurement and monitoring emerged as a greatly important topic. Regarding its importance, the forward-looking information on risks from EMF exposures, through some innovative monitoring techniques, experimental evidences are constantly required [3].

As a contribution to those requirements, the Serbian EMF RATEL network [4] offers the state-of-the-art, the service-based EMF level monitoring [5]. This monitoring network is intended to become a trustworthy mediator between requirements for the safe EMF environment and a necessity of operators to effectively develop their communication infrastructure. However, recently, an additional role of the EMF RATEL system appears: as a prospective solution for an emergency and disaster management. The presence of the COVID-19 had noticeable influence on the EMF radiation, which can be seen in the case study of the campus area of the University of Novi Sad (UNS).

In order to elaborate causality of the COVID-19 on EMF radiation, this paper is organized as following: Sect. 2 presents details of the EMF RATEL system and its EMF monitoring. The Sect. 3 explains spatial distribution of EMF sources in UNS campus, while Sect. 4 brings results of long-term EMF monitoring, as well as analysis of the COVID-19 presence on EMF radiation. Finally, Sect. 5 concludes paper.

2 The EMF RATEL Monitoring

The EMF RATEL was launched in 2017, by the Serbian Regulatory Agency for Electronic Communications and Postal Services (RATEL) [6]. It observes EMF radiation over the Serbian territory, offering real time information about present EMF levels.

2.1 The EMF RATEL Concept

This network uses autonomous EMF monitoring sensors [7], joined in a unified wireless sensors network, as shown in Fig. 1.

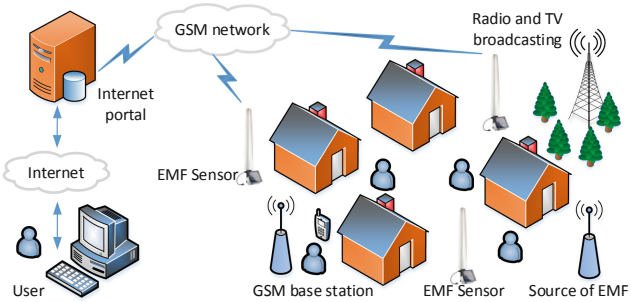

Fig. 1. The concept of the EMF RATEL monitoring network [7].

Those sensors gather measurement results of EMF levels, transmitting them wirelessly, over existing mobile telephony networks, to the centralized database of the EMF RATEL Internet portal [8].

Currently, eighty-eight sensors are active in the Serbian cities [4], as shown in Fig. 2, while the goal is to reach one hundred installed sensors in 2021.

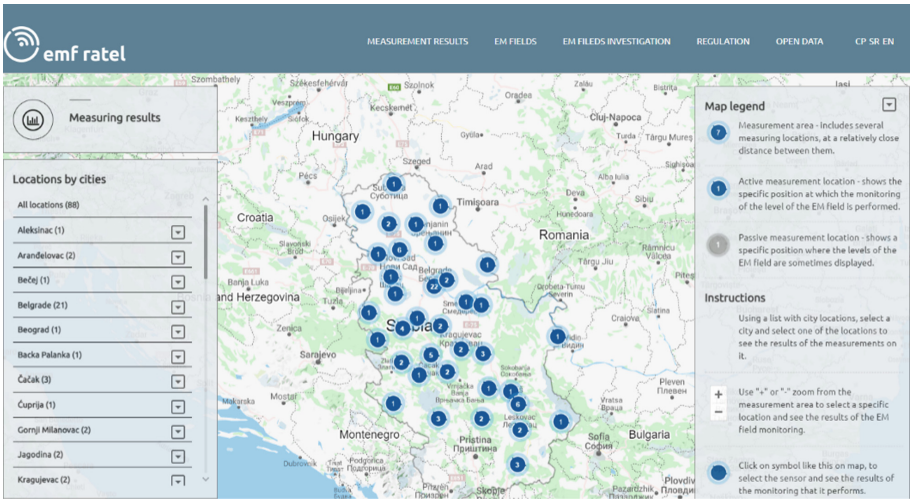

Fig. 2. Distribution of EMF sensors over the Serbian territory [4].

The EMF RATEL sensors are installed on dedicated spots, usually in zones of particular interest, such as zones in the vicinity of kindergartens, schools, dorms, hospitals and other public places, where a number of peoples can be exposed to EMF.

2.2 Continuous Wideband Approach for EMF Monitoring

The EMF RATEL system uses continuous wideband monitoring approach, providing daily EMF level fluctuation and much better insight into EMF behavior on specific location, as shown in Fig. 3.

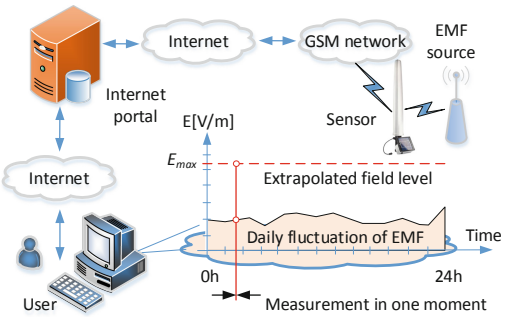

Fig. 3. The extrapolated field level versus continuous monitoring.

Besides, the EMF RATEL performs wideband monitoring, summing the EMF contributions of all active EMF sources in surrounding and results with cumulative field strength values, regardless the individual contribution of any source.

Such approach can not distinguish operating frequencies of EMF sources and thus can not offer the field level per frequency, as the frequency selective measuring does. However, it can be advantageous with its high measurement speed, particularly when cumulative field level is required, as it is the case in investigations over locations with unknown EMF sources.

Even though the extrapolation is widely accepted and standardized [9] for classical measurements, it should be indicated that it can result with overestimated EMF levels, as described in Fig. 3. The BSs usually radiates lower power than maximal possible and thus the radiated level of EMF is typically lower than the maximal possible.

3 Spatial Distribution of EMF Sources in UNS Campus

The UNS campus is one of the most important part of the city of Novi Sad, with more than 50.000 students and 5.000 personnel. It is the largest campus in the Republic of Serbia, requiring considerable mobile telephony signal coverage, as shown in Fig. 4.

The campus area has been monitored by two EMF RATEL sensors, where one of them is installed on the roof of the Faculty of Technical Sciences (FTS) building, as shown in Fig. 5. The FTS is individually a largest faculty in UNS, holding more than 15.000 students, while its building is a central building in the UNS campus.

In that sense, the FTS location has been deliberately chosen for sensor installation, covering the campus part where the largest number of students can be present.

The second sensor is placed on kindergarten “Veseli vrtic”, in which vicinity the mast with 2G/3G/4G BS of MTS mobile operator is installed [10]. The second sensor is intended to observe the exposure of the youngest population in UNS campus.

The campus has two student dorms, two student cafeterias and several plateaus for resting. The vicinity of the river Danube makes the campus a favorite and most vibrating place for extensive student life. In consequence, a number of students spends their time there, using mobile devices in a substantial EMF environment.

Fig. 4. The UNS campus coverage with 2G/3G/4G signals of MTS and Telenor operators [6].

Fig. 5. The EMF RATEL sensor on FTS building [4].

4 Long-Term EMF Monitoring in UNS Campus

The UNS campus can be considered as a zone of particular interest [11] and area with increased EMF level. It requires comprehensive long-term EMF monitoring, which is performed by the sensor on FTS building roof. The partial results are shown in Fig. 6.

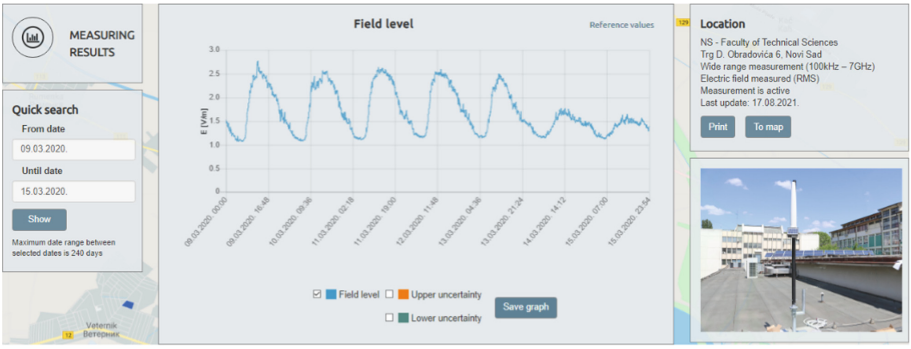

Fig. 6. The EMF RATEL sensor on the roof of FTS building records daily EMF fluctuation [4].

Figure 6 shows usual Monday to Saturday EMF fluctuation, while clearly distinguishing working days from weekend, as well as day from the night, regarding the level of EMF radiation. It can be seen that presence of students and UNS personnel, in working hours, increases the EMF level for about 2.5 times compared to the night.

4.1 COVID-19 Presence

The COVID-19 pandemic in Serbia was proclaimed on 2020/03/19, when authorities announced the country lockdown, requiring urgent leaving of student dormitories and closing all UNS faculties before that day. In sense of the EMF radiation this lockdown led to the decrease of the EMF levels, as it is shown in Fig. 7.

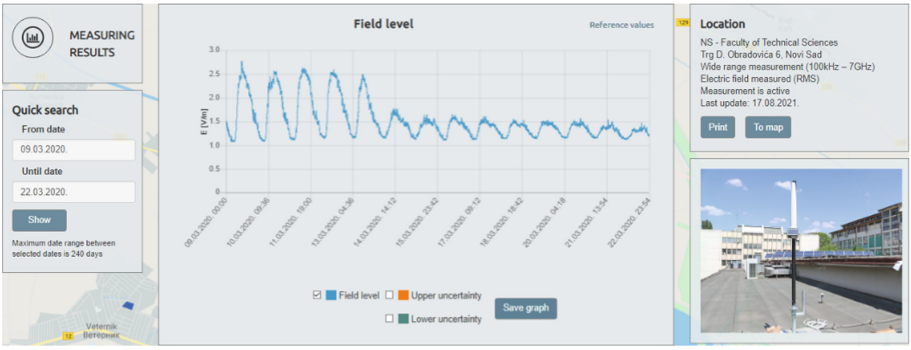

Fig. 7. Influence of the COVID-19 on EMF radiation in UNS campus [4].

It can be noticed that EMF radiation started to rapidly decrease in days before and during the lockdown. However, several essential UNS communication links/services stay turned on, enabling remote work of personnel, thus producing EMF radiation.

With appearance of summer days and long-waiting lockdown suspension, the UNS campus once again became a live area, even without full presence of students. It was reflected through the slight increased EMF radiation, as depicted in Fig. 8.

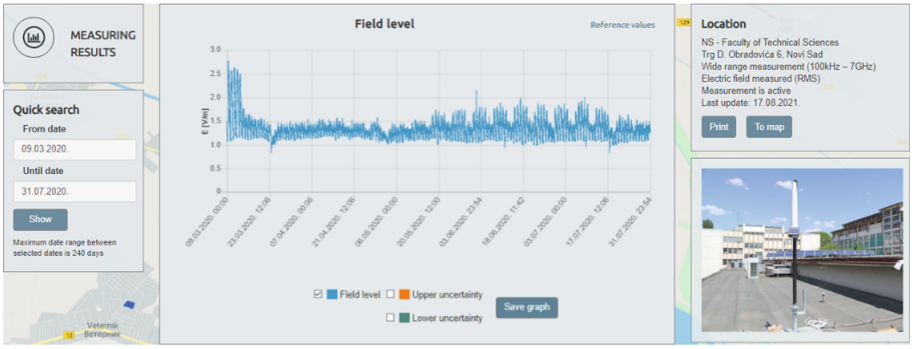

Fig. 8. The EMF radiation in UNS campus after suspension of the COVID-19 lockdown [4].

4.2 The Second COVID-19 Wave in UNS Campus

During the summer of 2020 the COVID-19 pandemic was under control in Serbia. Unfortunately, with cold days of autumn and consequent more time spent in closed space, the second wave of COVID-19 hit the Serbian population.

During November the number of infected people starts to rapidly increase, reaching 8000 incident cases per day at the end of the month. Therefore, the authorities had to introduce some new restrictive measures, including a partial daily lockdown, which also was reflected on recorded EMF levels in UNS campus, as shown in Fig. 9.

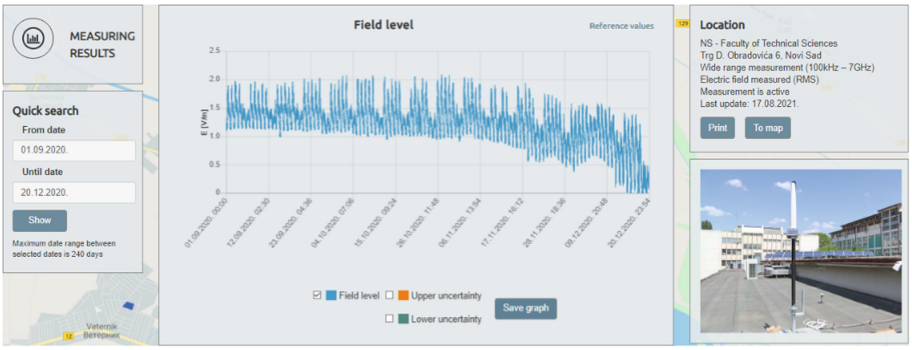

Fig. 9. The EMF radiation during second wave of the COVID-19 [4].

It should be pointed that during the COVID-19 pandemic, the residents around the UNS campus also had to switch on to the wireless internet/communication, regarding their private/business activities. It causes additional data traffic on BSs in campus and around it, affecting the recorded EMF levels.

4.3 Statistical Analysis of EMF Radiation in UNS Campus

Simple statistical analysis of the electric field levels in UNS campus is shown in Fig. 10. The acquired field levels, taken every 6 min by the EMF RATEL sensor [9, 12] were averaged on month levels for 2020 and first half of 2021.

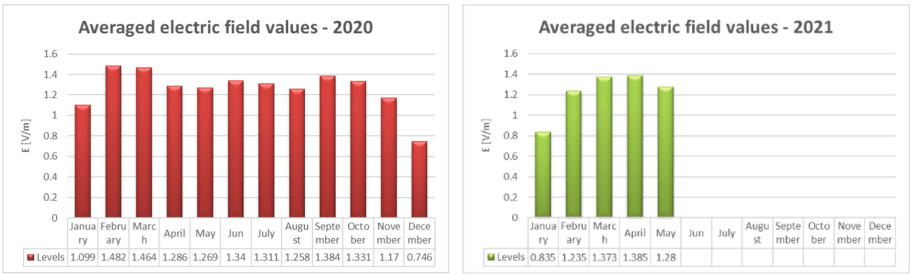

Fig. 10. Averaged field strength values during 2020 and first half of 2021 [4].

This simple statistical analysis confirms conclusions derived from daily graphs of electric field fluctuation, shown in Fig. 7, 8 and 9, distinguishing the beginning of COVID-19 pandemic, in March 2020, as well as drastic second wave at the end of November.

At the beginning of 2021, the campus life/activities start to recover, while thanks to the vaccination program, forced by the Serbian government, the life returned almost to the normal in the first half of 2021. It was reflected through recorded EMF levels.

Regarding the features of the national EMF RATEL monitoring network, the causality of COVID-19 pandemic on EMF radiation over the wide area, as in a case study of UNS campus, was able to be followed daily, as well as during long-term period.

It was shown that absence of students in UNS campus, caused by COVID-19 disaster, reflected on usual EMF radiation levels/patterns. Also, it is reasonable to imagine that sudden increase of existing EMF levels can indicate that something unusual happens in observed area, which can be helpful for emergency and disaster management, as an early warning sign. In that sense, the EMF monitoring networks and analyses of acquired EMF data can serve as a handy public/authority tool for detection of an unusual behavior in some areas.

5 Conclusion

The dense distribution of BSs, offers a number of features for mobile telephony, radically improving the technical capability of Internet access and data transfer. However, the installation of new BSs is followed by negative public campaigns, which insist on irregular the high-frequency EMF levels and their unsafe health effects.

Hawing in mind that technology has allowed a sophisticated continuous EMF monitoring, as implemented in Serbian EMF RATEL system, such approach can be used for comprehensive EMF surveillance, providing a plenty of details and important data regarding daily EMF levels over observed areas.

The EMF RATEL network and its continuous monitoring was primarily intended to enhance the quality of human life in imminent modern EMF environment, improving social awareness and knowledge on EMF effects on health and environment. Such continuous monitoring is able to provide daily EMF observation and better knowledge on EMF spatial distribution, as well as demanding feature to timely inform the public on existing EMF levels and their influence on health.

Also, this system can serve as an appropriate mediator between normal requests of the general public for the EMF safe living environment and need of commercial operators to improve their telecommunication infrastructure, by installing additional BSs.

In this paper, a bonus feature of the EMF RATEL system was analyzed, presenting its capability to become a perspective tool for emergency and disaster management. The worldwide presence of the COVID-19 pandemic, as well as in a case study of the UNS campus, clear shows existing causality on EMF radiation, which can be used for some other purposes.

The change of usual levels/patterns in daily EMF radiation can be considered as an early warning sign, which can be useful for various authorities, regarding monitoring of any kind of emergency and disasters.

The EMF RATEL system and some similar systems could serve as a valuable tool, since they are able to acquire, analyze and process in real time, as well as timely signalize if any unusual change appears in EMF radiation, as it was presented in the case study of COVID-19 pandemic and UNS campus area.

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