

Measurement of exposure to radiofrequency radiation from 5G-NR telephony in South Korea

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Contents

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Objectives

Available data on 5G-NR technology in South Korea

- / General data of the 5G-NR network in South Korea
- / Coverage of the 5G-NR network in South Korea in November 2019

Exposure measurement for different services including 5G-NR

- / Geographic variability of exposure according to different typologies of environment
- / Geographic variability of exposure close to a 5G base station
- / Geographic variability of exposure on transport networks
- / Temporal variability of exposure at fixed point

Characterization of a 5G-NR base station

Questions?

Objectives

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Objectives

- / The Ministry of Ecological and Inclusive Transition commissioned INERIS a study aimed at characterizing the exposure of people to non-ionizing radiation from these new 5G-NR networks in a context where its commercial exploitation is already effective.
 - mid 2019, only 2 countries entered the commercial exploitation phase of these new networks: Australia (since July 2019) and South Korea (since April 2019). Note that in Europe, Switzerland already has the infrastructure to initiate the commercial deployment of this technology but without putting it into service.
 - On the basis of these elements, it was decided to characterize the exposure of people to 5G-NR in South Korea since it has the greatest maturity in terms: of users, of coverage, etc. It was decided to make this assessment in November 2019 with its 3 Millions 5G-NR subscribers.

Available data

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Available data on 5G-NR technology in South Korea

/ General data of the 5G-NR network in South Korea

– Operator bandwidth

Operator	Bandwidth used
LGU+	3420 -3500 (630666)
KT	3500 -3600 (636666)
SKT	3600 -3700 (643334)

– Base station manufacturer

Manufacturer	LGU+ (Bandwidth 80) Central frequency (3459,99 (630666))	KT (Bandwidth 100) Central frequency (3549,99 (636666))	SKT (Bandwidth 100) Central frequency (3650,01 (643334))
HUAWEI	-180 kHz (3459,81)		
SAMSUNG	-31,15 (3428,84)	-41.22 (3508,77)	-41.22 (3608,79)
NOKIA	-630 kHz (3459,36)	90 kHz (3550,08)	-570 kHz (3649,44)
ERICSSON LG		-41.22 (3508,77)	-41.22 (3649,92)

Available date

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Available data on 5G-NR technology in South Korea

/ On November 24th, 2019

– Geographic repartition of base station

Region	KT 5G base station number
All over the country	38999
Seoul	9878
Seoul metropolitan area (Incheon)	11716
Gangwon-do	1107
Chungcheong-do	3529
Jeolla	3124
Gyeongsang-do	9241
Ile de Jeju	404

– Manufacturer repartition of base station

Manufacturer	KT 5G base station number
SAMSUNG	31464
ERICSSON LG	4317
NOKIA	3218

Coverage of 5G-NR technology in South Korea

/ Information source

– Operator source

» LGU + : <http://www.uplus.co.kr/css/iner/RetrieveCoverMapNoneSSL.hpi>

» SKT : <http://www.sktcoverage.com/html/sub01.html>

» KT : <https://coverage.kt.com/coverage>

– Governmental source

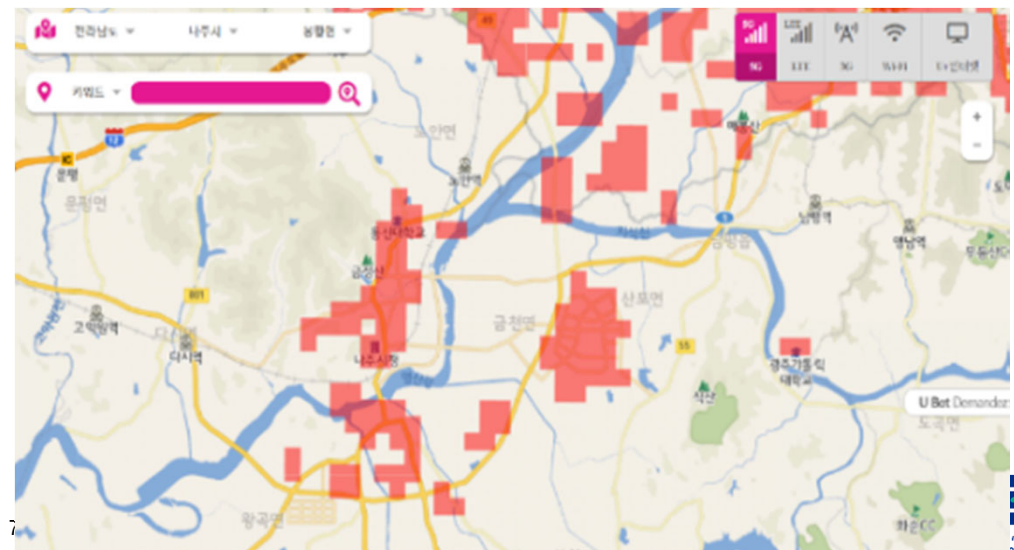
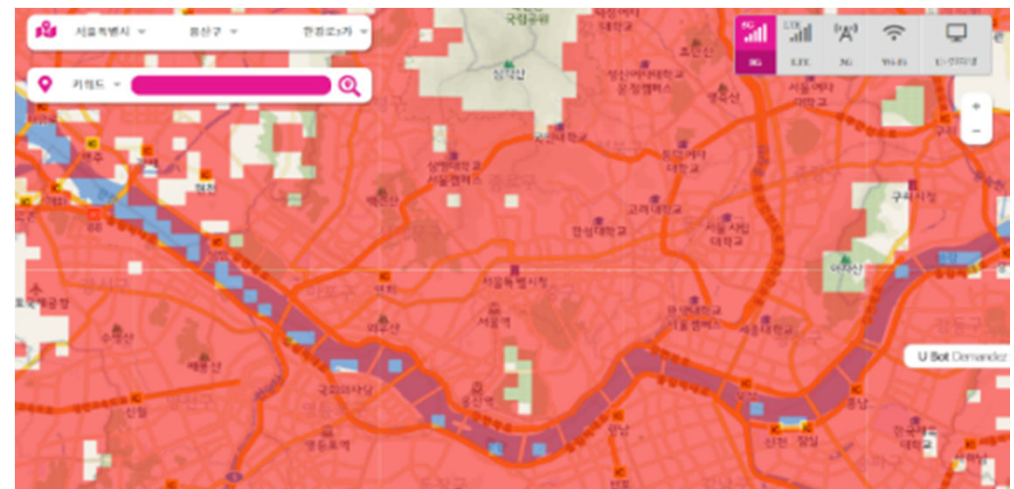
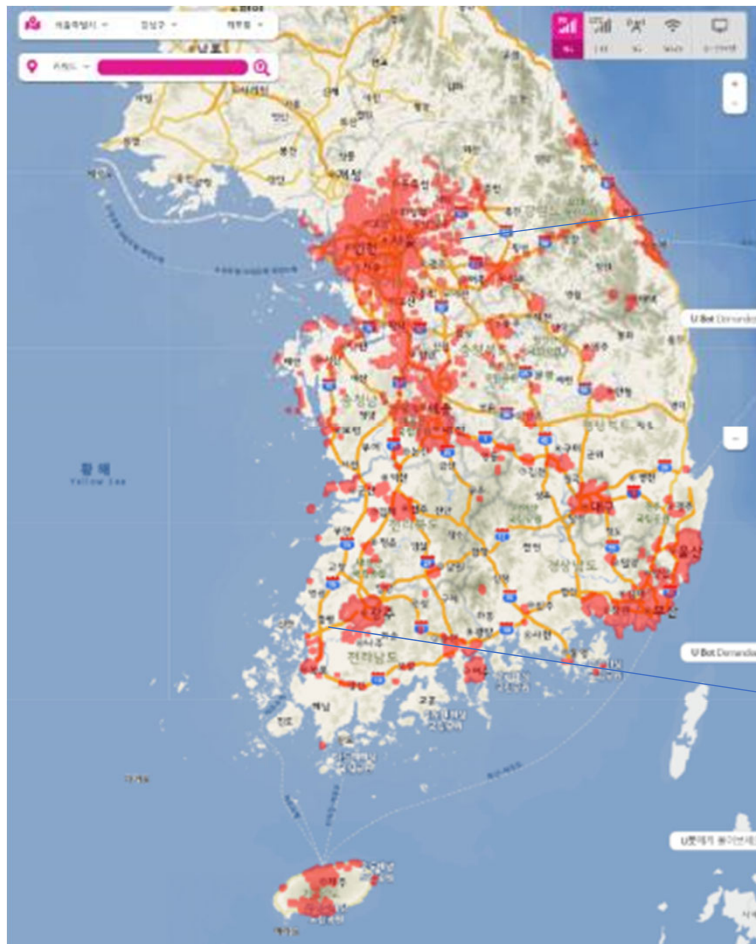
» www.spectrummap.kr

Available date

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Coverage of 5G-NR technology in South Korea

/ LGU+ coverage network on Seoul center and Naju (Old City and New City)

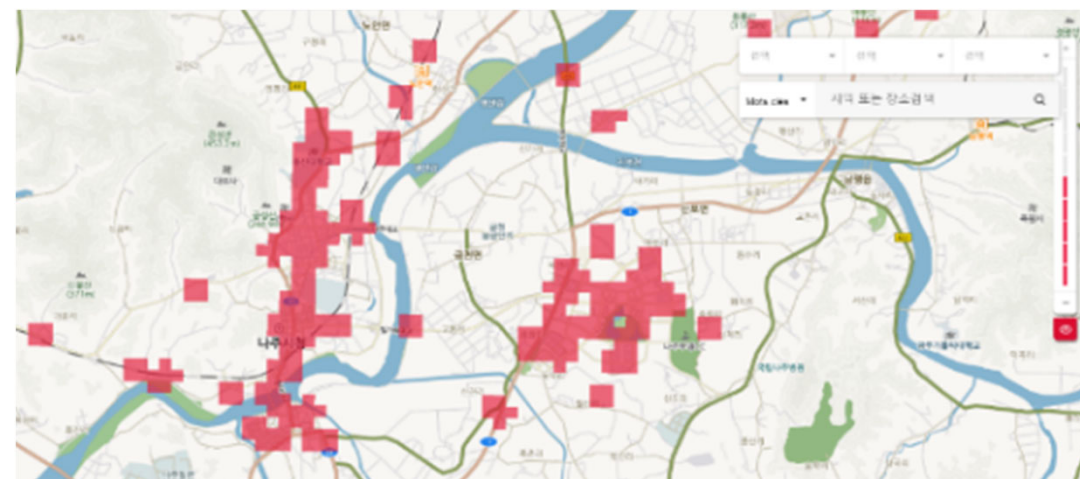
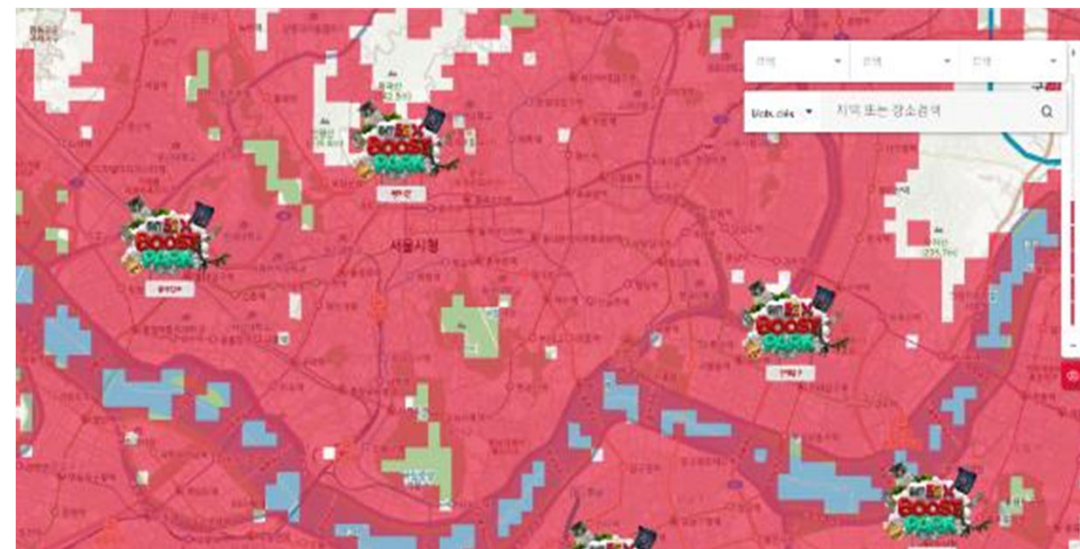
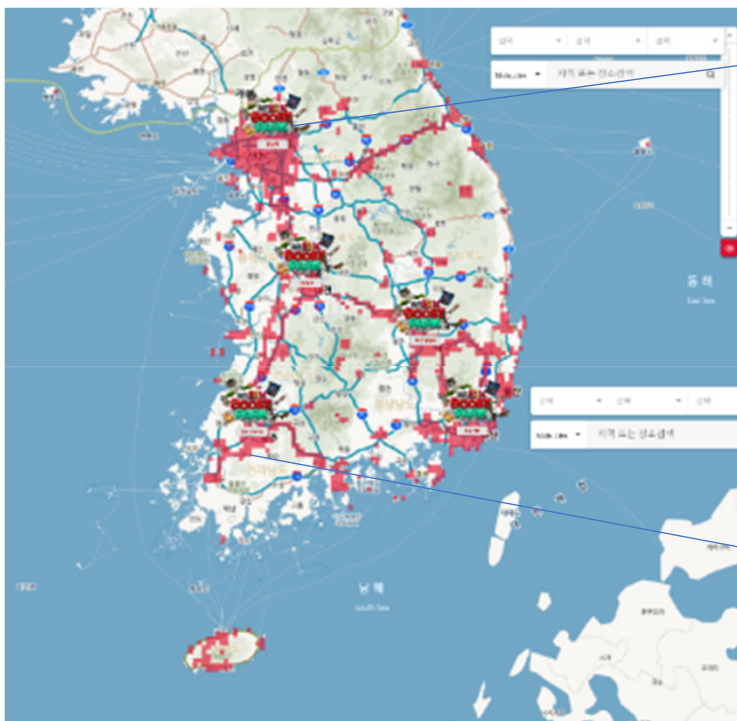


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Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Coverage of 5G-NR technology in South Korea

/ SKT coverage network on Seoul center and Naju (Old City and New City)

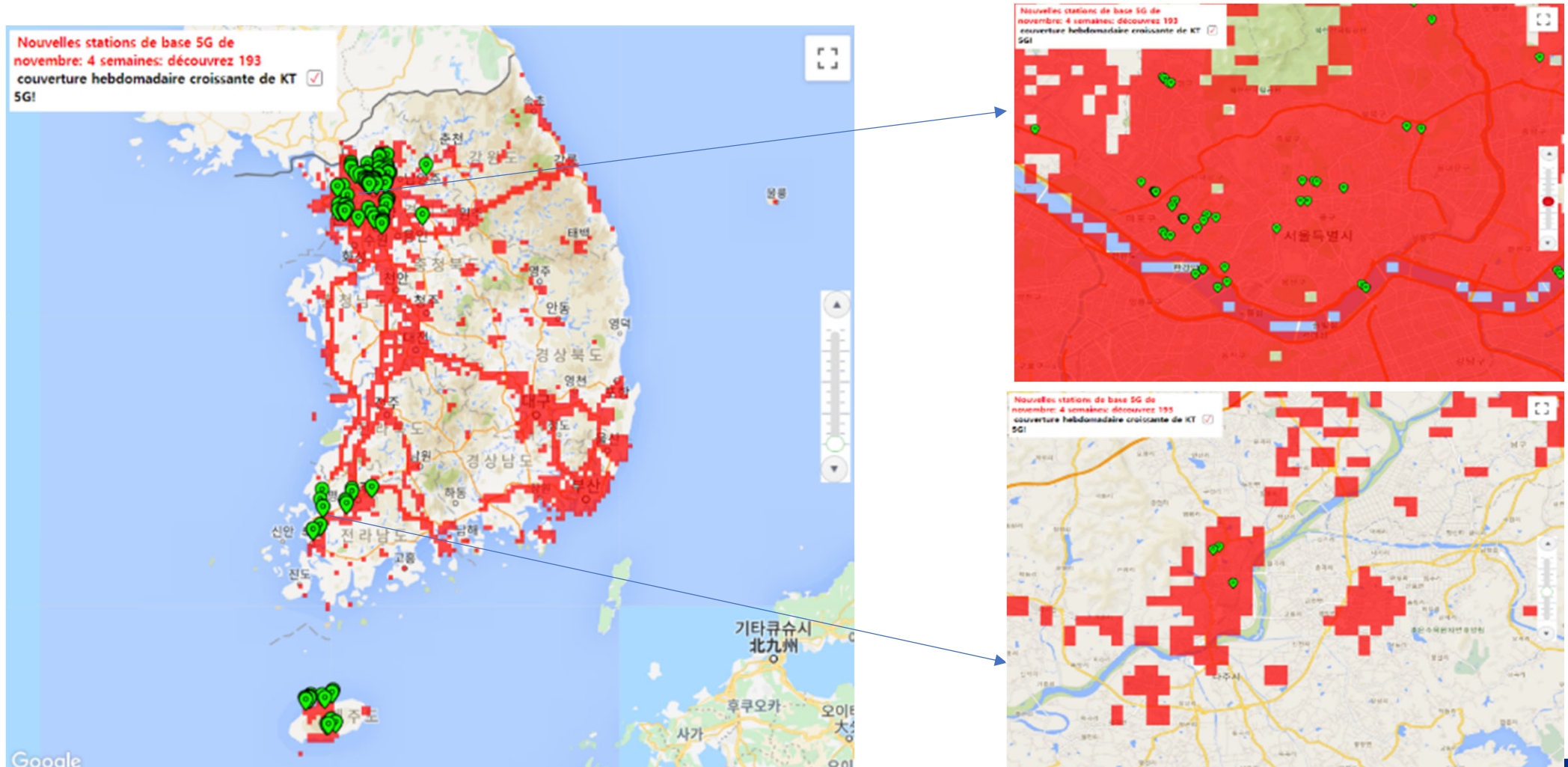


Available date

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Coverage of 5G-NR technology in South Korea

/ KT coverage network on Seoul center and Naju (Old City and New City)



Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Equipment used, and which services are measured

Designation	Exposimeter 88 - 5875		Exposimeter 88 – 6000	
Manufacturer / Model	Fields at Work / ExpoM-RF (MHz)		MVG / EME SPY 200 (MHz)	
Setup for measured service	FM	87.5 - 108	FM US	88 - 108
			VHF TV	174 - 223
			TETRA1	380 - 400
	DVB-T	470 - 790	TV45	470 - 615
	LTE 800 U L	791 - 821	LTE 700 UL	703-748
	LTE 800 D L	832 - 862	LTE 700 DL	758 - 803
	GSM -R 900 U L	880 - 915	GSM -R 900 U L	880 - 915
	GSM -R 900 D L	925 - 960	GSM -R 900 D L	925 - 960
	GSM / LTE 1800 UL	1710 - 1785	GSM / LTE 1800 UL	1710 - 1785
	GSM / LTE 1800 DL	1805 - 1880	GSM / LTE 1800 DL	1805 - 1880
	DECT	1880 - 1900	DECT	1880 - 1900
	UMTS / LTE 2100 UL	1920 - 1980	UMTS / LTE 2100 UL	1920 - 1980
	UMTS / LTE 2100 DL	2110 - 2170	UMTS / LTE 2100 DL	2110 - 2170
			4G TDD	2300 - 2400
	W2G	2400 - 2483	W2G	2400 - 2483
	LTE 2600 UL	2500 - 2570	LTE 2600 UL	2500 - 2570
	LTE 2600 DL	2620 - 2690	LTE 2600 DL	2620 - 2690
	5G TDD (Low Band)	2400 - 2600	5G TDD (Low	2400 - 2600

Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Different types of environnement measured

- / Dense urban residential area - Seoul,
- / Dense urban trade area - Seoul,
- / Dense urban commercial area - Seoul.

- / Urban trip - Seoul,
- / Extra urban trip - Seoul to Incheon,
- / Railways trip – Seoul to Naju

- / 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 trade area - New city of Naju,
- / Urban commercial area - New city of Naju,



Exposure measurement

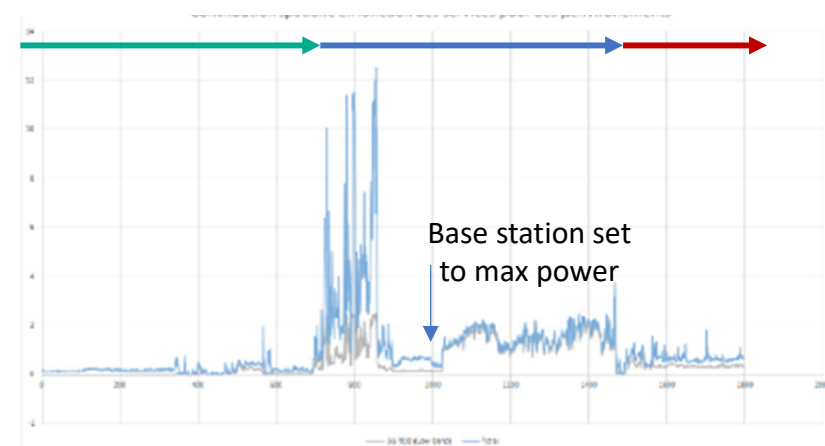
Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Three significative levels measured –
1st : Close to 5G-NR Base station

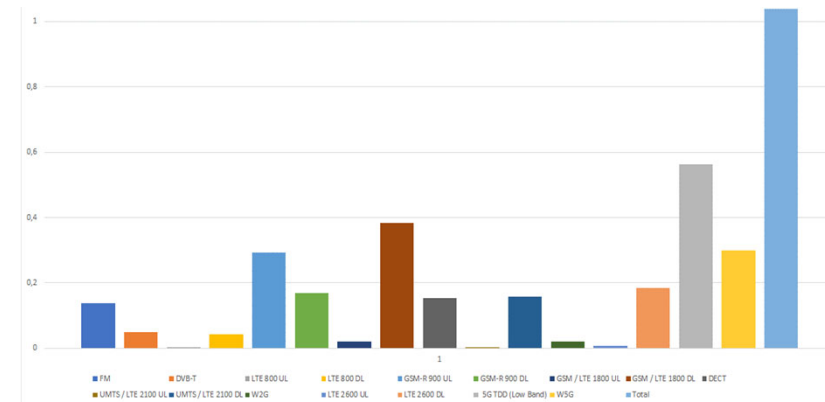
- / On the roof of building – Naju new city ,
- / In the main beam – Naju new city,
- / Building close to it (NRRA) – Naju new city.



ExpoM-RF results
Global level versus 5G TDD Low band [V/m]

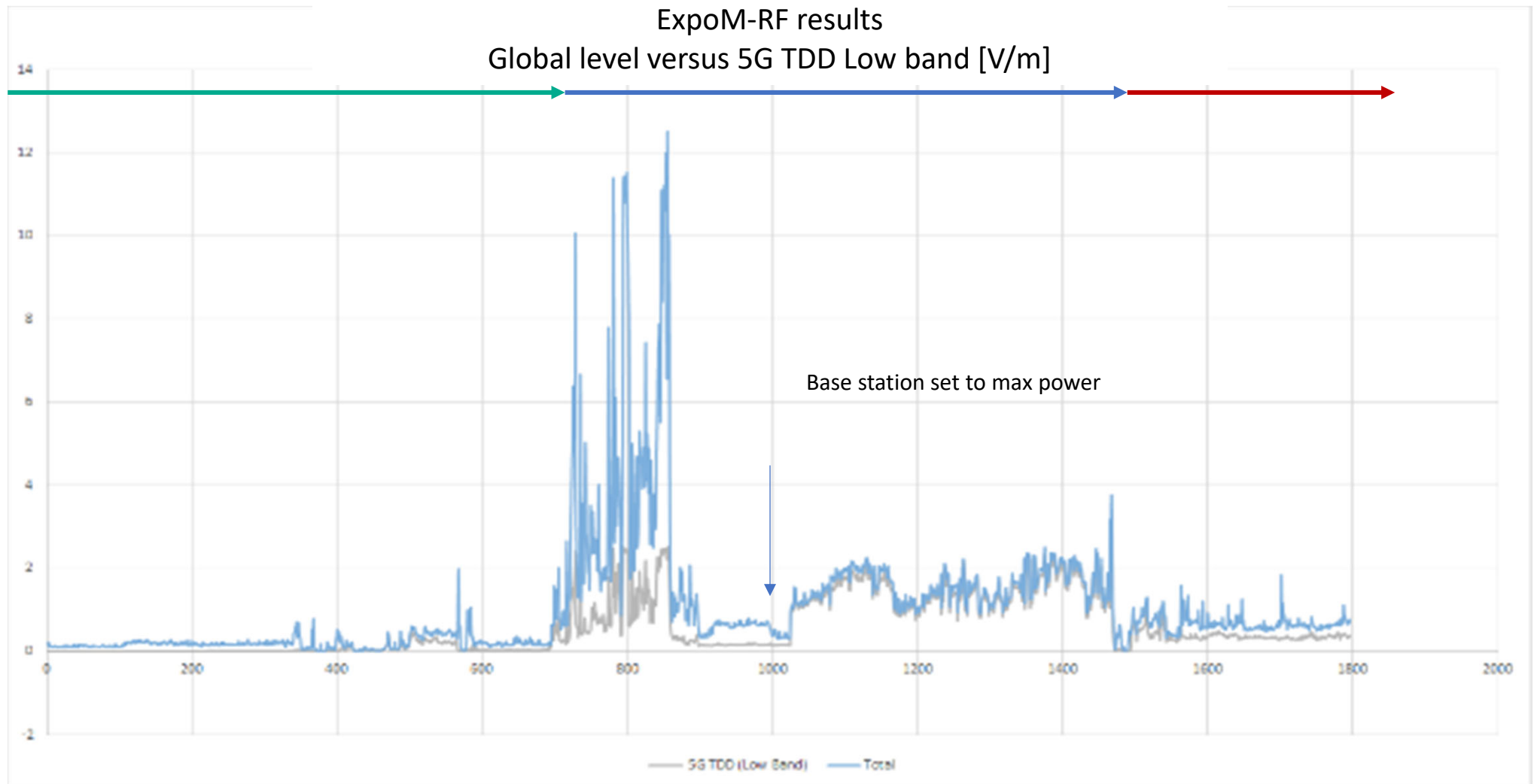


ExpoM-RF results
Global level versus other services [V/m]



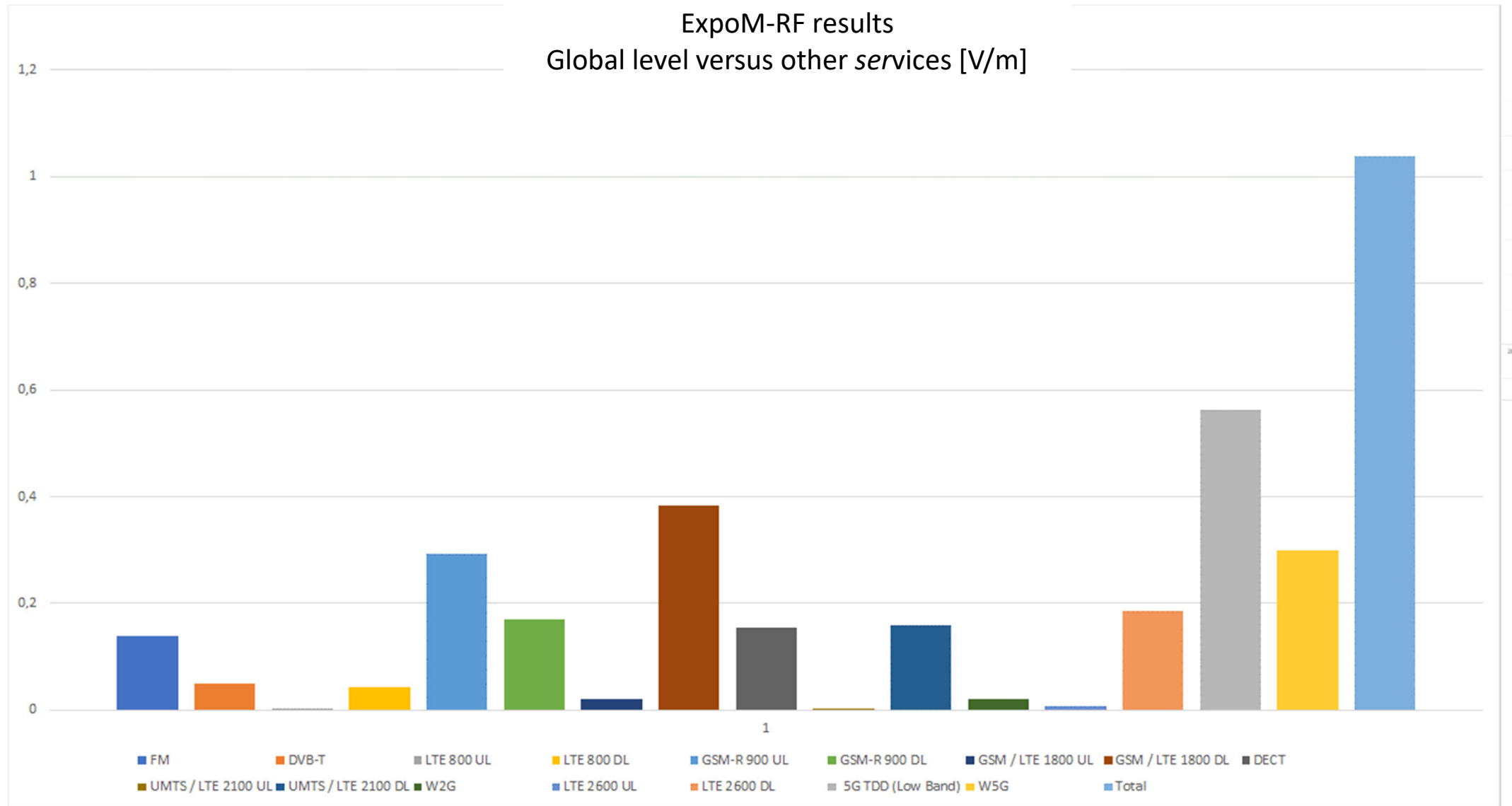
Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019



Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

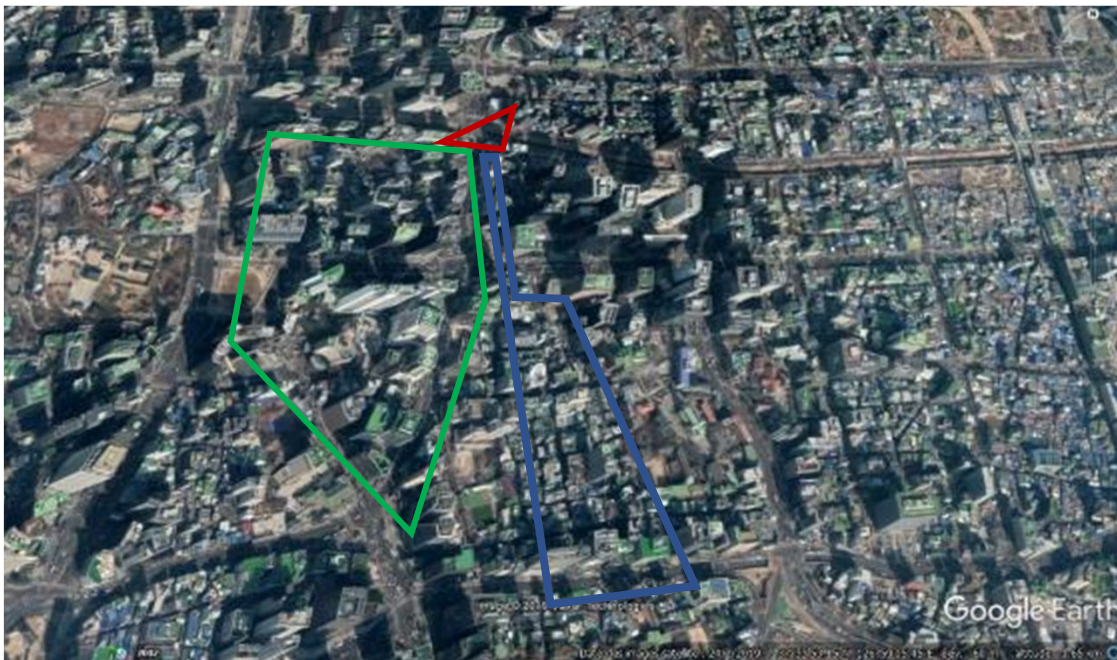


Exposure measurement

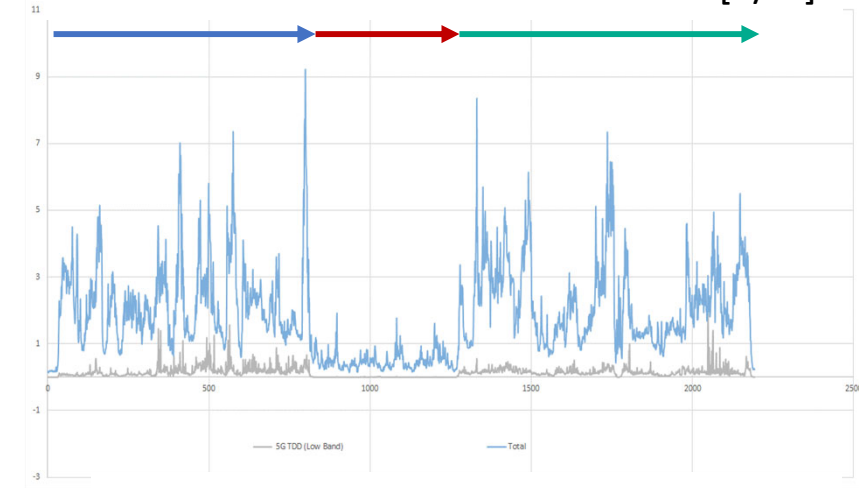
Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Three significative levels measured – 2nd : Seoul center

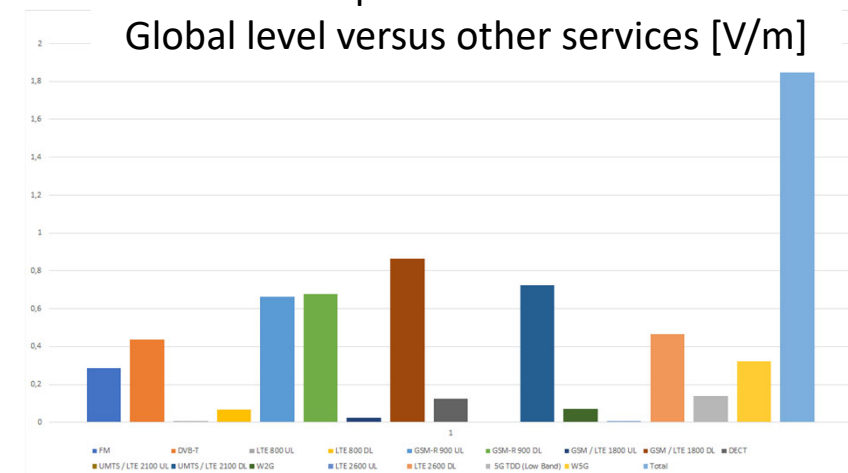
- / Dense urban commercial area - Seoul,
- / Dense urban commercial area (underground) - Seoul,
- / Dense urban trade area - Seoul.



ExpoM-RF results
Global level versus 5G TDD Low band [V/m]



ExpoM-RF results
Global level versus other services [V/m]



Exposure measurement

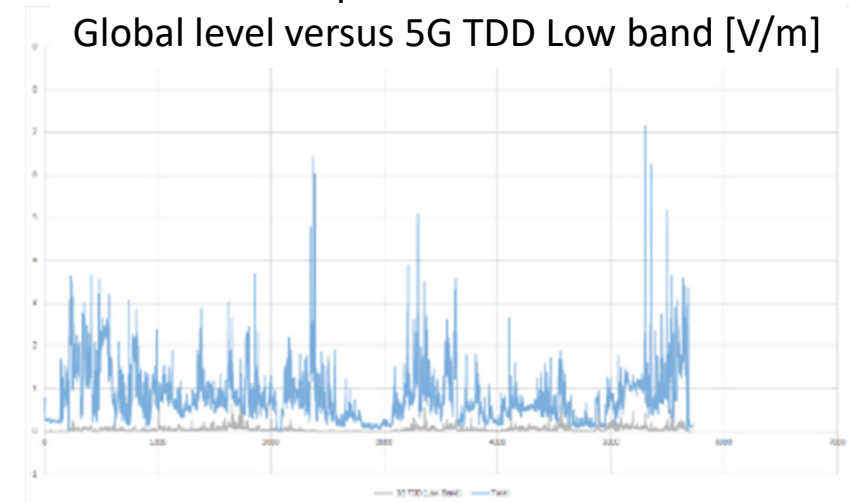
Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Three significative levels measured – 3rd : Seoul trip

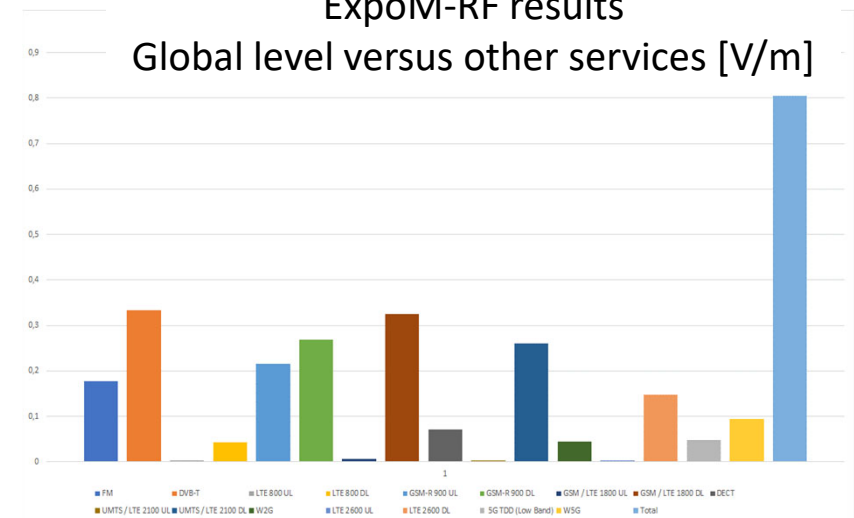
/ Dense urban area (underground) – Seoul trip,



ExpoM-RF results
Global level versus 5G TDD Low band [V/m]



ExpoM-RF results
Global level versus other services [V/m]



Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Summary of geographic measurements

/ For 5G TDD low band (EME Spy 200 and ExpoM-RF)

Evaluation type	Global level for all the services [mV/m]	5G TDD (Low Band) Average level [mV/m]	5G TDD (Low Band) Maximum level [mV/m]	5G TDD (Low Band) Standard deviation [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
Railways 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

Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Summary of geographic measurements

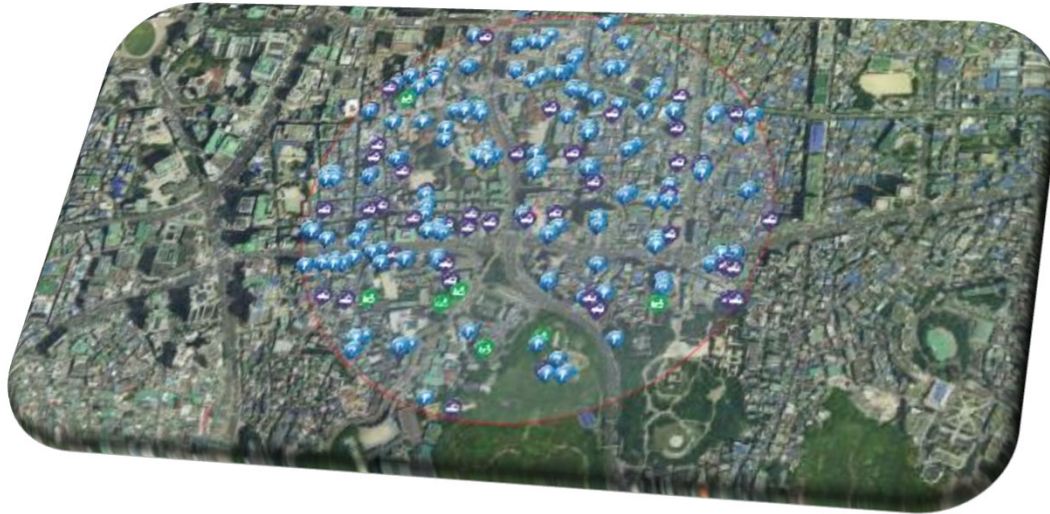
/ For 5G TDD high band (EME Spy 200),

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

Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

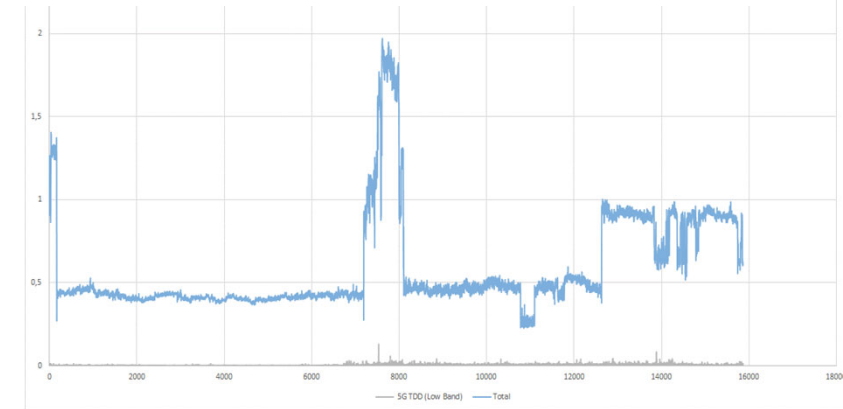
Temporal variability at fixed point exposure during 24 h



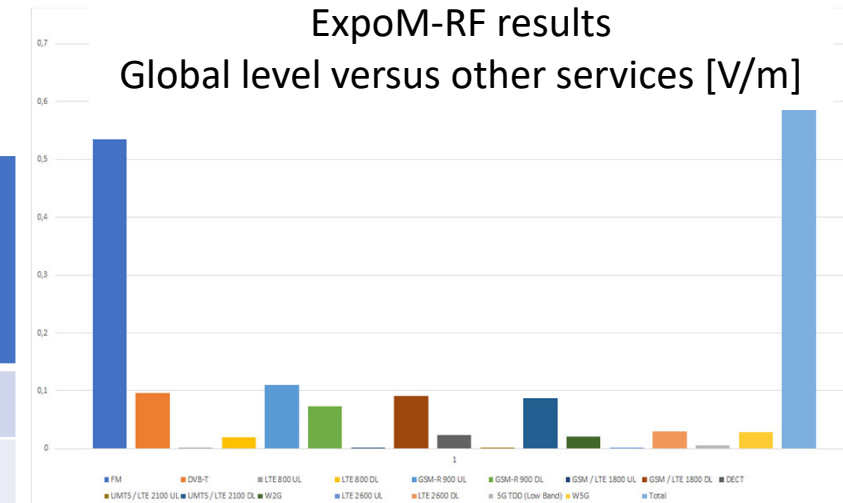
/ For 5G TDD low band (EME Spy 200 and ExpoM-RF)

Evaluation type	Global level for all the services [mV/m]	5G TDD (Low Band) Average level [mV/m]	5G TDD (Low Band) Maximum level [mV/m]	5G TDD (Low Band) Stand dev [mV/m]
At fixed point	590	5	130	4
	340	≤20	≤20	0,0

ExpoM-RF results
Global level versus 5G TDD Low band [V/m]



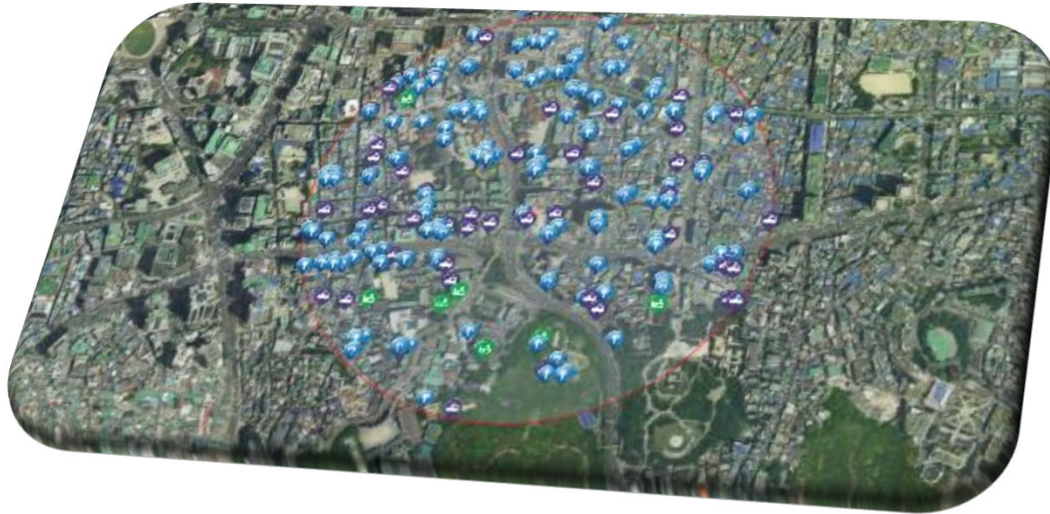
ExpoM-RF results
Global level versus other services [V/m]



Exposure measurement

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

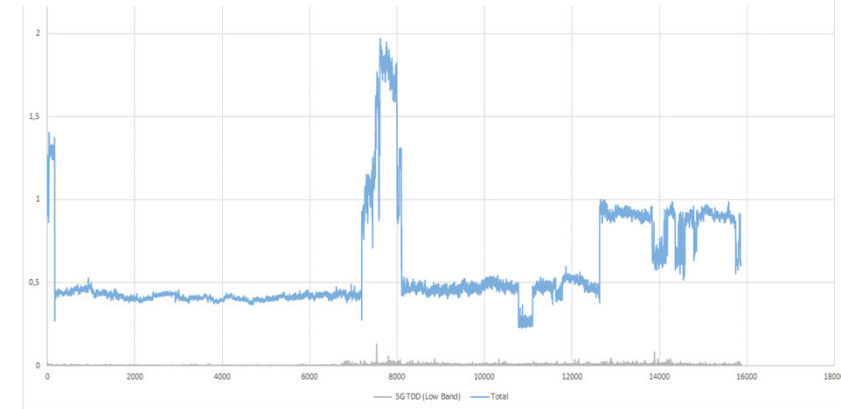
Temporal variability at fixed point exposure during 24 h



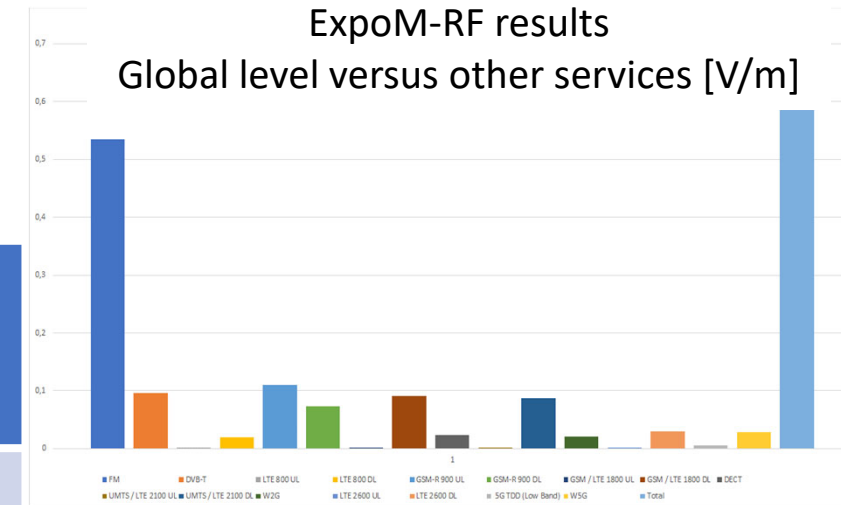
/ For 5G TDD high band (EME Spy 200)

Evaluation type	Global level for all the services [mV/m]	5G TDD (High Band) Average level [mV/m]	5G TDD (High Band) Maximum level [mV/m]	5G TDD (High Band) Stand dev [mV/m]
A point fixe urbain dense	340	≤20	≤20	0,0

ExpoM-RF results
Global level versus 5G TDD Low band [V/m]



ExpoM-RF results
Global level versus other services [V/m]



Characterization of a 5G-NR base station

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

Wide band level with a 100 kHz – 6 GHz fieldmeter

/ 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



Measurement point	Level [V/m] in the bandwidth 100 kHz – 6GHz	Comments
1 (at 15m far 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

Characterization of a 5G-NR base station

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

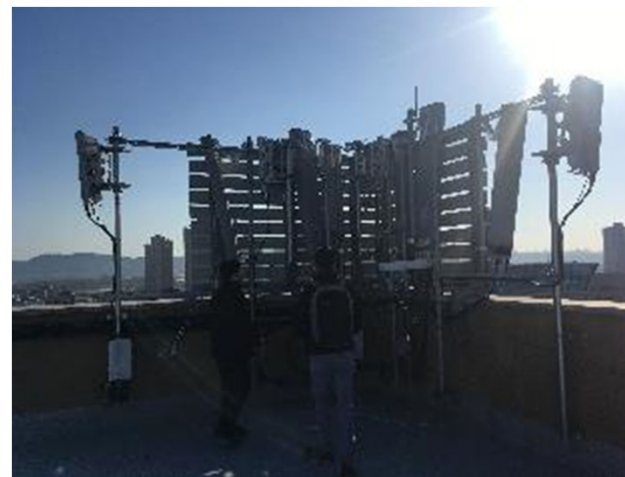
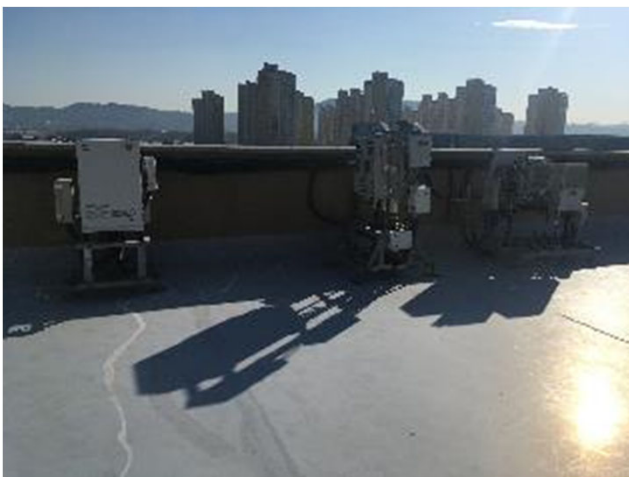
Spatial variability and services measurement

/ Spatial variability at max point, for a 100 kHz – 6 GHz bandwidth:

- at 1,70 m, $E = 20,9 \text{ V/m}$
- at 1,50 m, $E = 21,0 \text{ V/m}$
- at 1,10 m, $E = 21,0 \text{ V/m}$

/ Services measurement at max point, above 300 mV/m

- Mobile 1,8 GHz DL $E = 330 \text{ mV/m}$
- Mobile 5 GHz TDD $E = 1470 \text{ mV/m}$
- WiFi 5 G $E = 360 \text{ mV/m}$

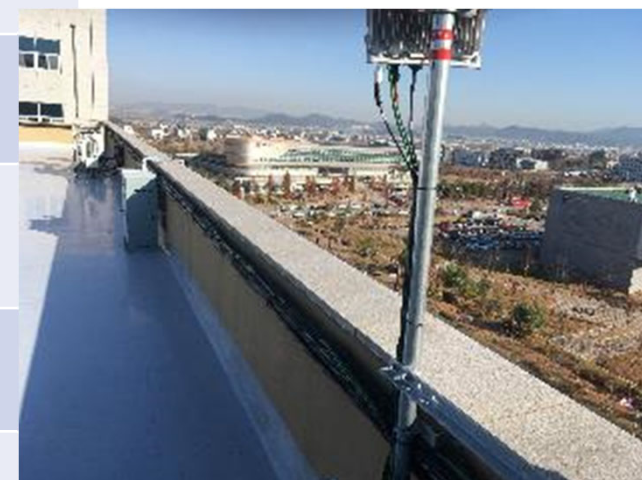


Characterization of a 5G-NR base station

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

5G Max level and 5G Power channel measurement

Measurement	Max level measured (mV/m)	Power Channel (mV/m) BW around 3,55GHz	
		BW 20	BW 100
On the roof at 15m far from the 5G antenna			
RMS measurement around KT central frequency with an horn antenna	47	300	680
RMS measurement around KT central frequency with an horn antenna (Max hold mode)	51	590	1310
RMS measurement around KT central frequency with an isotropic antenna	63	290	850
RMS measurement around KT central frequency with an isotropic antenna (Max hold mode)	85	650	1160
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	



Characterization of a 5G-NR base station

Measurement of exposure to radio frequency radiation from 5G-NR telephony in South Korea 11-2019

5G Max level and 5G Power channel measurement

Measurement	Max level measured (mV/m)	Power Channel (mV/m) BW aaround 3,55GHz	
		BW 20	BW 100
In the main lobe of the 5G antenna, in the street at 150m from the 5G antenna			
RMS measurement around KT central frequency with an horn antenna	2,2	14	37
RMS measurement around KT central frequency with an horn antenna (Max hold mode)	3,2	17	73
RMS measurement around KT central frequency with an isotropic antenna	0,8	4,6	9,8
RMS measurement around KT central frequency with an isotropic antenna (Max hold mode)	0,9	8,3	18
Power channel measurement around KT central frequency at 5G base station max power		15	





Questions?