Brahim Selmaoui, Paul Mazet, Pierre-baptiste Petit, Kihwea Kim, Donggeun Choi, René de Seze

Exposure of the South Korean population to the 5th generation (5G) of mobile phone networks (3.4 to 3.8 GHz)

Brahim Selmaoui,[1,2,*] Paul Mazet,[3] Pierre-Baptiste Petit,[3] Kihwea Kim,[4] Donggeun Choi,[4] and René de Seze[1,2]

[1] French National Institute for Industrial Environment and Risks (Ineris) 60550 Verneuil en Halatte France.

[2] PériTox-INERIS Laboratory UMR_I 01 Jules Verne University of Picardy 80000 Amiens France.

[3] Technical Center for Mechanical Industries (CETIM) 60300 Senlis France.

[4] National Radio Research Agency (RRA) Republic of South Korea

[*] Correspondence to: Brahim Selmaoui, Brahim.Selmaoui@ineris.fr

Mailing address: Parc Alata, Ineris B.P.2 Verneuil en Halatte 60550

Telephone: +33 344618268

Running Head: 5G Measurements in South Korea

Conflict of interest: None

Grant sponsor: This study was fully funded by Program 181 (No. DRC29) of INERIS, supported by the French Ministry for the Ecological and Inclusive Transition.

Abstract

As industrialized countries race to install and deploy 5G networks, some countries have taken the lead and already have operational 5G networks in place. South Korea is among these. In this study, we measured exposure to electromagnetic fields in South Korea to evaluate the relative contribution of 5G as compared to other frequencies such as 2G, 3G and 4G. Results show that the emission of 5G contributes about 15% to Total telecommunications emissions. The highest levels were observed in the vicinity of 5G antennas and remain below the limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Keywords: 5G; 3.4–3.8 GHz; radio frequencies; electromagnetic field; South Korea

Introduction

The next generation of mobile networks, known as 5G, has been introduced by the wireless telecommunications industry and standards organizations. The implementation of 5G is described by the requirements of the International Telecommunication Union (ITU), or International Mobile Telecommunications-2020 (IMT-2020), which defines the main categories of performance that these new technologies will achieve. This new mobile technology is expected to provide high quality services such as high-speed, low-latency, efficient and reliable mobile networks. Recent estimates project that a total of 3.5 billion 5G subscriptions are expected by the year 2026 [Möller, 2020].

If the implementation of this technology on new frequencies brings more capacity to mobile networks, 5G will make several important technological breakthroughs in wireless communication, such as:

1) ultra-mobile broadband (eMBB: enhanced Mobile Broad Band) – combined with higher frequencies, theoretical speeds will be at least 10 times higher than those of existing technologies;

2) massive internet of things (IoT) (mMTC: massive Machine Type Communication) – 5G should allow a high density of connected objects per surface as well as the simultaneous connection of large numbers of objects. Additionally, it is expected to have greatly reduced energy consumption, which will substantially increase the battery life of the objects thus connected;

3) ultra-reliable and very low latency networks (uRLLC: ultra-Reliable Low Latency Communication) – this breakthrough serves use-cases requiring guaranteed network access and very high reactivity, and therefore very low latency, for the communications carried by the 5G connection; and

4) "tailor-made networks" – this last notion concerns the technology known as "network slicing," which allows both the end-to-end management of service quality and the organization of networks such that services requiring different performance levels can coexist on the same network.

Based on this improved performance, the development of new innovative services is expected; these services could not have been provided with existing technologies, or in any case, not with the same ease or flexibility.

In 2016, the European Commission launched an action plan aimed at defining a common European calendar for the launch of the first 5G networks. The aim was to clear and allocate pioneer frequencies for 5G (700 MHz, 3.5 GHz and 26 GHz) in order to be able to launch 5G commercial services in each country of the European Union before the end of 2020.

The present study characterizes the exposure of people to non-ionizing radiation from these new networks in an area where the commercial implementation of 5G is already fully effective. Some countries that have taken the lead include China, Australia, the United States and South Korea. We decided to characterize the exposure of people to 5G in South Korea.

The frequencies reserved for 5G in South Korea coincide with the frequency chosen in France for network start-up, i.e., 3.5 GHz (3.4–3.8 GHz).

The measurements were carried out at the end of November 2019 in collaboration with the Korean institute in charge of telecommunications regulation—the National Radio Research Agency (NRRA)—six months after the network was opened to public customers. This collaboration provided early insight into the organization of the 5G service, distinctions between the antennas of the various Korean operators and information on the distribution of antennas in the country. The measurements carried out included exposimeter measurements, total exposure measurements and spectral measurements. We made these measurements in several different areas of activity and in two South Korean cities representing two different types of urban environment: South Korea's largest city, Seoul, and a smaller city, Naju.

In addition, measurements were made during transportation by car or bus and, along train routes. Fixed-point measurements over 12 h or 24 h were also made to quantify variability in traffic with the time of day.

Materials and Methods

General data on the 5G network in South Korea

The three main operators that activated their 5G services in South Korea were KT, SKT (SK Telecom), and LGU+ (LG Uplus). LGU+ was allotted the frequencies 3.4–3.5 GHz, KT was given 3.5–3.6 GHz and SKT was given 3.6–3.7 GHz. However, these different operators chose different manufacturers for the base stations constituting their 5G networks. Available information on the number of KT base stations on 24 November 2019, is listed in Table 1. This table shows the number of base stations spread over the largest Korean cities at that time. The city of Seoul and its metropolitan area have the largest number of base stations. Samsung had 81% of the total antennas deployed for 5G in South Korea, while Ericsson and Nokia had 11% and 8%, respectively [data retrieved on 24 November 2019].

Areas covered by measurements

To ensure the representation of the diversity of environments throughout South Korea, we identified different types of environment where exposure measurements should be carried out. These different areas were the following:

- Rural residential area—Old town of Naju;
- Rural administrative area—Old town of Naju;
- Rural commercial area—Old town of Naju;
- Urban residential area—New city of Naju;

- Urban business area—New city of Naju;
- Urban commercial area—New city of Naju;
- Dense urban residential area—Seoul;
- Dense urban business zone—Seoul; and
- Dense urban commercial area—Seoul.

Because 5G New Radio (5G-NR) technology can offer high network availability on transport routes, we carried out measurements during car, bus and, train journeys in parallel to measurements in the zones above representing different environments.

Measurements at fixed points over 12 h or 24 h were carried out to consider the variability in traffic according to the time of day.

The measurement equipment and base station features

To perform the dosimetry recordings, two devices were used: Dosimeter 88-5875 MHz (ExpoM-RF, Fields at Work, Zurich, Switzerland) and Dosimeter 88-6000 MHz (EME SPY 200, Microwave Vision Group, Brest, France). These dosimeters were programmed to acquire electric field data for several services, including 5G-NR, 5G TDD low band (LB; B42TDD 3400–3600 MHz) and 5G TDD high band (HB; B43TDD 3600–3800 MHz).

ExpoM: The ExpoM device employed a true-RMS detection method with a 0.3 s integration time for each band and a sampling interval of 4 s. It had a three-axis isotropic antenna. Calibration was performed for each frequency band at 15 field levels for the three axes. The ExpoM device has two measurement bands above 3 GHz: band 42 (3400–3600 MHz) and band ISM 5.8 (5150–5975 MHz). It cannot measure frequencies between 3600 and 3800 MHz, i.e., band B43. The ExpoM has a sensitivity of 0.005 V/m in the range 470–1900 MHz and 0.003 V/m in the range 1920–3600 MHz.

EME SPY 200: The EME SPY 200 is a three-axis E-field probe with a sampling interval of 4 s. Calibration was performed by the manufacturer before use; it has a sensitivity of 0.05 V/m in the ranges 80 MHz–0.7 GHz and 3–6 GHz), and a sensitivity of 0.02 V/m in the range 0.7–3 GHz.

During measurements, the dosimeter was carried in a backpack at about 1.50 m above the ground, which is the reference height of the National French Agency for Radiofrequencies (ANFR) method.

Power channel measurement were carried out with a spectrum analyzer (Rohde & Schwarz FSH8, Meudon-la-forêt, France) and horn antenna (Schwarzbeck BBHA9120D, Schönau, Germany) mounted on a tripod at a height of 1.50 m above the ground (RMS detector with an RBW of 300 kHz and an SWT of 20 ms, Meudon-la-forêt, France). In the results, a maximum level was extracted from maximum power.

For power channel measurements, total transmitted power in the channel was measured. With a horn antenna at a center frequency of 3.55 GHz and Channel widths were 20–100 MHz.

As beamforming is directed to a very narrow region, we then measured the EMF of the base station after setting the conditions for maximum exposure using the Orthogonal Channel Noise Simulator (OCNS) function. Therefore, our measurements represent the worst-case exposure scenario. Measurements were carried out in the vicinity of the 5G-NR base station with the field meter (NARDA NBM550, Villebon sur Yvette, France) along with its isotropic probe (NARDA EF-0691, Villebon sur Yvette, France).

With the field meter, we have measured the EMF exposure level at selected test locations. This followed the in-situ RF based exposure measurement method, set by ICNIRP. However, with dosimeters, the objective of our work is to give real time values, which are sampled every 4s.

Results

Table 2 presents 5G TDD LB measurements in different areas of South Korea. These measurements were performed with two dosimeters (ExpoM-RF and EME Spy 200). The average levels of 5G TDD LB varied with both the type of environment and the area and ranged from 20 to 560 mV/m with the ExpoM-RF dosimeter and from 20 to 70 mV/m with the EME Spy 200 dosimeter. The 5G TDD HB measurements are presented in Table 3 and were only performed with the EME Spy 200 dosimeter due to the insensitivity of the ExpoM-RF to EMF in this band. Average EMF measured in different locations were similar (20–30 mV/m) except for measurements close to a 5G-NR base station (170 mV/m).

The variability in traffic was estimated using the 24-h measurement at a fixed point (Table 4). The maximum recorded EMF for 5G was 130 mV/m. Figure 1 represents the temporal variation over 24 h of the 5G TDD LB EMF measured with the ExpoM-RF. Figure 2 presents the arithmetic mean for different signals measured over 24 h, showing the contribution of the 5G signal in the context of other signals.

Tables 5 and 6 show the 5G maximum level and the 5G power channel measurement, either on the building roof at 15 m from the antenna or in the street at 150 m from where the 5G antenna was set, in the main lobe of the 5G antenna beam. Measurements were carried out in the vicinity of the 5G-NR base station with the NARDA NBM550 fieldmeter along with the NARDA EF-0691 isotropic probe. Power channel measurements were carried out with the spectrum analyzer (Rohde & Schwarz FSH8) and horn antenna (Schwarzbeck BBHA9120D). Power channel measurement include measurements of the total transmitted power in the channel of width 20–100 MHz and with a center frequency at 3.55 GHz. Tables 5 and 6 also present the evolution of the electric field levels as a function of the measurement parameters (bandwidth, type of antenna, etc.) and of the settings of the 5G antenna, considered at either nominal power or at maximum power.

Discussion

In this work, a measurement campaign in South Korea was carried out to determine the contribution of the newly deployed 5G-NR infrastructure to human EMF exposure. These measurements were carried out by a field meter and exposimeters to determine the total exposure to EMF spectra in several areas of activity in the South Korean cities of Seoul and Naju.

The human body is affected by the cumulative EMF. It is therefore of interest to address the cumulative radiation emitted by various RF signal sources, in addition to the radiation emitted by cellular network antennas, when assessing EMF exposure. Most of the signals belonging to other radio technologies present during our measurements have been included in the reported cumulative EMF exposure level. As a result, our methodology considers additional RF signal sources, including those operating in different coexisting radiocommunication systems in a given area.

It appears that the contribution of 5G-NR to the overall EMF exposure is small in comparison to other frequencies. Indeed, the measurements carried out in Seoul and in different geographical areas of Naju showed that this contribution is less than 15% of the total exposure in rural and urban zones, and results were similar outside the city. The 5G exposure during the urban trip (the trip inside of the city) contributed about 15% of the Total exposure.

Our results show that 5G exposure levels were under the exposure limit set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (ICNIRP, 1998; 2020). Indeed, for 5G, the threshold is 39 V/m at 700 MHz and 61 V/m at 3.5 GHz and 26 GHz. Our data show that the maximum exposure measured on the rooftop in the vicinity of the base station was still below the threshold exposure limit set by ICNIRP, and at moving positions in the nearby street, it was far below this level (below 0.08 V/m). Our Study is in line with other reports (Ofcom, Telstra and ANFR) that were published online.

In the different areas where the measurements were performed, it appears that the largest contribution to the measured exposure levels comes from the frequencies of the previous generations of mobile technology (2G, 3G and 4G) (Figure 2). The highest level we observed in the band used for 5G was 25% of the Total level.

Measurements over 24 h at a fixed point showed that the EMF emission from the base station is usually stable over time, at around 5 mV/m, except during rush hours, which are concentrated in the morning (around 8–9 AM), where exposure increases up to 130 mV/m, and in the evening (around 6–8 PM), which shows only a two-fold increase compared to the median day and nighttime levels. It can also be seen in this location that 5G is only a small fraction of the total exposure. The variability is in part due to the adaptability of the antenna power in response to traffic during the 24 h measurements.

Measurements with a field meter in the vicinity of the 5G-NR base station were found to be 12 V/m (15 m from the antenna) with its baseline power. This value increased to 21 V/m when the antenna was at its maximum power at the same distance. The exposure level remained under the ICNIRP limit.

This is in line with other experimental studies based on measurements recorded for operational mobile networks, which have highlighted that for 2G, 3G and, 4G systems, a base station's output power rarely approaches the theoretical maximum [Colombi et al., 2013; Joshi et al., 2015].

Some studies have experimentally assessed base station exposure in urban environments with different signals from previous generation networks. Joseph et al. [2010] looked at the contribution of EMF exposure of the general public in Stockholm, Sweden, for the LTE network in comparison to other RF sources. They found that the average contribution of the LTE signal to the total RF exposure was 4%.

Likewise, a measurement campaign conducted in China by Wu et al. [2013], which measured the GSM band exposure in the vicinity of base stations, showed that the level of GSM signal near these base stations was very low. A similar study performed in Greece reported that the vast majority of exposure values were below reference levels for general public exposure set by Greek legislation [Christopoulou et al., 2015].

Taking into account differential beam direction, some studies have estimated the maximum antenna power level contributing to EMF exposure. As the beams are directed to provide service to connect users, the average power in each beam direction has been found to be well below the theoretical maximum. According to Thors et al. [2017], the 95th percentile of power transmitted per beam is 7–22% of the theoretical maximum. A study by Colombi et al. [2020], showed that all base stations operated at a cell-wide power level of less than 2.5% of the maximum.

In our study, the results with the two different dosimeters, ExpoM-RF and EME Spy 200, present some variability. This is mainly attributed to the different sensitivity thresholds of each device when the ambient exposure is close to the measurement threshold. However, at significant exposure levels, the measured values converge.

This study, in line with other reports (Ofcom, Telstra, ANFR) published online, is a preliminary study because electromagnetic field measurements were carried out only six months after the opening of the network to the Korean public. It is therefore likely that the 5G network was not being used to its maximum, the number of subscribers was still relatively low and the tendency of young people to use Wi-Fi spots for free service. It is necessary to continue conducting EMF measurements to monitor the overall trends in the long term. Nevertheless, it appears from this study that exposure levels from 5G were in a low range. Moreover, the fact that the radio signal beam mainly focuses on the end users will contribute to reducing exposure in unnecessary areas.

This work is part of a measurement campaign in South Korea whose final report was published in 2019 [French Expertise Report, 2019].

Funding and Acknowledgments
This study was fully funded by Program 181 (No. DRC29) of INERIS, supported by the French Ministry for the Ecological and Inclusive Transition.

References

Agence National des Fréquences (ANFR). April 2020. Assessment of the exposure of the general public to 5G electromagnetic waves. Part 2: first measurement results on 5G pilots in the 3,400-3,800 MHz band. Available from: https://www.anfr.fr/fileadmin/mediatheque/documents/5G/20200410-ANFR-rapport-mesures-pilotes-5G-EN.pdf. [Last access 03 March 2021]

Christopoulou M, Karabetsos E. 2015. In situ measurements of radiofrequency exposure levels in Greece from 2008 to 2013: a multi-parametric annual analysis. Bioelectromagnetics 36(4):325-9.

Colombi D, Joshi P, Xu B, Ghasemifard F, Narasaraju V, Törnevik C. 2020. Analysis of the Actual Power and EMF Exposure from Base Stations in a Commercial 5G Network. Applied Sciences 10(15): 5280.

Colombi D, Thors B, Persson T, Wirén N, Larsson LE, Jonsson M, Törnevik C. 2013. Downlink power distributions for 2G and 3G mobile communication networks. Radiation Protection Dosimeter 157(4), 477–487.

French Expertise Report (2019). Mesure de l'exposition au rayonnement radiofréquence de la téléphonie 5G-NR en Corée du sud. Ineris. Available at: https://www.ineris.fr/fr/mesure-exposition-rayonnement-radiofrequence-telephonie-5g-nr-coree-sud [Last accessed 08 January 2021].

International Commission on Non-Ionizing Radiation Protection (ICNIRP). 1998. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Health Physics 74(4): 494–522.

International Commission on Non-Ionizing Radiation Protection (ICNIRP). 2020. Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz). Health Physics 118(5): 483–524.

Joseph W, Verloock L, Goeminne F, Vermeeren G, Martens L. 2010 Assessment of general public exposure to LTE and RF sources present in an urban environment. Bioelectromagnetics 31(7):576-579.

Joshi P, Agrawal M, Thors B, Colombi D, Kumar A, Törnevik C. 2015. Power level distributions of radio base station equipment and user devices in a 3G mobile communication network in India and the impact on assessments of realistic RF EMF exposure. IEEE Access 3: 1051–1059.

Möller R. 2020. Mobile subscriptions outlook. In P. Cerwall (Ed.), Ericsson Mobility Report (page 4). Ericsson. Available at: https://www.ericsson.com/4adc87/assets/local/mobility-report/documents/2020/november-2020-ericsson-mobility-report.pdf [Accessed 28 January 2021].

Ofcom report. Electromagnetic Field (EMF) Measurements near 5G Mobile Phone Base Stations. Available online: https://www.ofcom.org.uk/__data/assets/pdf_file/0034/199717/statement-sut-modelling-700mhz-3.6-3.8ghz-spectrum.pdf [Last accessed on 24 February 2021].

Telstra report. 5 Surveys of 5G. In BioEM Conference Montpellier France 24-28 June 2019. http://1u0b5867gsn1ez16a1p2vcj1-wpengine.netdna-ssl.com/wp-content/uploads/2019/07/5-Surveys-of-5G-flyer-A4.pdf [Last accessed on 24 February 2021].

Thors B, Furuskär A, Colombi D, & Törnevik C. 2017. Time-averaged realistic maximum power levels for the assessment of radio frequency exposure for 5G radio base stations using massive MIMO. IEEE Access 5:19711–19719.

Wu T, Shao Q, Yang L, Qi D, Lin J, Lin X, Yu Z. 2013. A large-scale measurement of electromagnetic fields near GSM base stations in Guangxi, China for risk communication. Radiation Protection Dosimetry 155(1):25-31.

Figure legends

Figure 1: Temporal variation of exposure of 5G over 24 h measurement. Vertical axis is expressed in (V/m) and horizontal axis represents the date and the hours of the day. (Measurements taken with ExpoM-RF)

Figure 2: Contribution of 5G signal to total signal including other networks. Values correspond to the arithmetic means of the 24 h measurements. (Measurements taken with ExpoM-RF)

Figure 3: Schematic of the building and its roof. Left: the position of the 5G-NR antenna; right: the green dot represents the location of the antennas. The red numbers represent the positions where the measurements were performed on the roof with field meter NARDA NBM550, and its isotropic probe NARDA EF-0691 (see Table 7).

Figure 1:

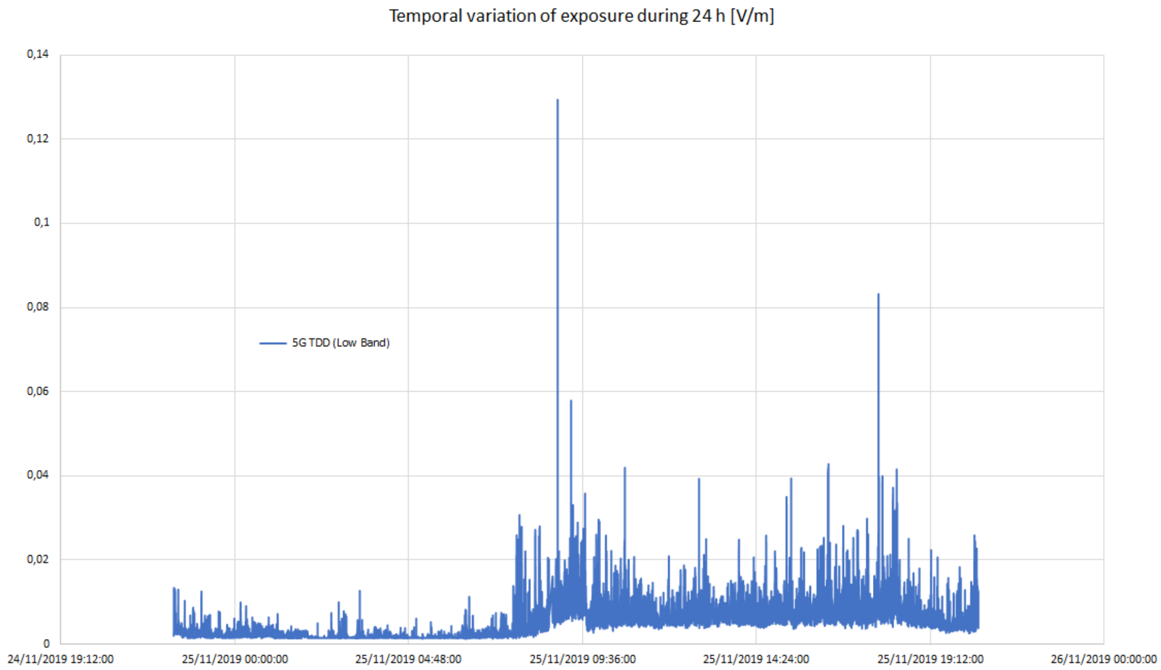

Figure 2:

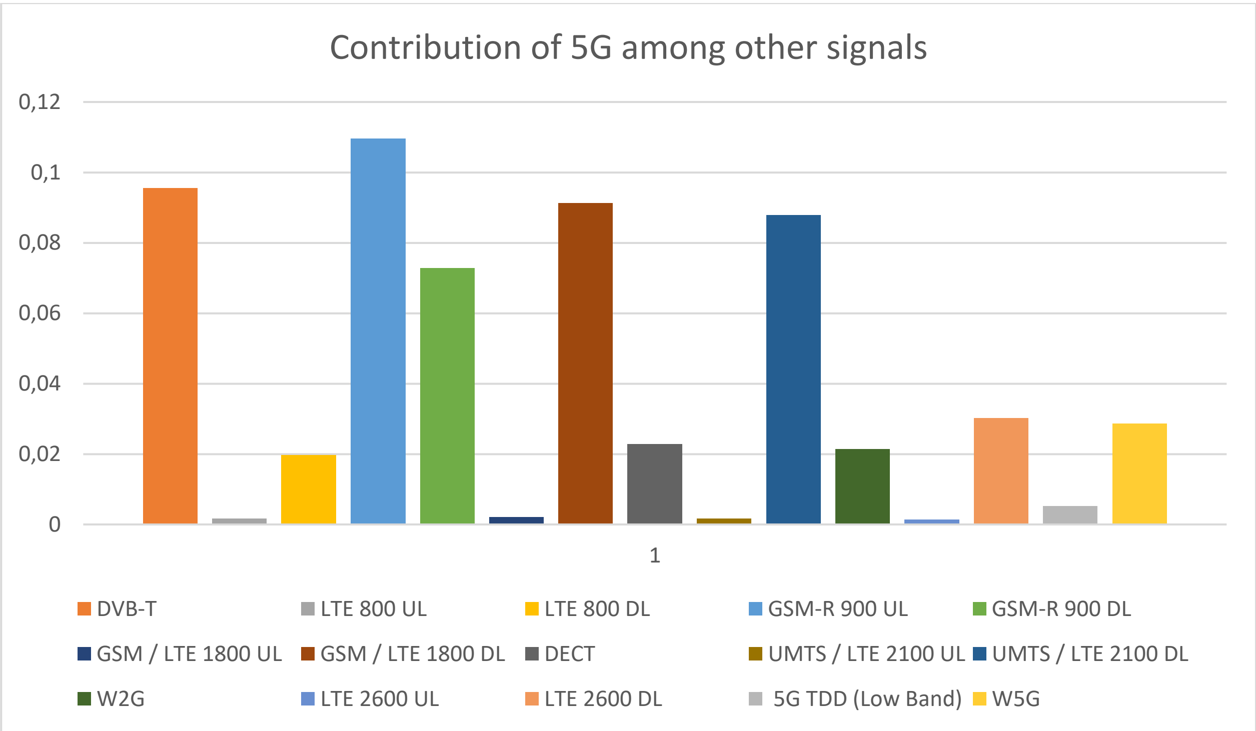

Figure 3:

Table 1. *Geographic repartition of base stations*

Region	Number of KT 5G base stations
All over the country	38999
Seoul	9878
Seoul metropolitan area (Incheon)	11716
Gangwon-do	1107
Chungcheong-do	3529
Jeolla *(Naju is a city in South Jeolla Province)*	3124
Gyeongsang-do	9241
Ile de Jeju	404

Table 2. *5G TDD low band measurements in different geographical areas. First line measurements were performed with the ExpoM-RF dosimeter (blue backwall) and second line measurements with the EME Spy 200 dosimeter (white backwall).*

Evaluation type	Total level for all the services [mV/m]	5G TDD (LB) Average level [mV/m]	5G TDD (LB) Maximum level [mV/m]	5G TDD (LB) SD [mV/m]
Dense Urban zone	1850	140	2140	160
	1740	70	2060	130
Rural zone	340	20	800	50
	120	20	90	2
Urban zone	470	20	260	30
	120	20	100	7
Close to 5G-NR base station	1040	560	2580	670
	300	50	2550	170
Railway line (Seoul – Naju)	370	20	730	30
	500	20	90	3
Urban trip	810	50	1550	60
	190	20	300	10
Extra urban trip	280	20	500	40
	120	20	90	4

SD: Standard deviation, LB: Low Band; Total level = Electromagnetic field quadratic sum of all the signals giving by the ExpoM or EME Spy 200

Table 3. *Electric field measurement for 5G TDD high band within different geographical areas (performed only with the EME Spy 200).*

Evaluation type	Total level for all the services [mV/m]	5G TDD (HB) Average level [mV/m]	5G TDD (HB) Maximum level [mV/m]	5G TDD (HB) SD [mV/m]
Rural zone	120	30	150	20
Urban zone	120	30	520	20
Close to 5G-NR base station	300	170	4090	550
Railway line (Seoul – Naju)	500	20	160	8
Urban trip	190	30	3440	60
Extra urban trip	120	30	350	20

HB: High band; Total level = Electromagnetic field quadratic sum of all the signals giving by the EME Spy 200

Table 4. *Temporal variability at a fixed-point exposure over 24 h for 5G TDD low band (EME Spy 200 and ExpoM-RF).*

Evaluation type	Equipment	Total level for all the services [mV/m]	5G TDD (LB) Average level [mV/m]	5G TDD (LB) Maximum level [mV/m]	5G TDD (LB) SD [mV/m]
At fixed point	ExpoM-RF	590	≤50	130	≤50
	EME Spy 200	340	≤50	≤50	≤50

Total level = Electromagnetic field quadratic sum of all the signals giving by the ExpoM or EME Spy 200

Table 5. *5G maximum level and 5G power channel measurements on the building roof at 15 m distance from where the 5G antenna was set. Power channel measurements were carried out with spectrum analyzer Rohde & Schwarz FSH8 and horn antenna Schwarzbeck BBHA9120D.*

Measurements	**Power Channel [mV/m] BW around 3.55 GHz**	
	BW 20 (20 MHz)	BW 100 (100 MHz)
RMS measurement around KT central frequency with a horn antenna	300	680
RMS measurement around KT central frequency with a horn antenna (max. hold mode)	590	1310
Power channel measurement around KT central frequency at 5G base station max. power	290	
Power channel measurement around KT central frequency at 5G base station initial power	170	

BW 20: Bandwidth 20 MHz; BW 100: Bandwidth 100 MHz. Power channel measurement consist of measuring total transmitted power in the channel of 20MHz – 100MHz width with center frequency at 3.55GHz in this case.

Table 6. *5G maximum level and 5G power channel measurements carried out in the main lobe of the 5G antenna beam, in the street at 150 m from the antenna. Measurements were carried out with spectrum analyzer Rohde & Schwarz FSH8 and horn antenna Schwarzbeck BBHA9120D.*

Measurement	**Power Channel BW around 3.55 GHz [mV/m]**	
	BW 20 (20MHz)	BW 100 (100 MHz)
RMS measurement around KT central frequency with a horn antenna	14	37
RMS measurement around KT central frequency with a horn antenna (max. hold mode)	17	73
Power channel measurement around KT central frequency at 5G base station max. power	15	

BW 20: Bandwidth 20 MHz; BW 100: Bandwidth 100 MHz. Power channel measurement consist of measuring total transmitted power in the channel of 20MHz – 100MHz width with center frequency at 3.55GHz in this case.

Table 7. *Wide band electric field with a 100 kHz-6 GHz field meter on the roof, close to the antenna (15 m). GPS coordinates: 35° 01'17.45''N/126° 47'37.50''E; At the corner of Hanbit Road and Bitgaram Road; Level R + 6; NAJU - SOUTH KOREA (See Figure 3).*

Measurement point	Level in the bandwidth 100 kHz – 6 GHz [V/m]	Comments
1 (15 m from the antenna)	12.1	KT base station initial power
1	21.0	KT base station max. power
2	8.8	KT base station max. power
3	3.8	KT base station max. power
4	4.7	KT base station max. power

Max power: the maximum power is the full power transfer that could be produced by the device and measured during transmitter ON period (in our case Max was obtained with the help of KT operator who put the system at his max)

Initial power: the power produced in normal traffic; it is time averaged value from the equipment under test using the averaging time specified in the applicable RF exposure limits (e.g. 6 minutes using ICNIRP)