



AKOS

4G mobile coverages and drive tests

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- Questions and discussion?



Agency for communication networks and services of the Republic of Slovenia - AKOS

Agency for Communication Networks and Services of the Republic of Slovenia is an independent body that:

- regulates and supervises the electronic communications market,
- manages and supervises the radio frequency spectrum in the Republic of Slovenia,
- performs tasks in the field of radio and television broadcasting,
- regulates and supervises the postal and railway service markets.

The Agency's mission is:

- to promote competition,
- to ensure equal conditions for the operation of electronic communication network operators and service providers, as well as providers of postal and railway services,
- to manage the radio frequency spectrum and numbering space,
- to monitor radio and television programming content,
- to protect consumer rights in the Republic of Slovenia as well as the European Union.

The fourth-generation mobile technology (4G) which enables high download speeds and, as a result, ensures a sufficiently high-quality internet connection, even when there is no other connection to the internet, was introduced in Slovenia in **2014**.

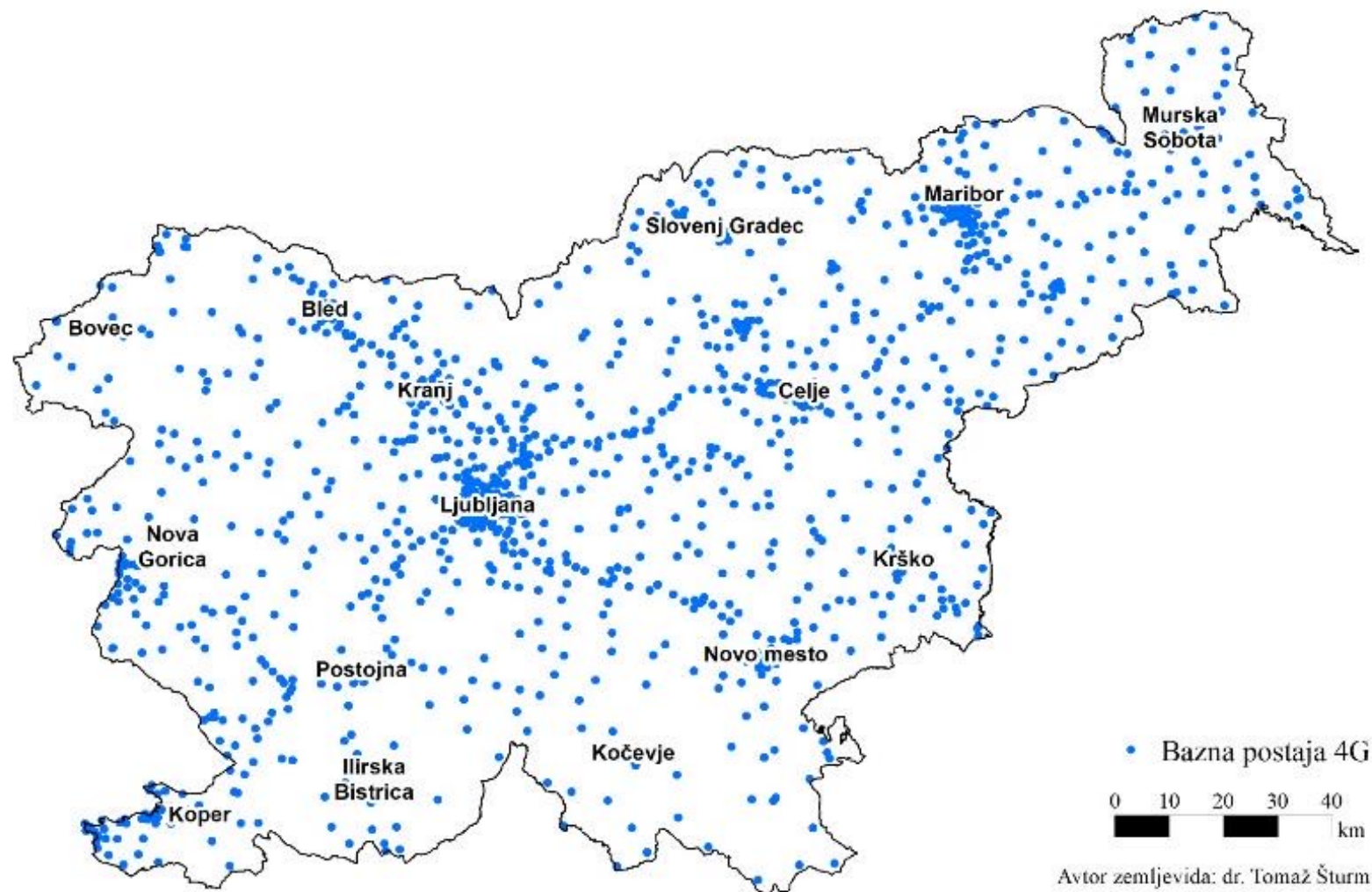
The mobile operators (A1, T2, Telemach Slovenija, Telekom Slovenija) acquired the necessary spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz and 2600 MHz radio frequency bands to provide 4G mobile access services. The conditions of use and the operators' commitments are set out in the Decision on the assignment of radio frequencies (DARFs).

Mobile operators are setting up base stations not only in urban centers, but also in rural areas, in an effort to cover as much of the country as possible and to provide residents and visitors with sufficiently fast and reliable internet access at all times. Mobile operator T2 is not covering the whole country with its own mobile network and it was not included in further analysis.



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Base stations 4G



Avtor zemljevida: dr. Tomaž Šturm

Vir: AKOS, GURS

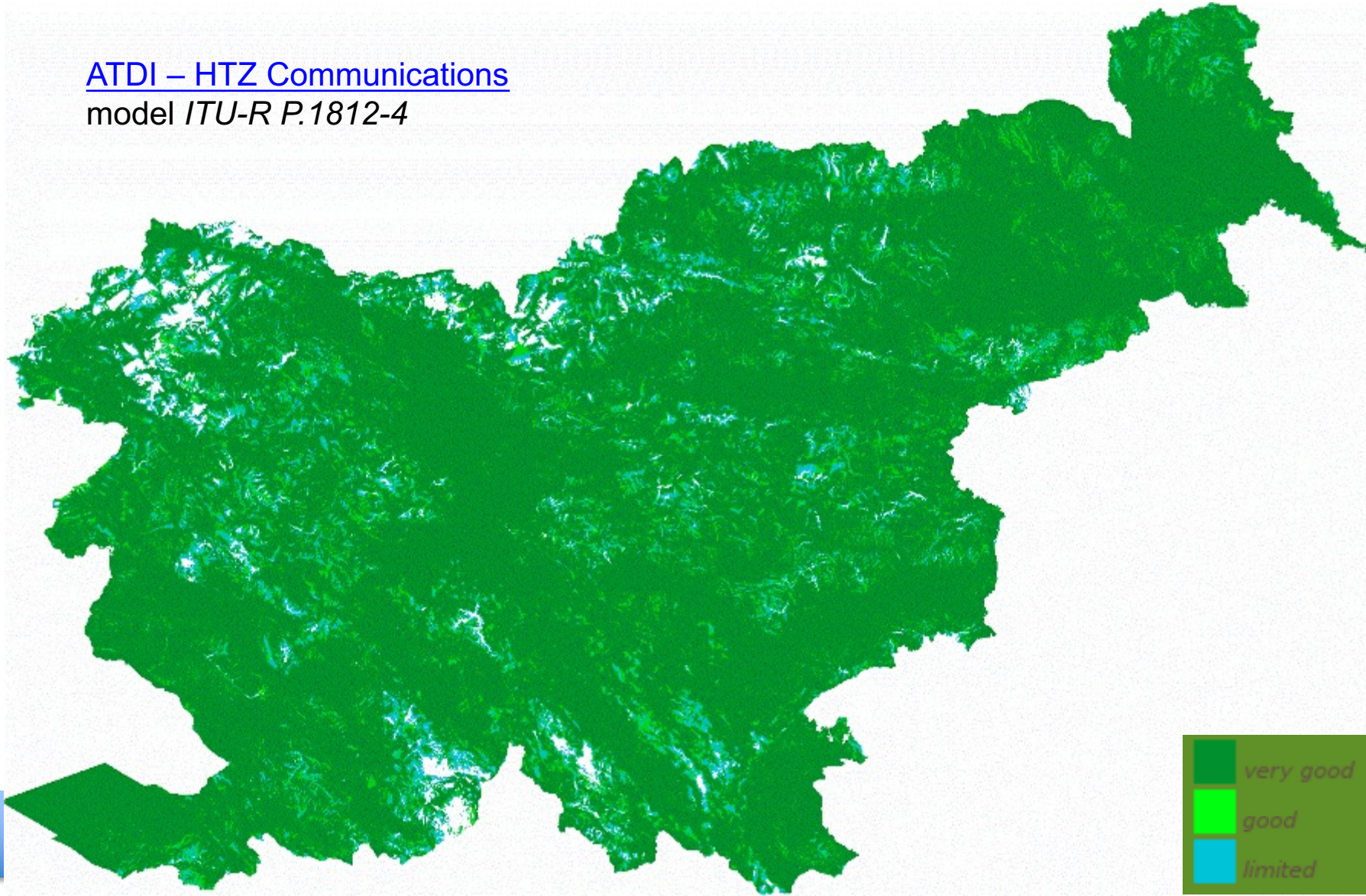
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Mobile coverage 4G

[ATDI – HTZ Communications](#)
model *ITU-R P.1812-4*



Mobile coverages 4G are made for each mobile operator using base station data. The mobile signal coverage quality is divided into three classes (very good, good and limited) according to signal strength. There are also areas on each map where the theoretical 4G mobile coverage shows there is no signal.

Shares of mobile coverages by signal strength by operators (%)

Signal strength	operator 1	operator 2	operator 3
Very good	68	80	72
Good	13	11	12
Limited	10	6	9
No signal	9	3	7

The operators covers with a very good signal more than 68% of Slovenian territory. Taking very good and good signal together, more than 80% of the total Slovenian territory is covered by each operator.

Agency is responsible for verifying compliance with the conditions of the decision on the assignment of radio frequency (DARFs).

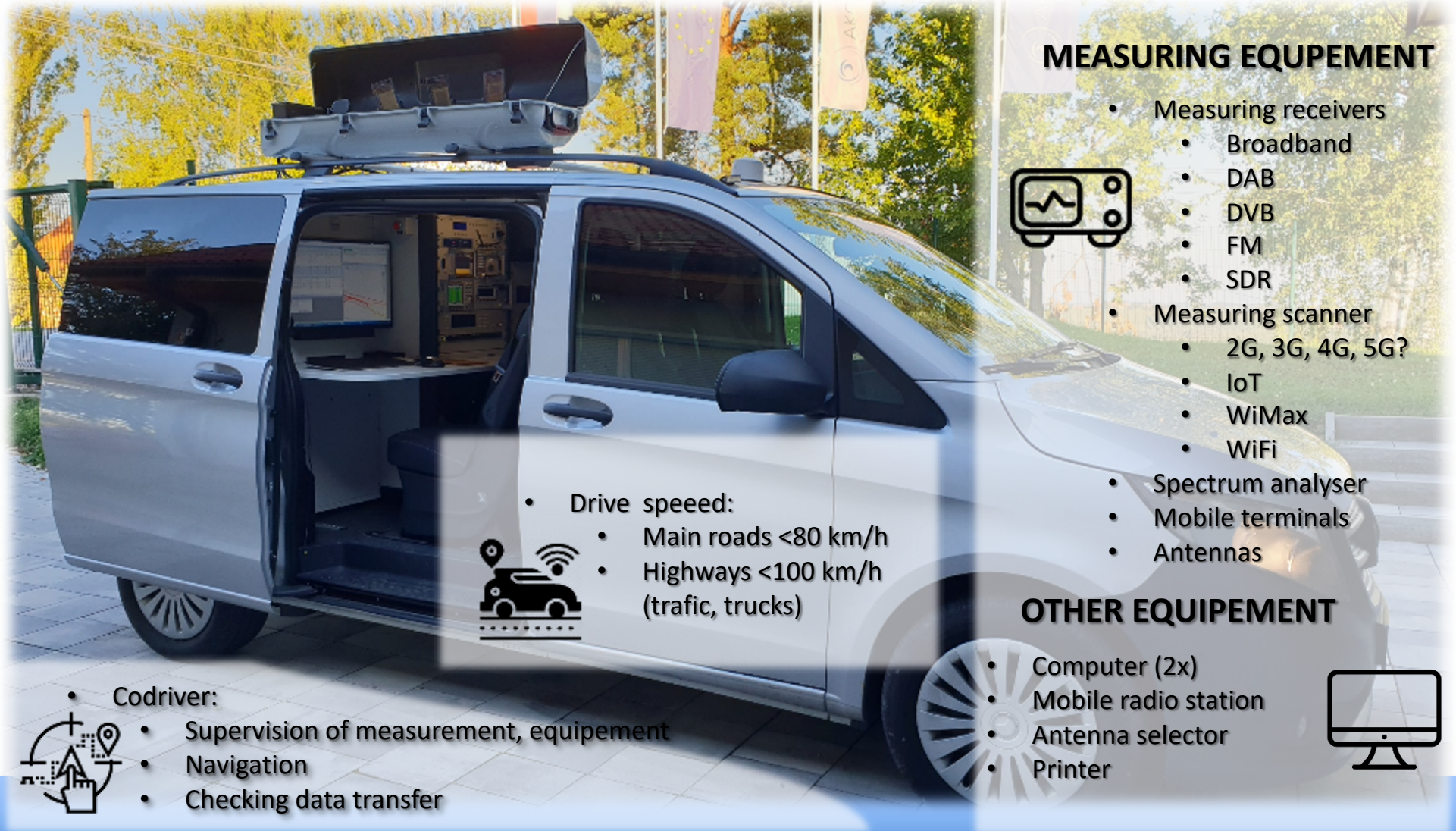
The 2020 measurement campaign included measurements of 3G and 4G mobile signals.

The reason for the measurement campaign was 4G, as the period during which operators had to meet certain conditions they had acquired when awarding frequency bands for 4G technologies had expired.



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Measuring vehicle – Mercedes Vito 4x4



MEASURING EQUIPEMENT

- Measuring receivers
 - Broadband
 - DAB
 - DVB
 - FM
 - SDR
- Measuring scanner
 - 2G, 3G, 4G, 5G?
 - IoT
 - WiMax
 - WiFi
- Spectrum analyser
- Mobile terminals
- Antennas



- Drive speed:
 - Main roads <80 km/h
 - Highways <100 km/h (traffic, trucks)



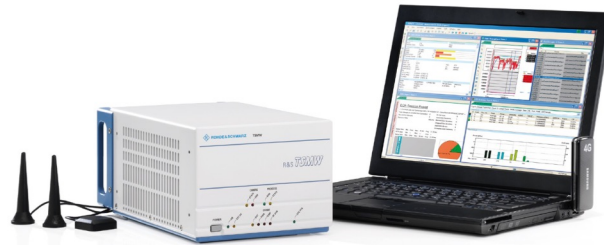
- Codriver:
 - Supervision of measurement, equipment
 - Navigation
 - Checking data transfer



OTHER EQUIPEMENT

- Computer (2x)
- Mobile radio station
- Antenna selector
- Printer





- R&S TSMW
- R&S ROMES 19.03
- PcTel BMLPVMB-LTE

- Technical parameters
- Verification of operators lists
- RSRP / RSCP values
 - Mobile coverage maps
- Base stations Cell ID
 - Number of cells / BTS

MOBILE TERMINALS

SONY XPEIRA XZ Premium



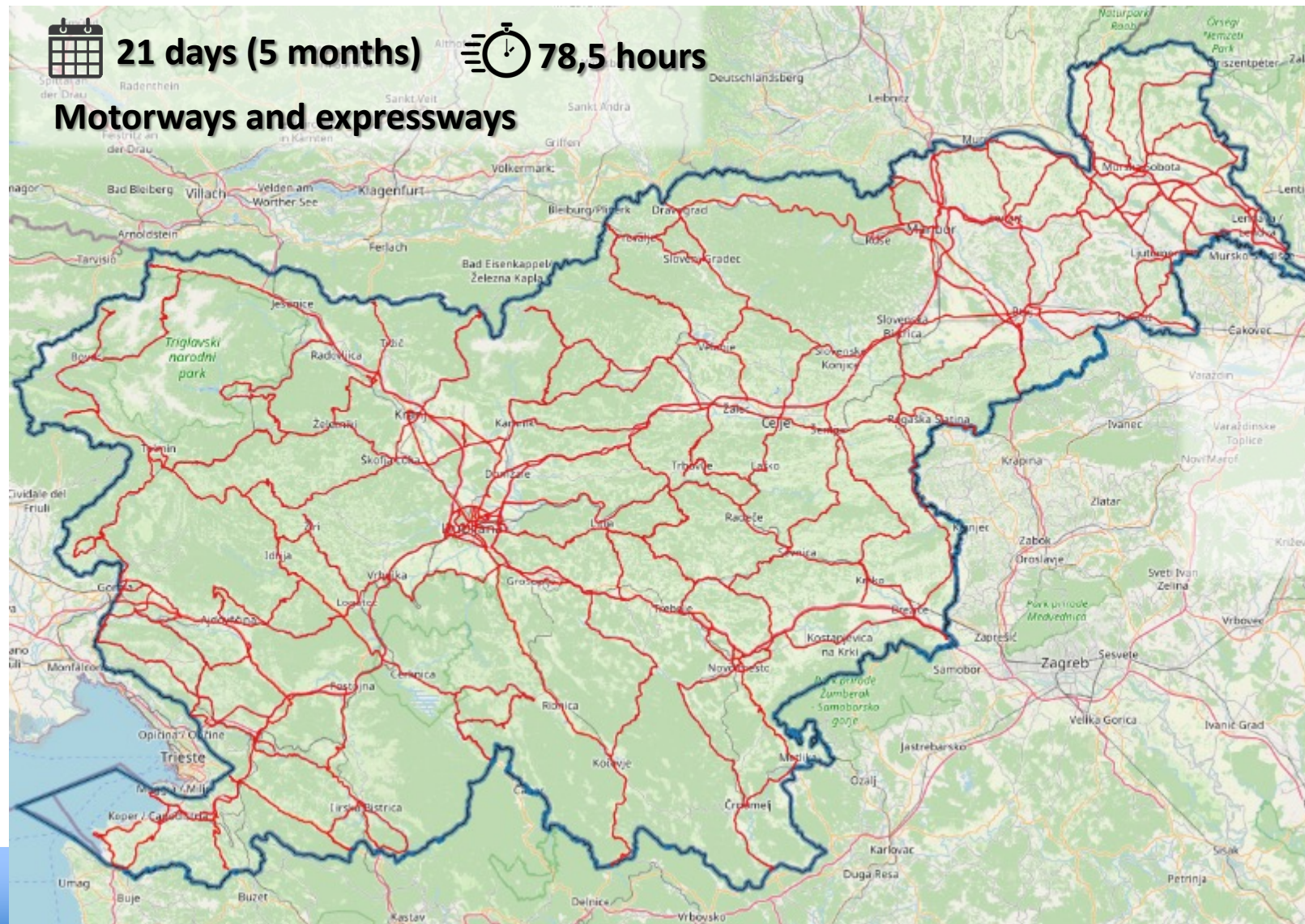
LTE cat. 16 - 2CA
R&S QualiPoc v.19.3

- User experience
- Auto Dial
- Connection time
 - Successful / unsuccessful calls / data
- Average / maximum speeds
 - FTP DownLink / UpLink
 - Ping



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Measurement campaign 2020



9860 km

4200 km



16,57 GB / 42 files

1.733.868 measured locations

Quality of Experience (QoE) assessment of mobile networks is of big importance to ensure a high quality user experience on the network.

The user experience itself is difficult to measure, but to a large extent, the most important factor for users is how quickly we get the information we want, i.e. how long it takes from the moment we request the information to the moment we have it on our device.

There are many different factors and network parameters that affect data rates, but the easiest and most accurate way to measure data rates is to measure the level of reference signals received by each base station.

Through measurements have been determined three classes, based on the Reference Signal Received Power (RSRP), dBm (decibels per miliwatt):

- Very good: high transmission speeds are expected in both directions, both inside and outside the premises,
- Good: high transmission speeds are also expected in both directions, but outside the facilities,
- Limited: satisfactory transmission speeds are expected in the direction of the user.



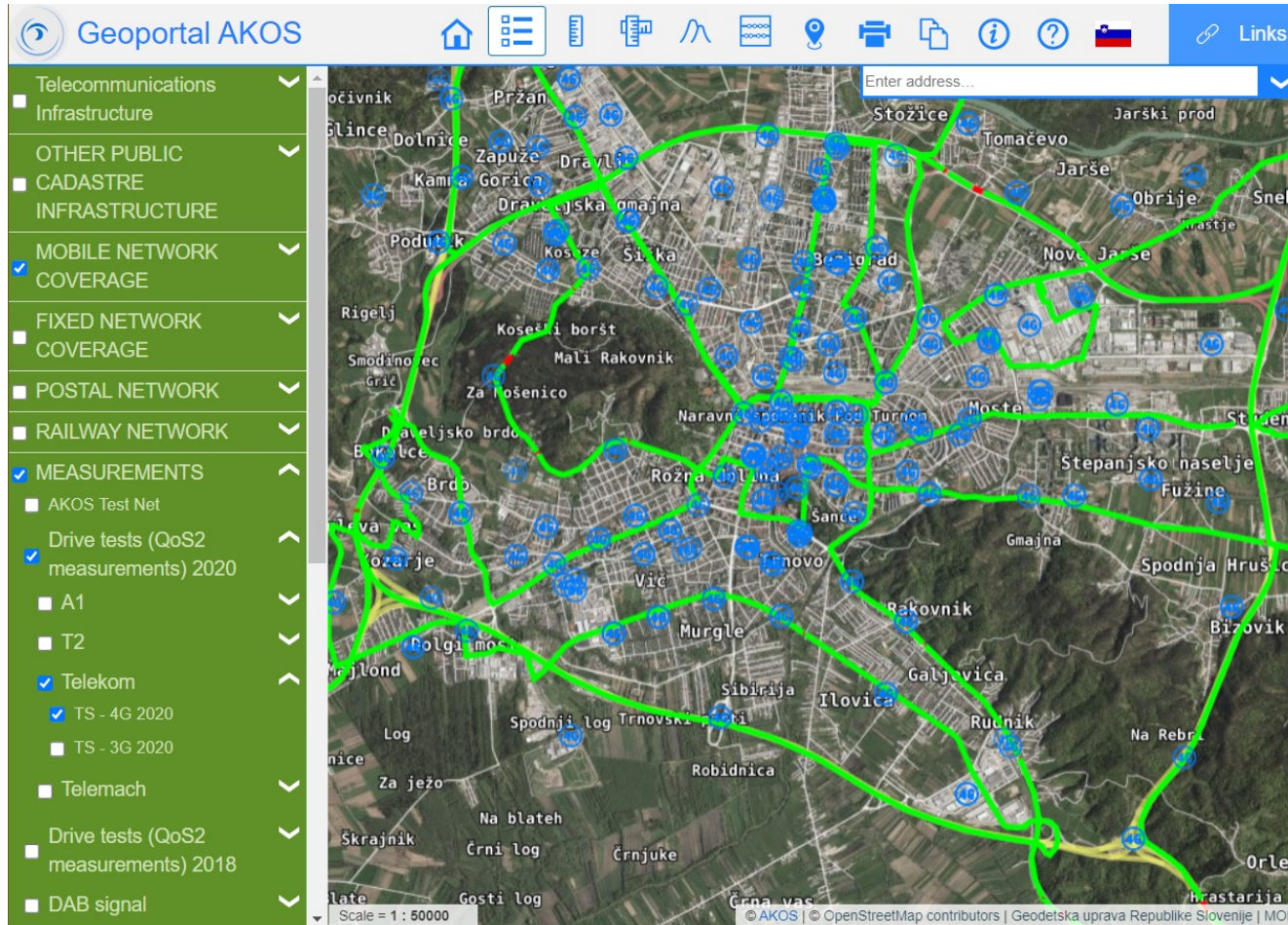
Comparison of the mobile coverage maps with measured values

The comparison between the 4G mobile coverage maps and the measured mobile signal values was made to identify differences between the simulated data and the situation in the field. Three types of deviations were determined to calculate the match:

- a) No deviation: the mobile coverage map shows the same values as the field measurements,
- b) Measurement deviation: the mobile network coverage map shows that the area is not covered, while the measurements show the opposite, i.e. the area is covered with very good, good or limited signal,
- c) Simulation deviation: the mobile coverage map shows that the area should be covered by a very good, good or limited signal, but the measurements show that it is not.

The most important figure for assessing the quality of the mobile coverage map is the proportion of the no deviation category (90%).

Types of deviations	operator 1	operator 2	operator 3
No deviation	91	90	92
Measurement deviation	3	1	2
Simulation deviation	6	10	6



The main purpose of the AKOS Geoportal is to reduce the cost of building very high-speed networks (VHCN) and to encourage sharing and joint construction.

AKOS geoportal allows public access to agency data and provide access to the data that has not been accessible so far in one place. Main goals of providing these data are related to higher transparency of operation and proactive publication of spatial information.

The measurement campaign enabled the quality control of 4G mobile coverage maps and pointed out the main features of the 4G mobile network in Slovenia.

A comparison between the measured points and the 4G mobile coverage maps showed *very good matching*.

The differences between the 4G mobile network of individual mobile operators depend on:

- the spatial distribution of base stations,
- used frequency bands,
- the distance between the measured locations and base stations.

The measured data also provided information on the differences in mobile network configurations between mobile operators, which at first glance may not be so pronounced.



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Thank you



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