РЕПУБЛИКА МАКЕДОНИЈА
АГЕНЦИЈА ЗА ЕЛЕКТРОНСКИ КОМУНИКАЦИИ

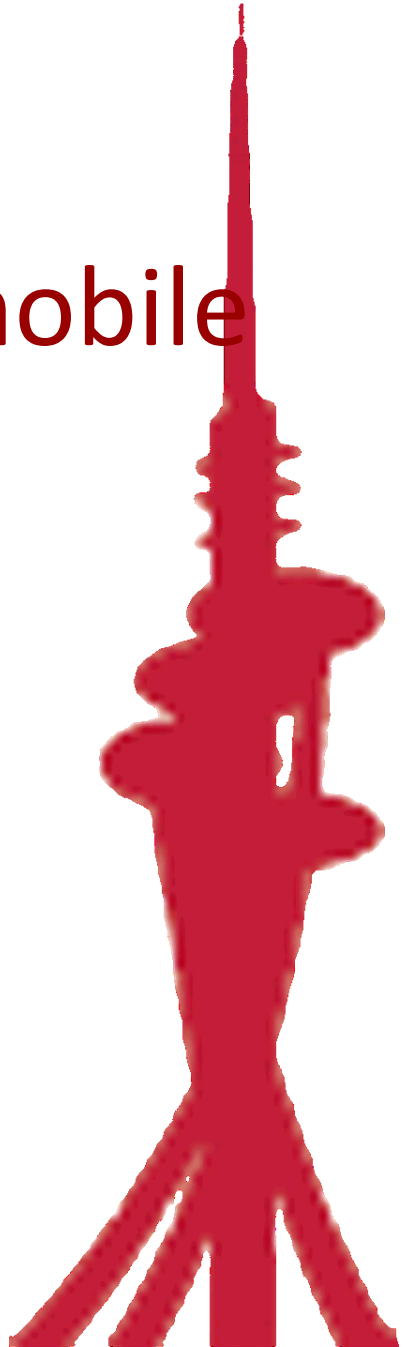
Mobile Networks QoS and DVB-T Networks Measurements (Macedonian Case)

Regulating Electronic Communications Market
26-27 September 2016, Budva

Igor Bojadjiev
igor.bojadjiev@aec.mk

1. QoS measurements of mobile networks in Macedonia

2. Measurements of DVB-T networks in Macedonia

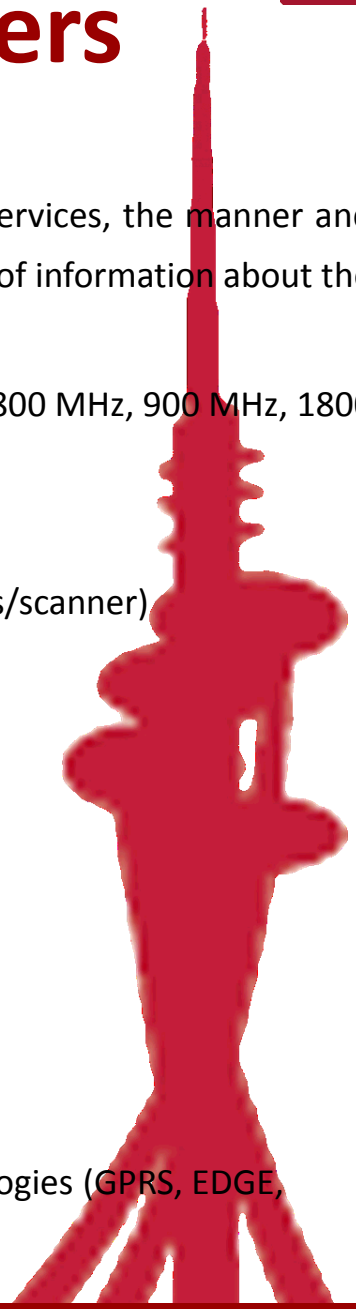


1. QoS measurements of mobile networks in Macedonia

Bylaw and QoS Parameters

- Obligation according Electronic Communications Law
- AEC adopt a Bylaw for quality parameters of public electronic communications services, the manner and procedure for control and measurement, content, form and manner of disclosure of information about the quality of public electronic communications services
- In Macedonia exist four main wireless technologies: GSM, UMTS, LTE and DVB-T (800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 470-790 MHz)
- Responsibility of the Control and Monitoring of Radiofrequencies Department

- Network coverage (signal strength on mobile phones independent by technologies/scanner)
- Network availability (network availability during the drive tests)
- Failure calls
- Dropped calls
- Call setup time
- Quality of speech (Calling Voice server)
- SMS send success rate
- Unsuccessful rate for IP connection (failure data attempt)-SAFR
- Dropped data session (SSFR)
- Speed of data transfer via radio communications network independent by technologies (GPRS, EDGE, UMTS and LTE) (Connection to IP server)
- Signal strength for DVB-T (Spectrum analyzer)



Bylaw for Quality Parameters of Public Electronic Communications Services, the Manner and Procedure for Control and Measurement, Content, Form and Manner of Disclosure of Information About the Quality of Public Electronic Communications Services

- Implemented the obligations from ECL
- Implemented ITU Recommendation (ITU P.800)
- Implemented CEPT Reports (ECC Report 118, ECC Report 103, Draft ECC Report 256)
- Implemented ETSI Standards (ETSI TS 102 250, ETSI TS 136 104)

Draft ECC Report 256

The following example describes this approach as used in Macedonia.

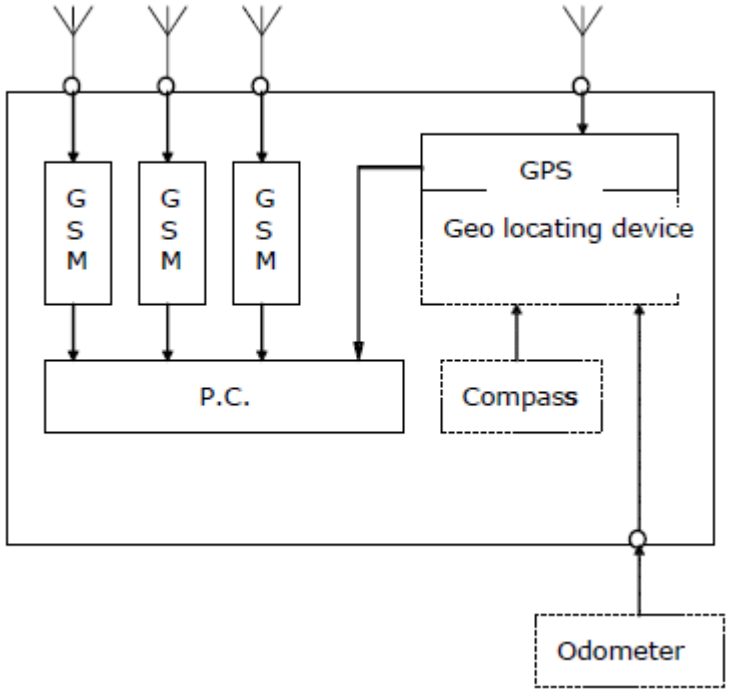
- The measurement is done by using commercial UE´s controlled via a software running on a dedicated laptop;
- Download file size is 1 GByte and is placed on an IP server for measuring the download speed;
- The same file is copied to the UE for measuring the upload speed;
- The servers is connected to support the maximum LTE technology throughput;
- File transfer is done by using the FTP/HTTP protocol;
- Before starting the actual measurement of each data session a maximum setup time of 30 seconds is granted to allow the UE to connect to the server. This long time allows recovering from a network connection loss;
- Session length is 10 seconds;
- Waiting time between consecutive data session is 10 seconds;
- Like in other approaches the number of sessions depend on size of the measurement area, in order to gain a common spatial resolution in every measured area;
- All operators are measured simultaneously;
- Software for post processing is used to average the measured samples.

Maximum and minimum throughput per UE may be measured in the same way as described above. However, the requirement that the LTE radio link is slower than the remaining way to the target server may be critical especially when measuring maximum throughput that are close to the total capacity of the LTE base station. Furthermore, the direct measurement of maximum throughput is only possible during times where (nearly) no other UEs are active in the cell, or with SIMs that are granted priority access over other users by the network operator. Minimum throughput may be measured during busy hours or, alternatively, calculated from measurement of average throughput and calculation using agreed average and maximum numbers of concurrent UEs in a cell.

6.4.2 Indirect throughput measurement

Due to the described practical problems involved in direct throughput measurements it may be feasible to determine the physical maximum throughput of a LTE base station by measuring other, dependant parameters such as CQI or RSRP, and then calculate the available throughput per UE with agreed numbers of maximum, average or minimum UEs in one cell. Since the typical use of internet services requires more

Measuring Equipment and Software



- Measuring Equipment

  - scanner and measuring mobile phones (test modules) for measuring all the operators simultaneously

  - laptop in which is installed a software for measuring

  - positioning system

- Software

  - controlling the measuring phones

  - collecting all the signaling data that are exchange between measuring phones and serving BTS

  - collecting the positioning information from the positioning system

  - save the raw data

  - process and show the wanted data

  - export the necessary data in defined format

Measuring System for QoS

- The measuring system for QoS have to fulfill the following requirements:

- Accuracy
- Comparability
- Openness
- Flexibility
- Upgrade capability
- Scalability

Measurement Equipment

- Anite equipment for QoS measurements:

  - NEMO scanner and Multilite hardware with six Samsung Galaxy S4 mini phones

  - NEMO OUTDOOR and ANALYZE software for post processing

Measuring Scenario (User Experience)

- Script 1 (VIP 1, T-Mobile 1 and ONE 1):

  - call setup (30 s) + call duration (120 s) + pause (10 s) + sending SMS (30 s) + pause (10 s)

- Script 2 (VIP 2, T-Mobile 2 and ONE 2):

  - call setup (30 s) + call duration (120 s)/quality of speech + pause (10 s) + sending file (5 MB/1 MB) + pause (5 s) + receiving file (5 MB/1 MB) + pause (10 s)

РЕПУБЛИКА МАКЕДОНИЈА
АГЕНЦИЈА ЗА ЕЛЕКТРОНСКИ КОМУНИКАЦИИ

QoS Benchmarking Report for Skopje, Comparison 2015 and 2016

National Networks of Mobile Operators in Macedonia

- one.Vip (ONE)
- Makedonski Telekom/T-Mobile
- one.Vip (VIP)

- The period when the measurements were performed in 2015:
  23/07–17/08/2015
- The distribution of the number of calls generated in certain municipalities representative is obtained by proportional division in terms of population density in a given municipality according to data taken from data provided by the State Statistical Office of Macedonia

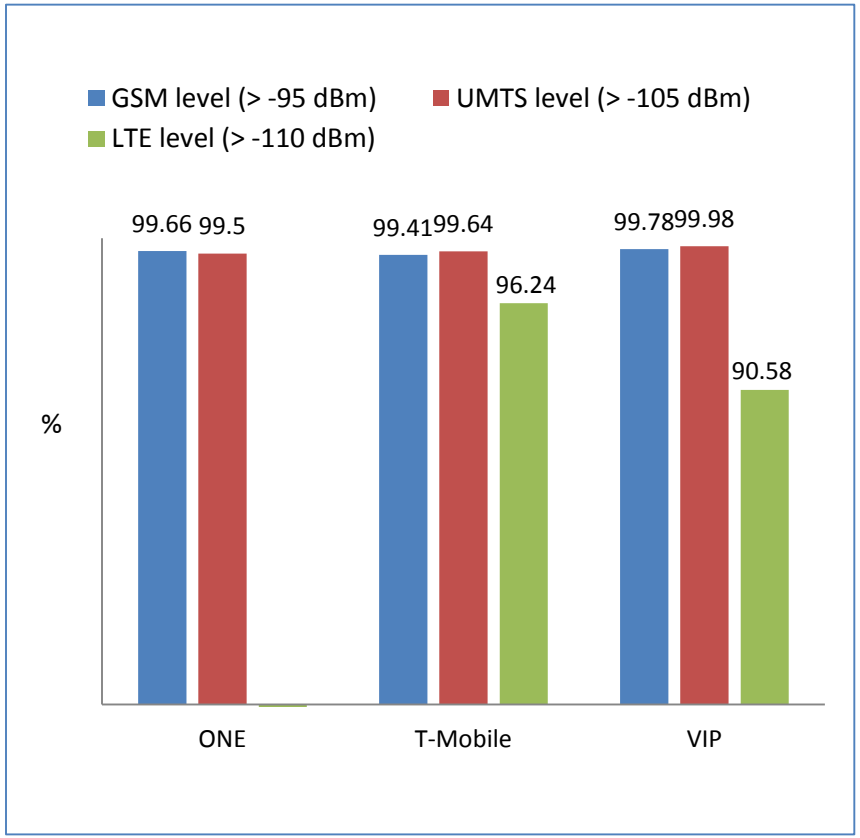
City	Population	Min number of calls	Call attempts ONE	Call attempts T-Mobile	Call attempts VIP
Skopje	506926	2028	2095	2172	2338

- The period when the measurements were performed in 2016:
  06/07–26/072016

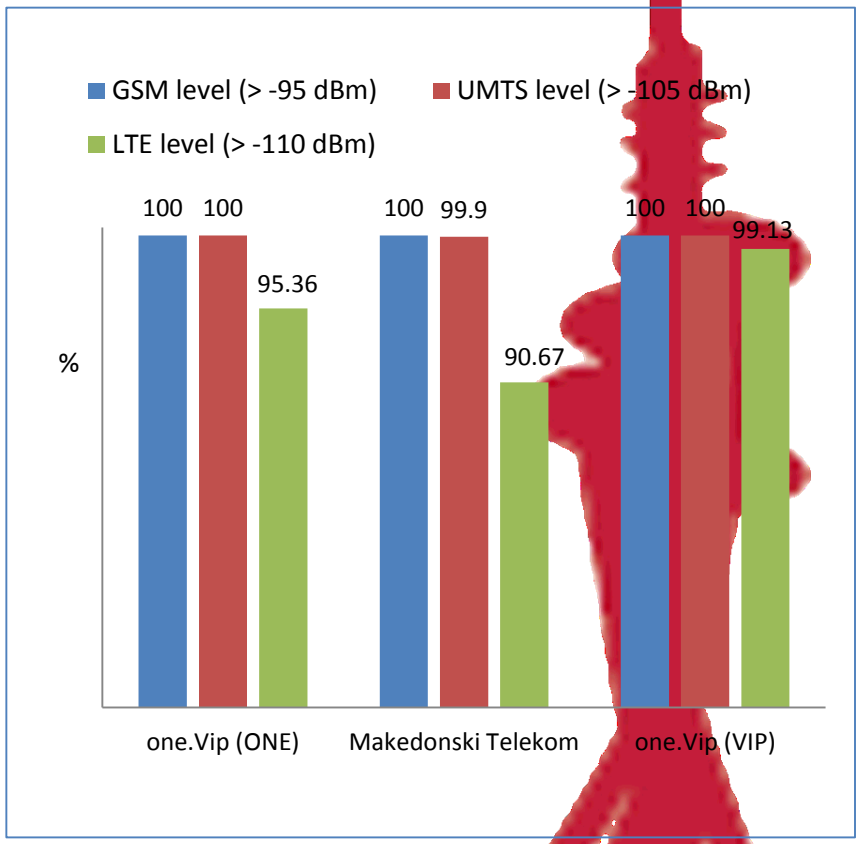
City	Population	Min number of calls	Call attempts one.Vip (ONE)	Call attempts Makedonski Telekom	Call attempts one.Vip (VIP)
Skopje	506926	2028	3112	3112	3255

Network Coverage-Level of Measurement Signal on the Phone

2015

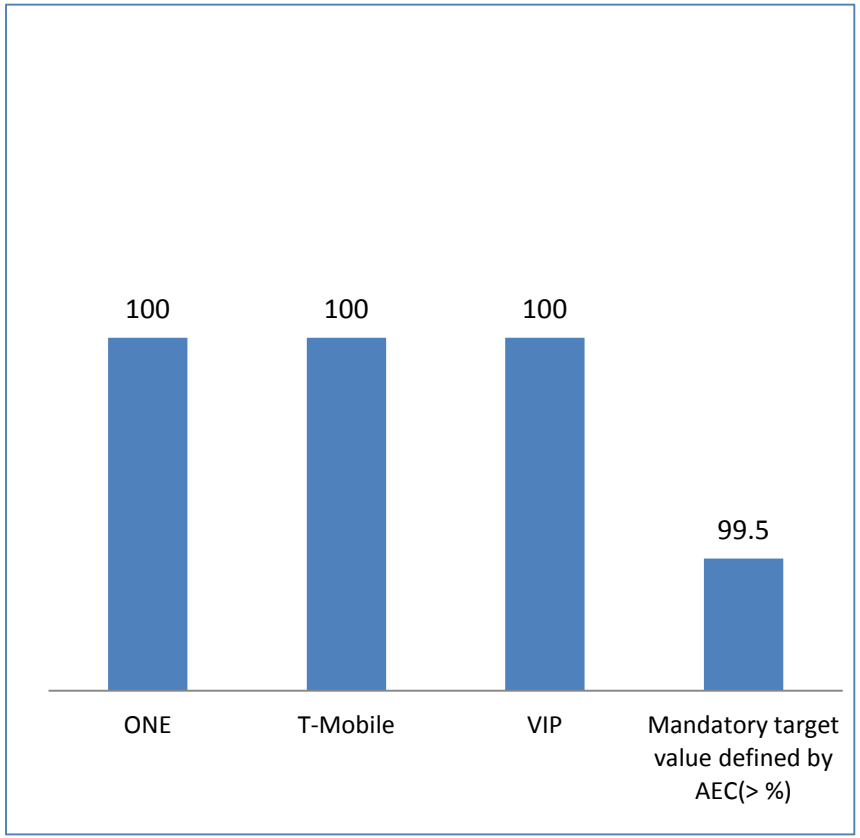


2016

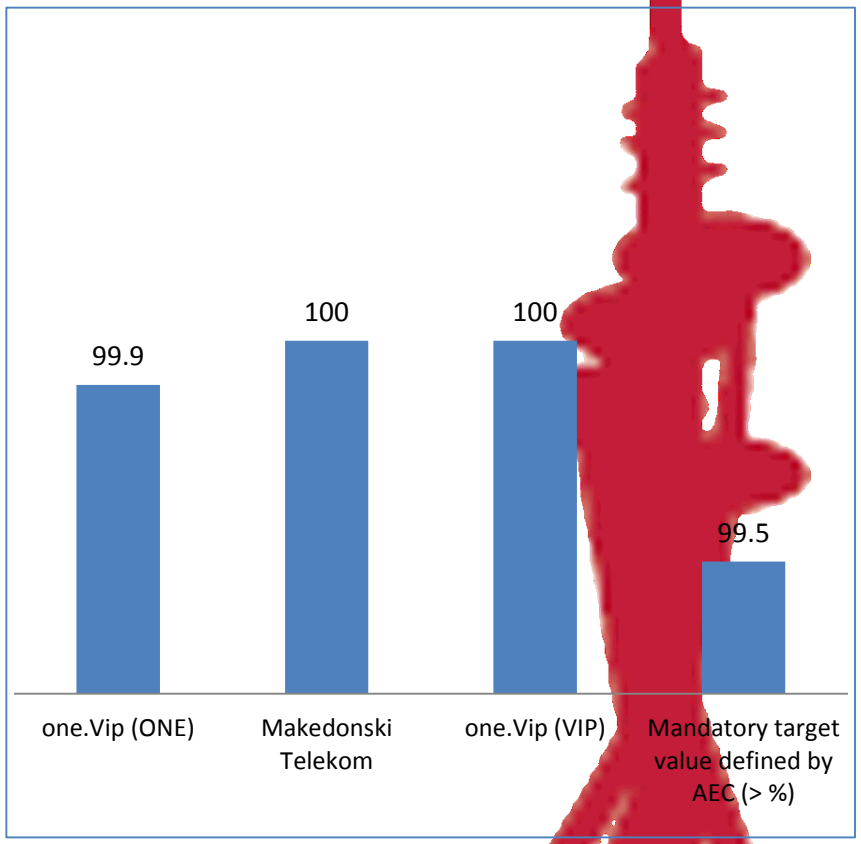


Network Availability (how much time the mobile device detect network coverage regardless of technology)

2015

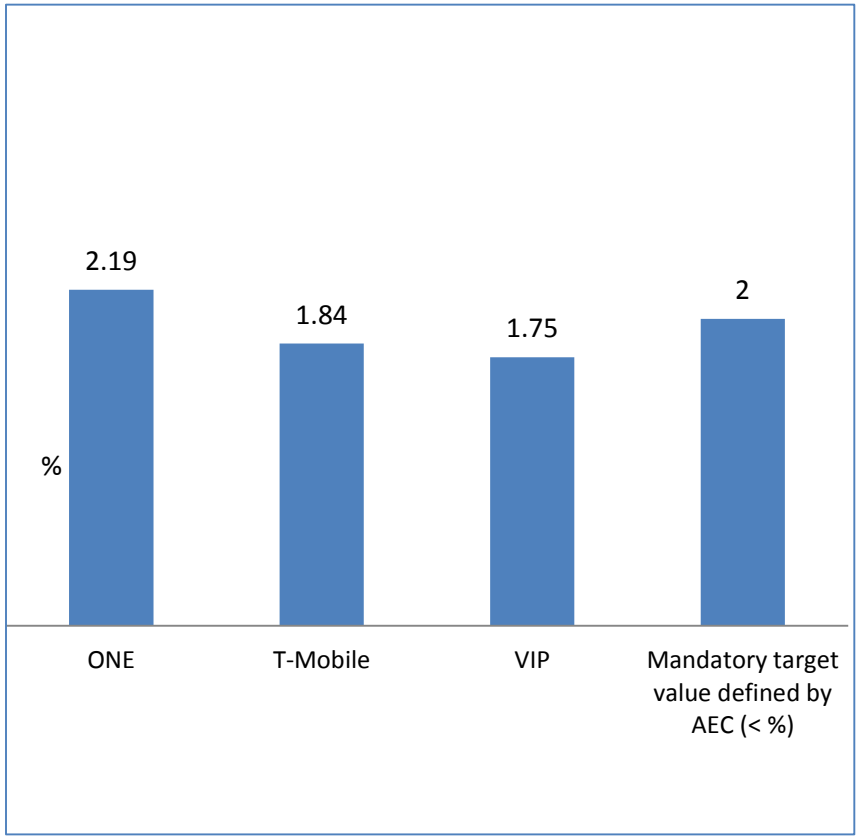


2016

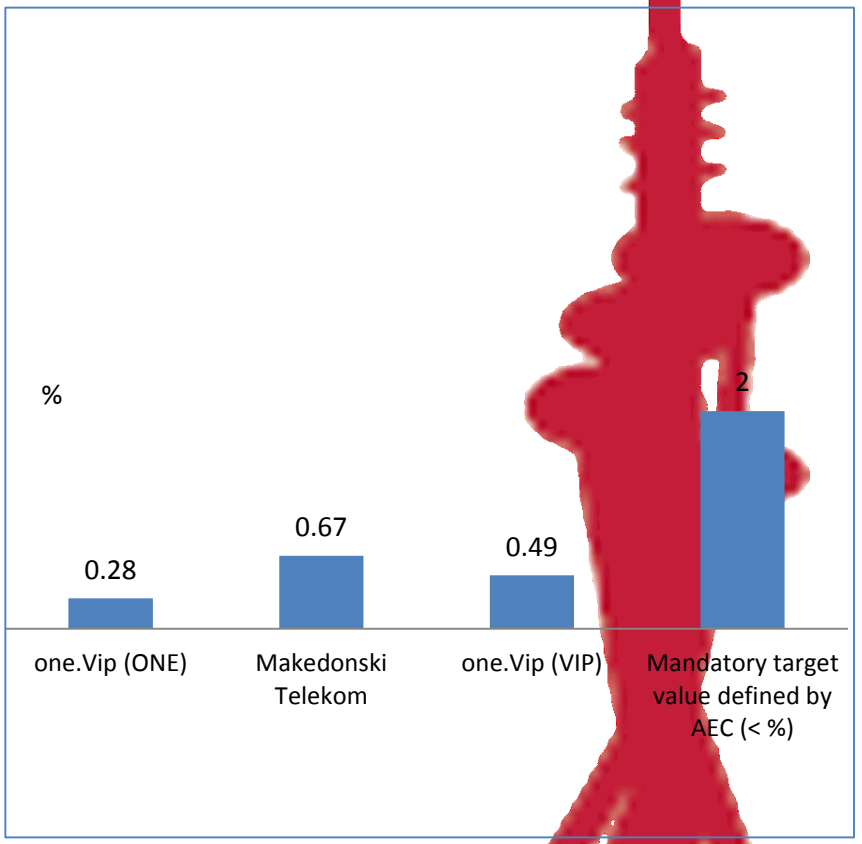


Failure Calls

2015

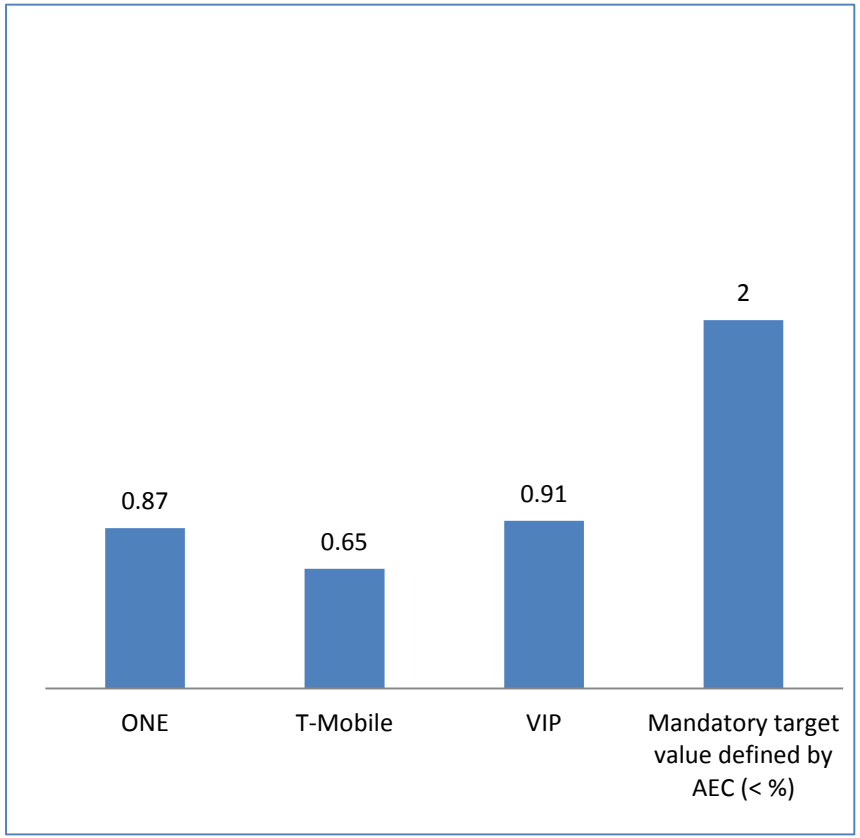


2016

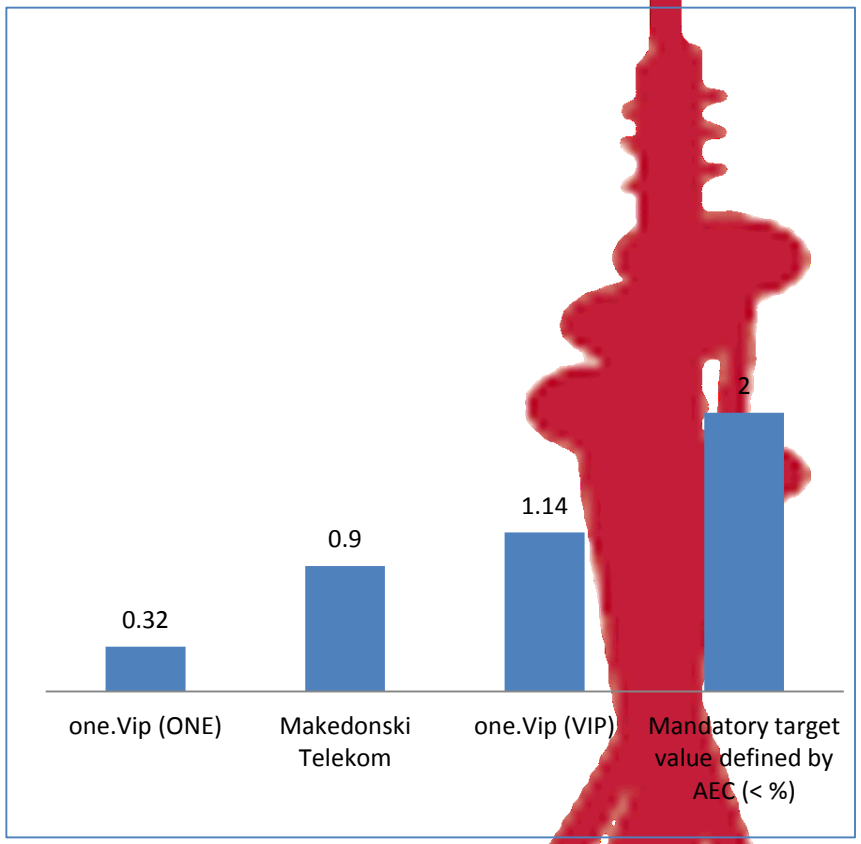


Dropped Calls

2015

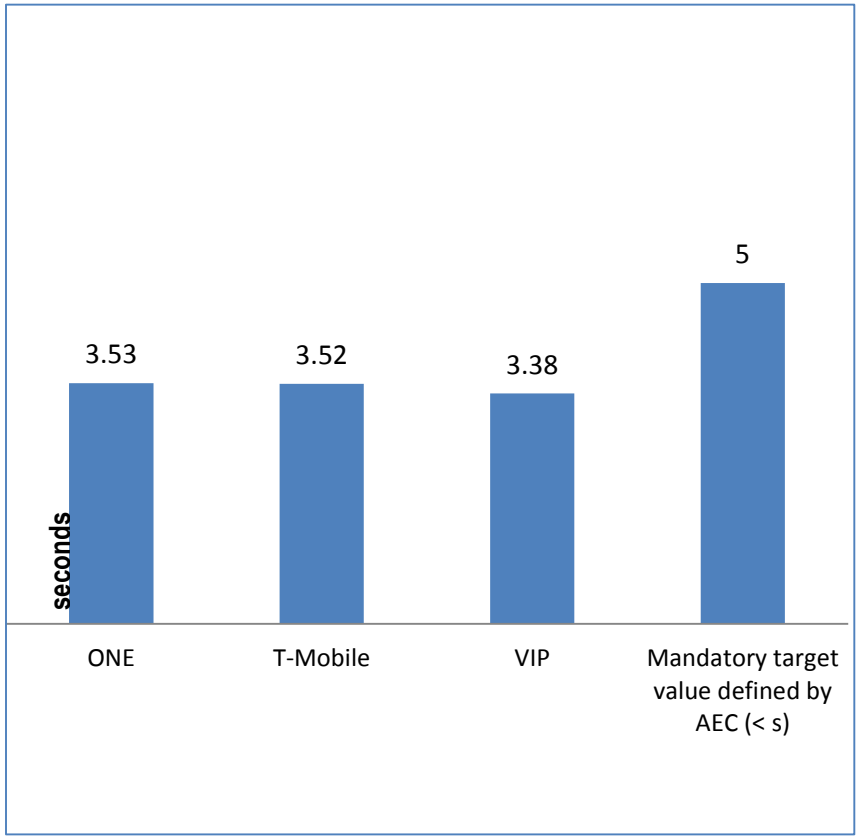


2016

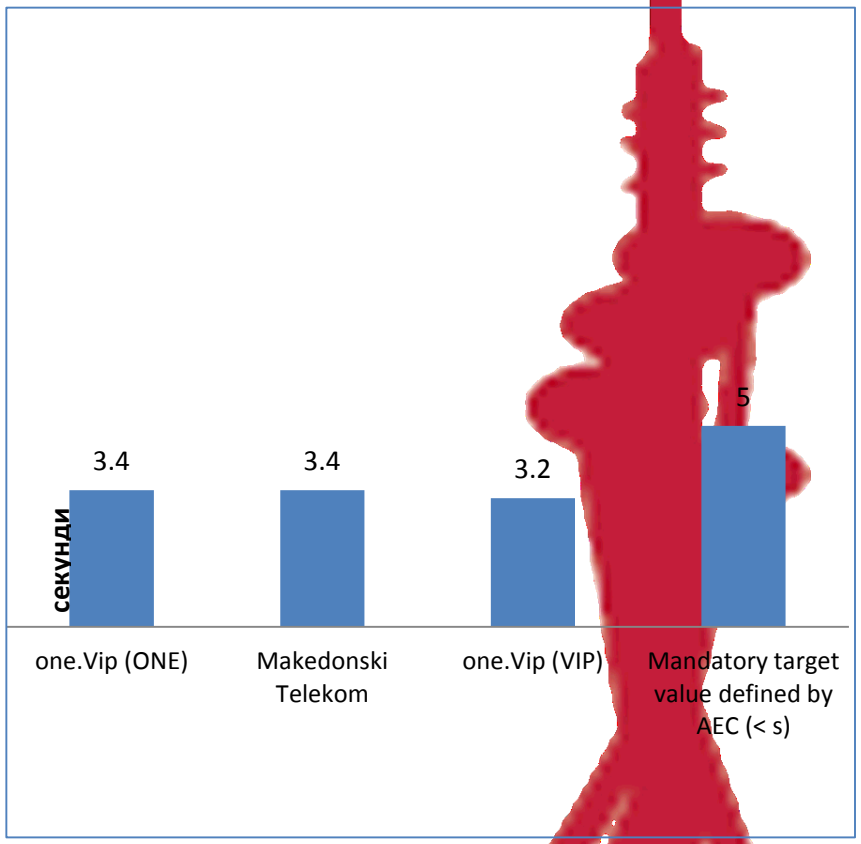


Call Setup Time

2015

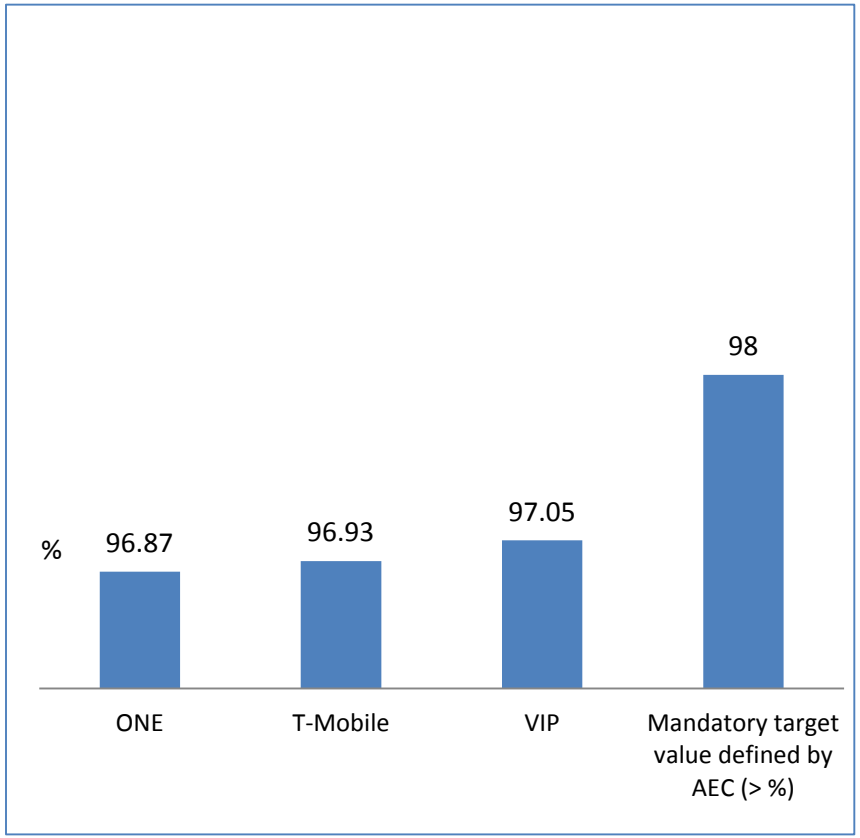


2016

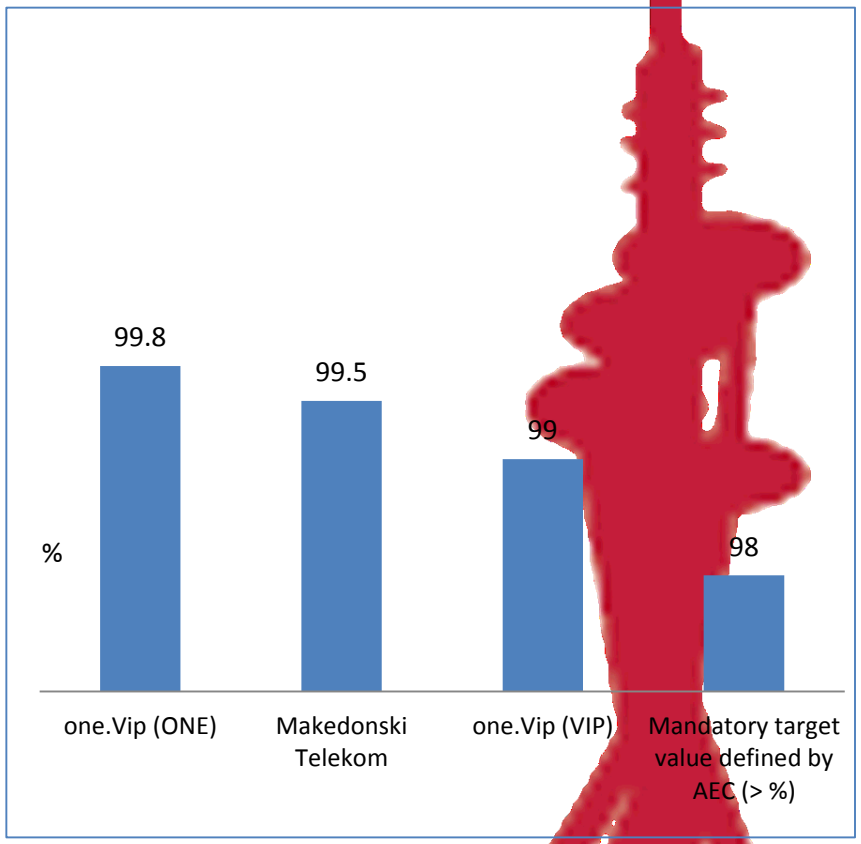


SMS Send Success Rate

2015

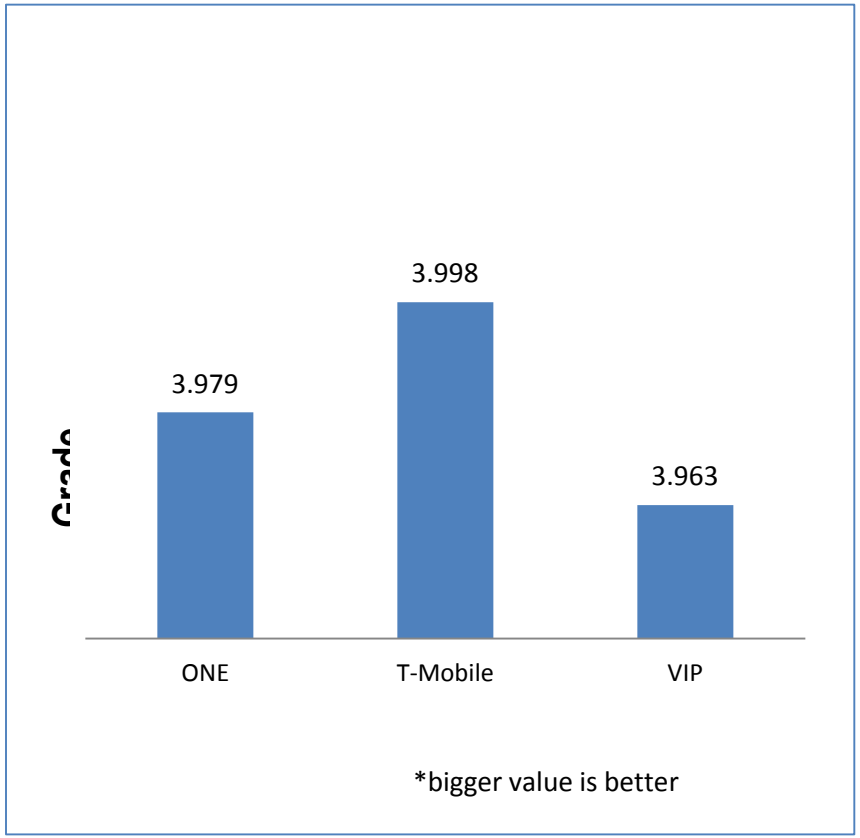


2016

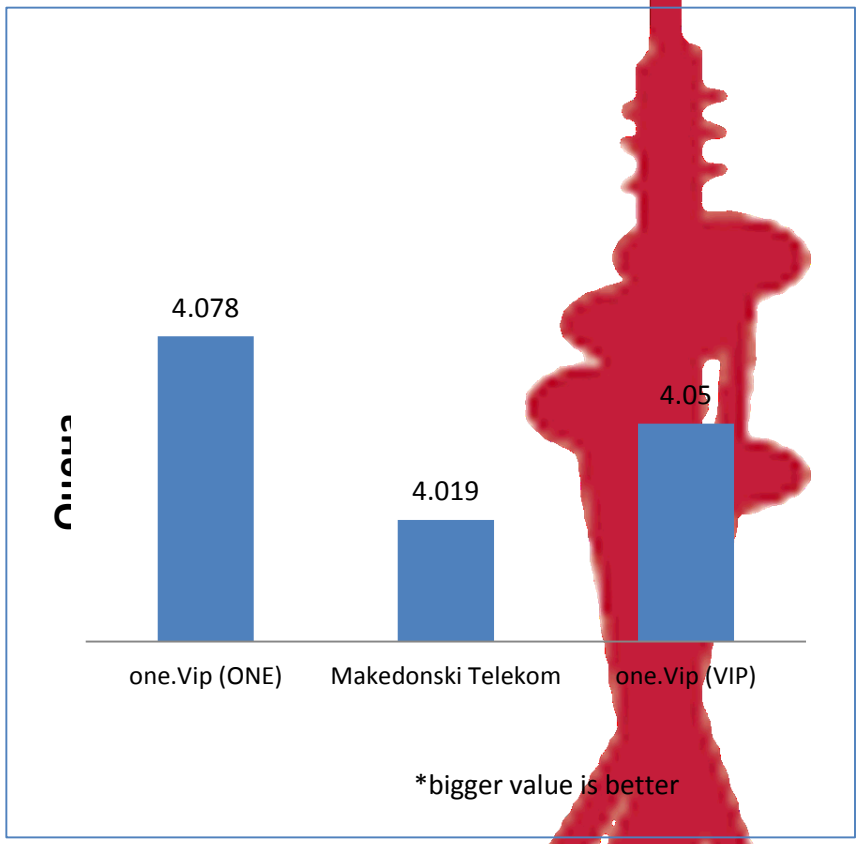


Quality of Speech

2015

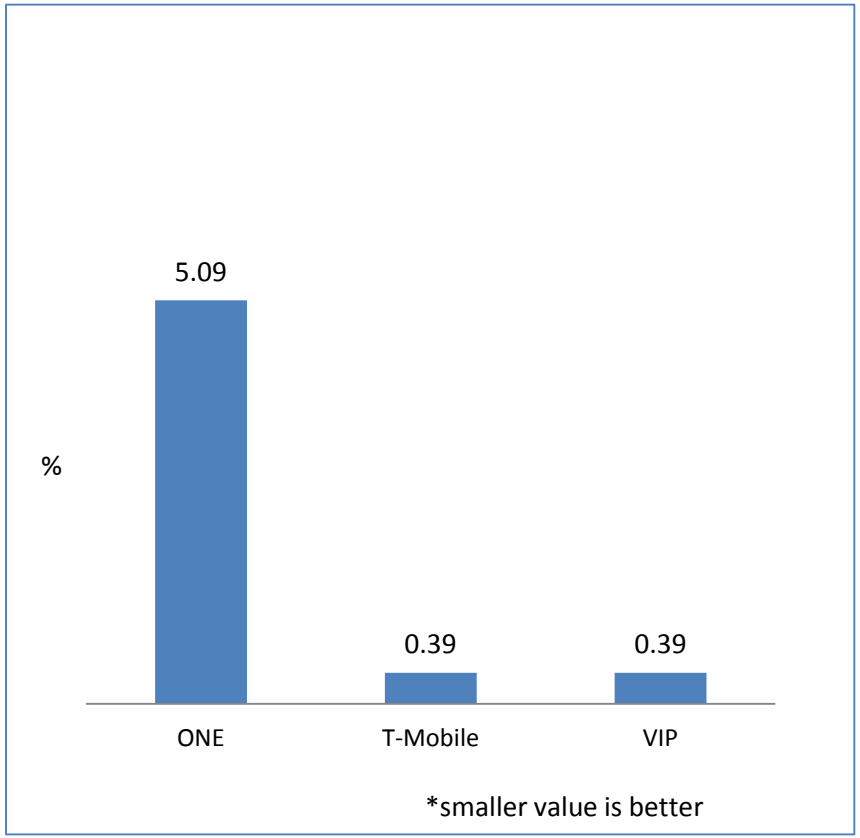


2016

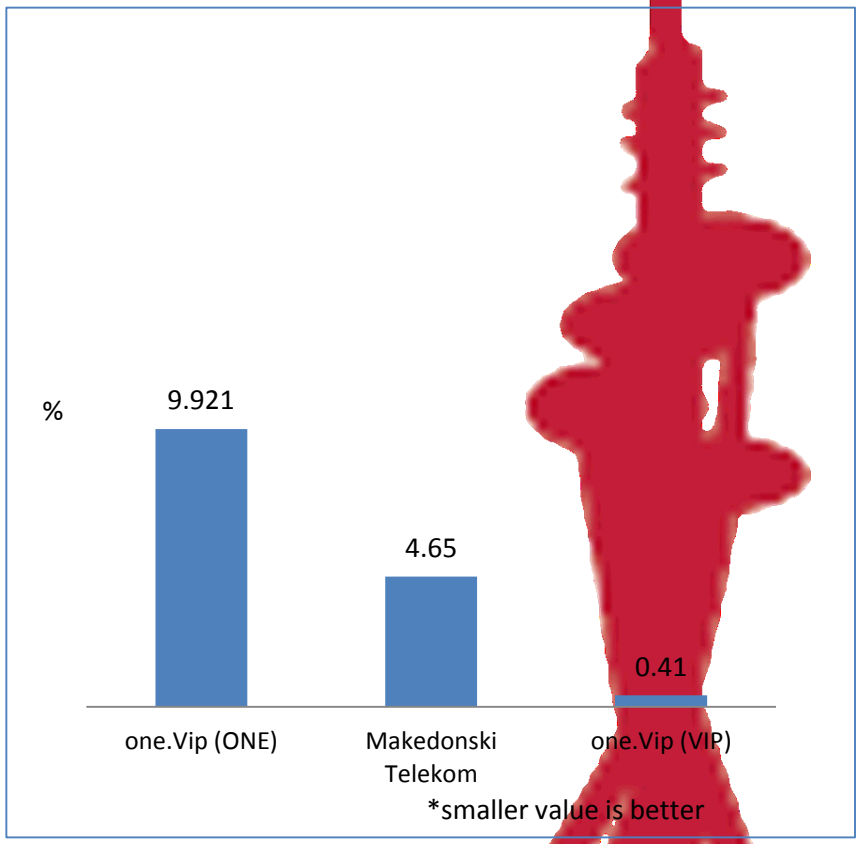


Unsuccessful Rate for IP Connection (failure data attempt)-SAFR

2015

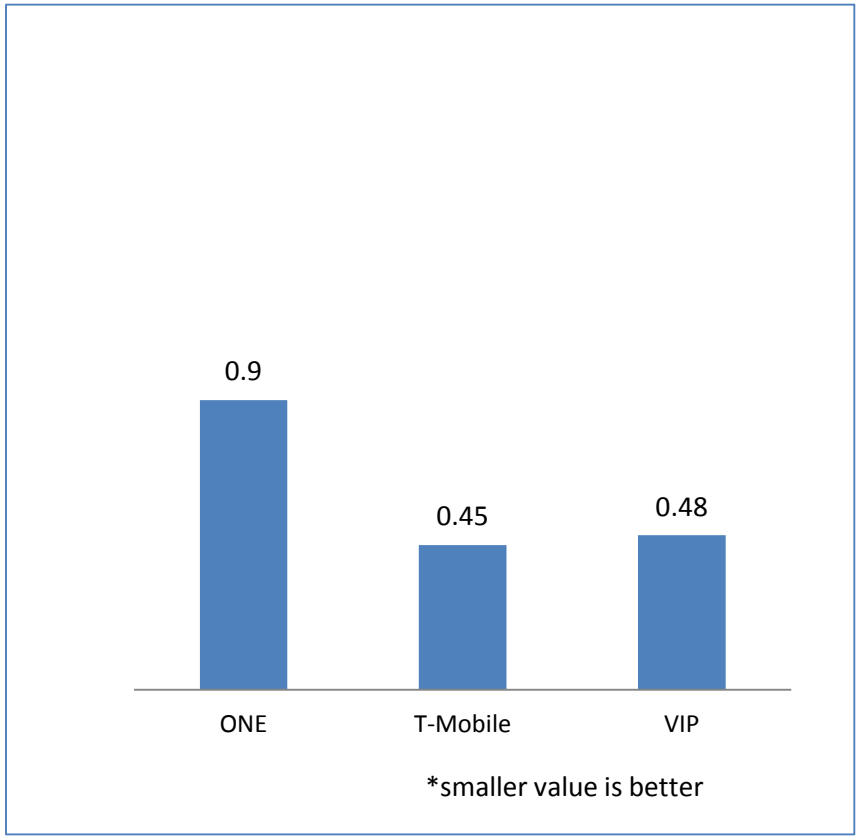


2016

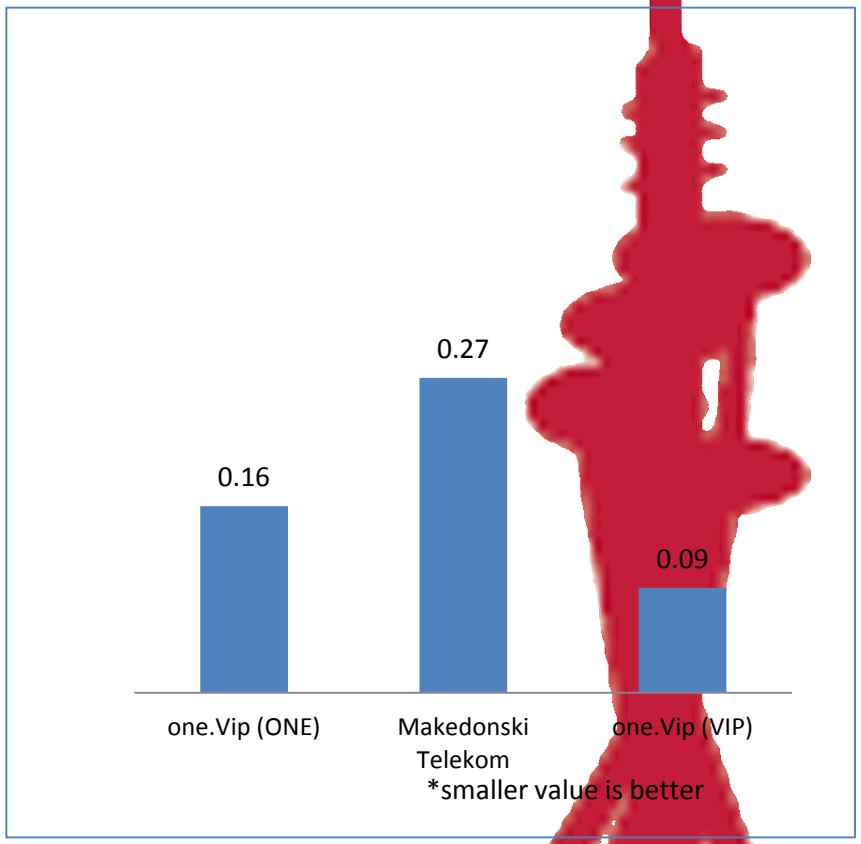


Dropped Data Session (SSFR)

2015

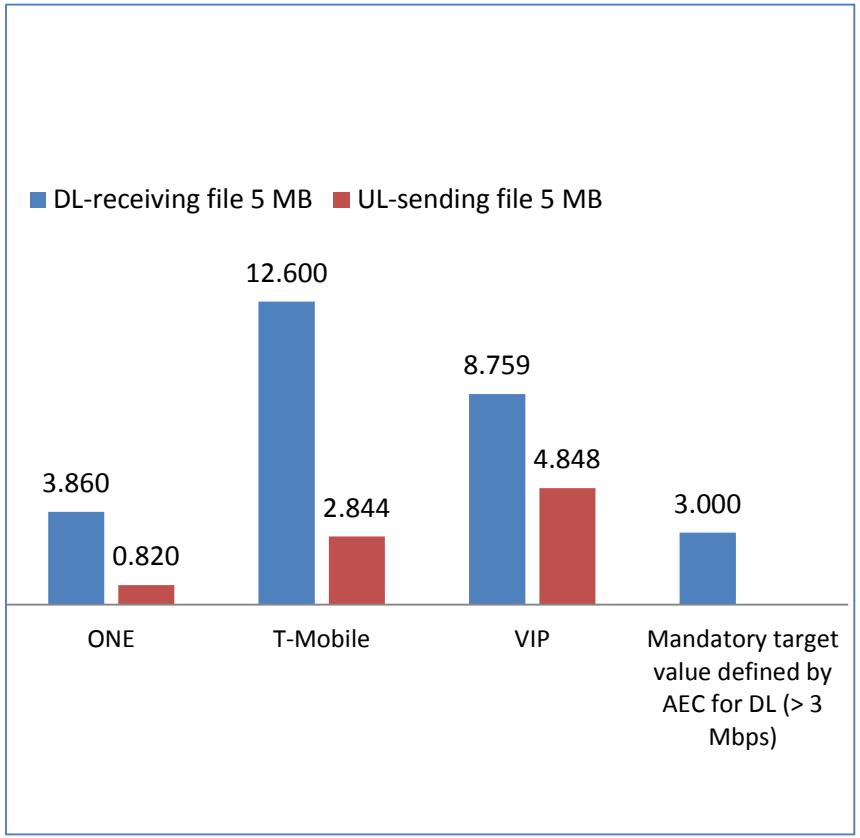


2016

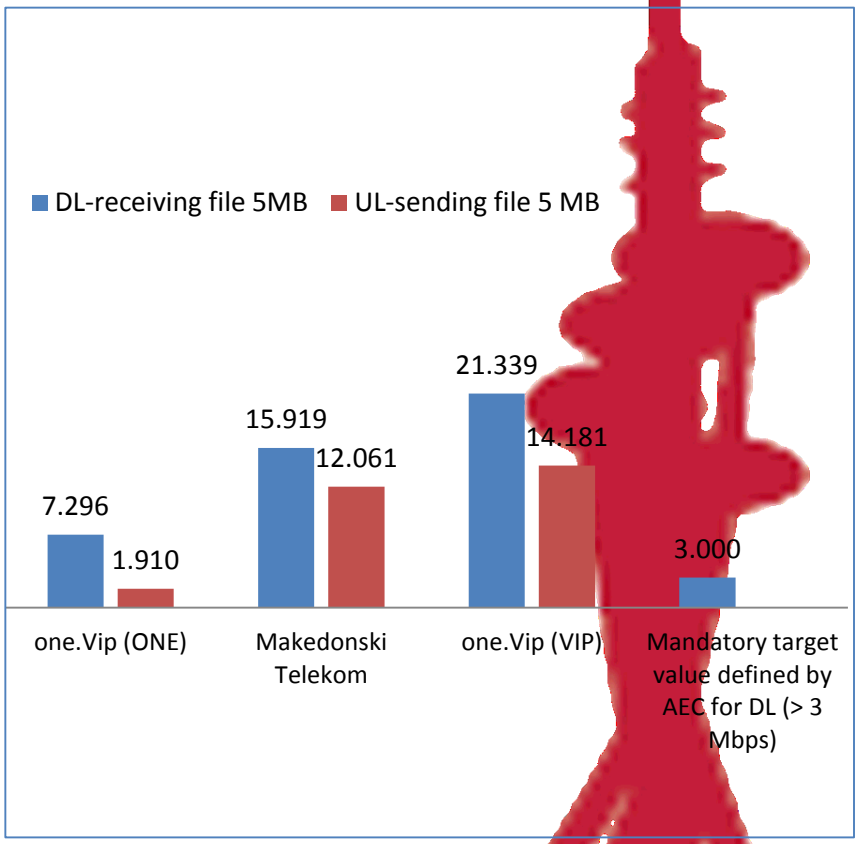


Speed of Data Transfer via Radio Communications Network Regardless of Technology (GPRS, EDGE, UMTS and LTE)

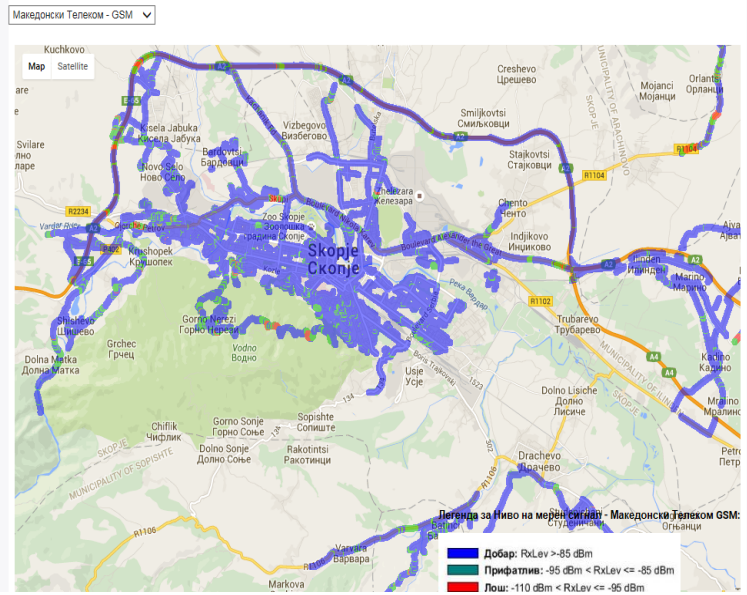
2015

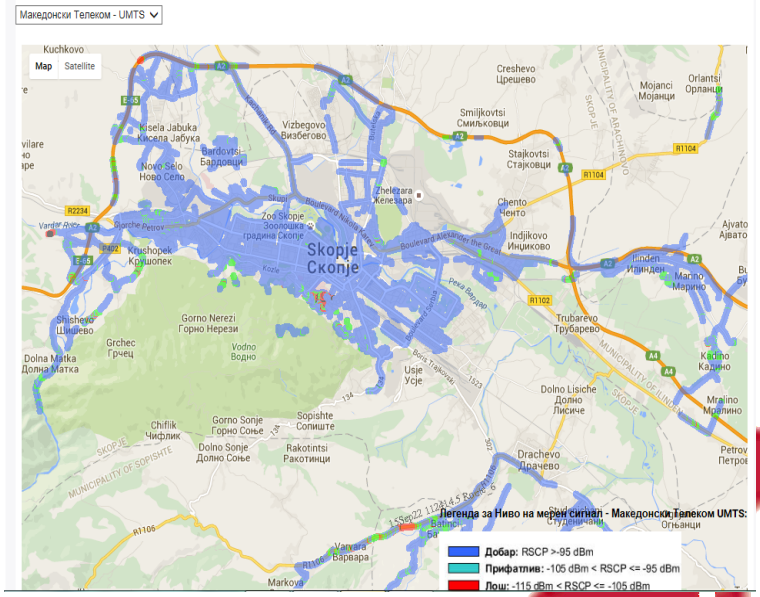


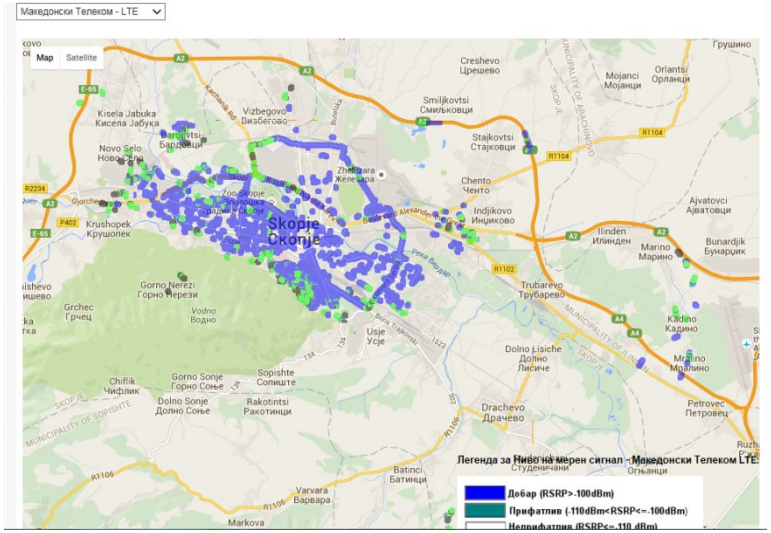
2016



Coverage Map (drive-test)



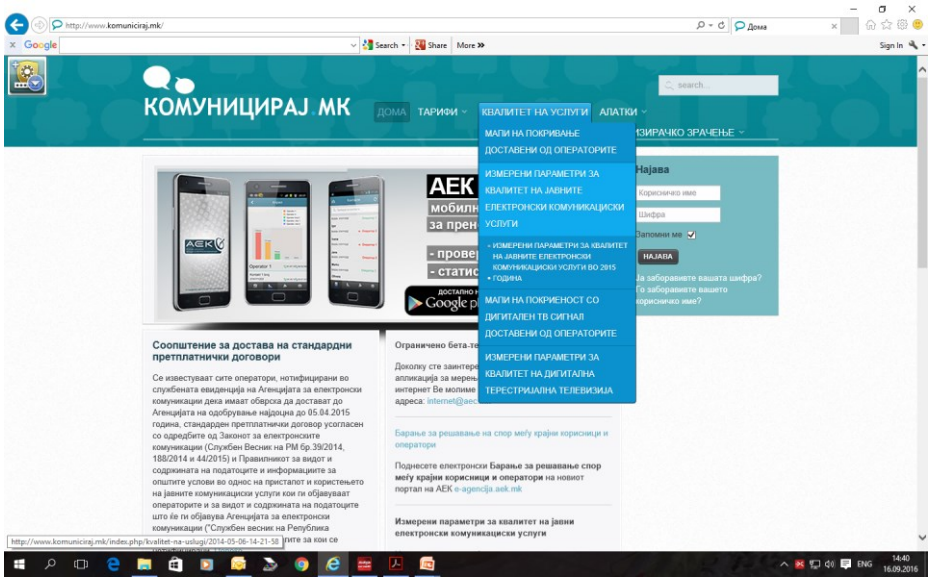


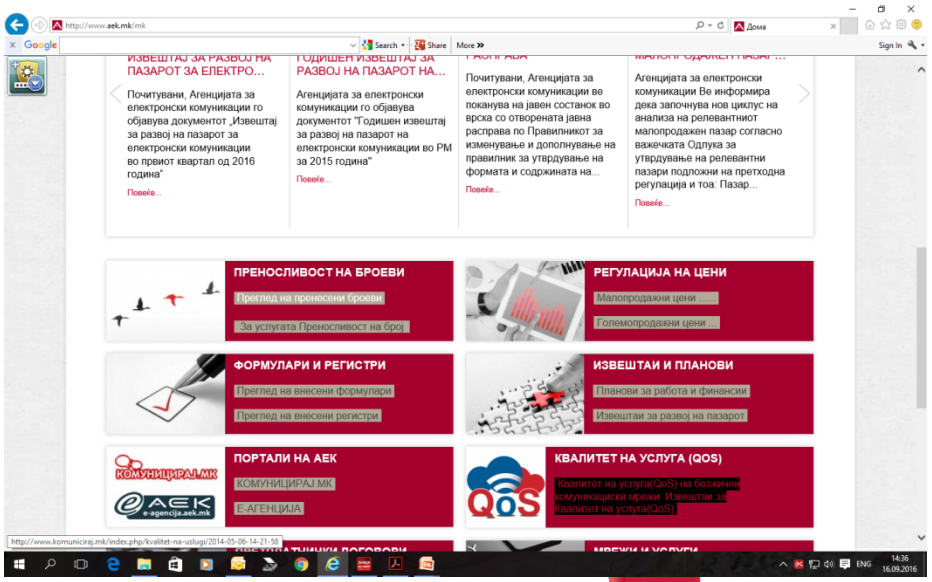


Publish Results

www.komuniciraj.mk

www.aec.mk





2. Measurements of DVB-T networks in Macedonia

DVB-T in Macedonia Started Broadcasting in November 2009

In Macedonia exist three operators for terrestrial transmission of television program services via DVB-T platform:

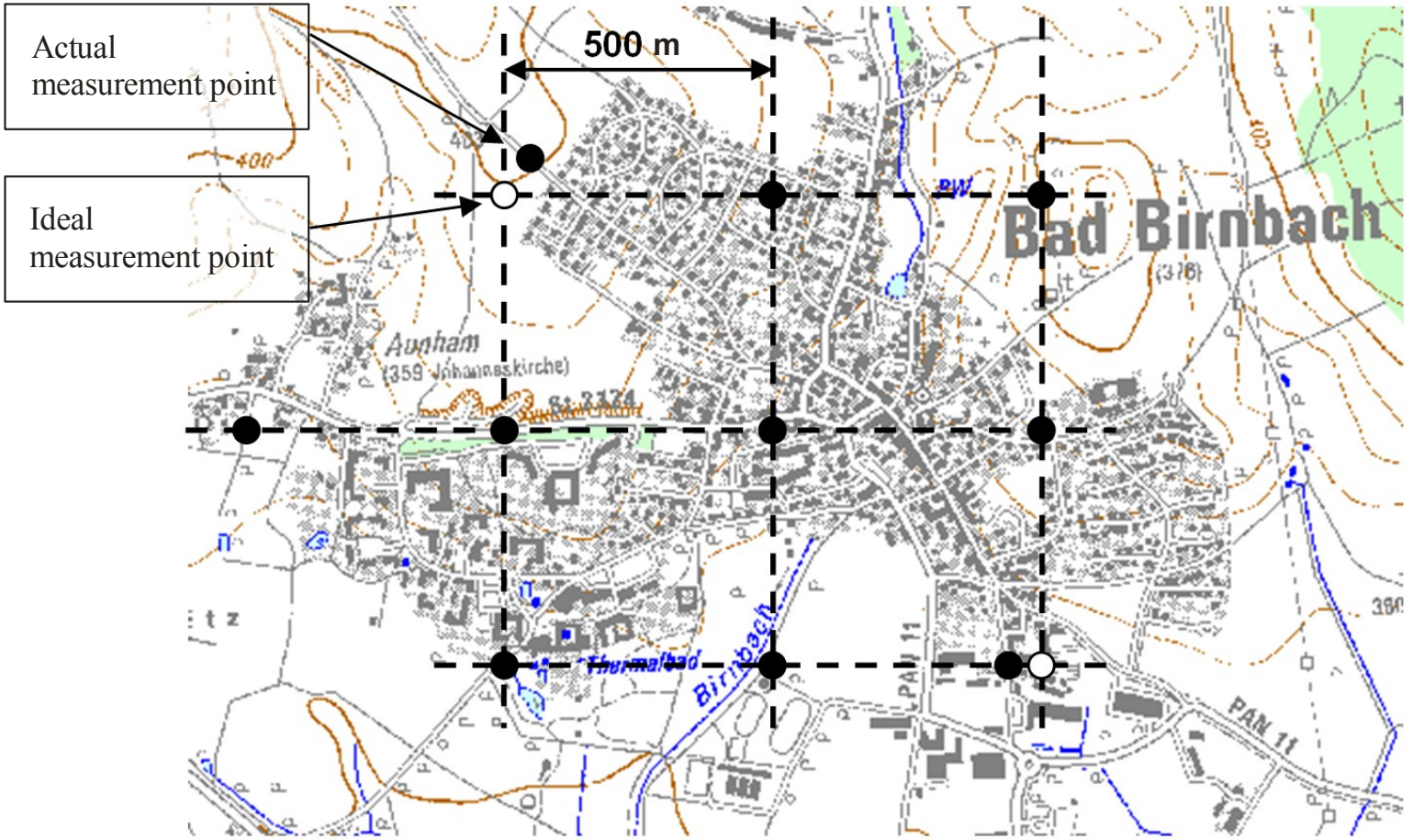
- Macedonian Broadcasting (transmitting the programs of the public broadcaster-MTV1, MTV2, MTV Parliamentary channel HD);
- DIGI PLUS MULTIMEDIA BOOM TV (transmitting commercial televisions);
- one.Vip (transmitting the programs of national and regional televisions-free to air platform)

Recommendation ITU-R SM.1875-2 1/2

Procedure for measurement of quality of service (coverage with Digital terrestrial TV):

- ✓ Measurements are made at fixed points at a height of 10 m with Omni directional horizontal antenna;
- ✓ Measuring points are selected with no direct obstacle (building, wood, etc.) to the transmitter-line of sight, if the terrain allows it;
- ✓ Measurements of DVB-T signal in the cities are performed on multiple fixed points allocated in a mesh of 500 m x 500 m;
- ✓ In small villages measurement is performed in a fixed point or more than one point in case of a bigger village

Recommendation ITU-R SM.1875-2 2/2



SM.1875-04

Mobile Monitoring Stations

- 20–8000 MHz broadband antenna for DF, monitoring

Portable Spectrum Analyzers Agilent N9010A EXA

- 10 Hz to 44 GHz;
- Internal preamplifier options up to 44 GHz
- 25 MHz (standard) analysis bandwidth; optional 40 MHz analysis bandwidth
- Fast sweep capability ships standard on new instruments equipped
- Extend frequency to 110 GHz with Keysight's smart harmonic mixers and up to 1.1 THz with other vendors' mixers
- Supports >25 measurement applications, covering cellular communication, wireless connectivity, digital video and general purpose
- Advanced analysis of more than 75 signal formats, software runs inside the EXA with 89600 VSA software

Measuring Parameters

We measure the following parameters:

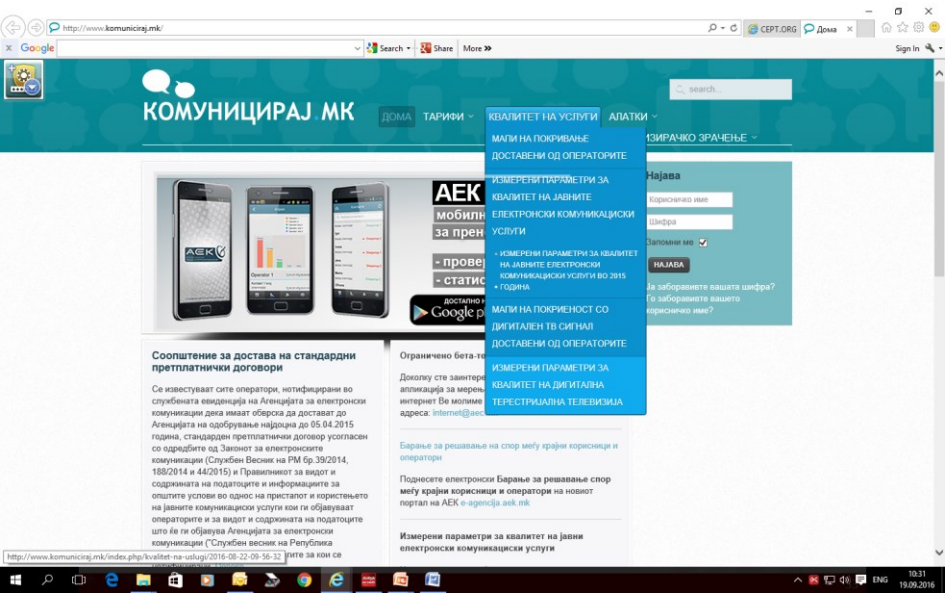
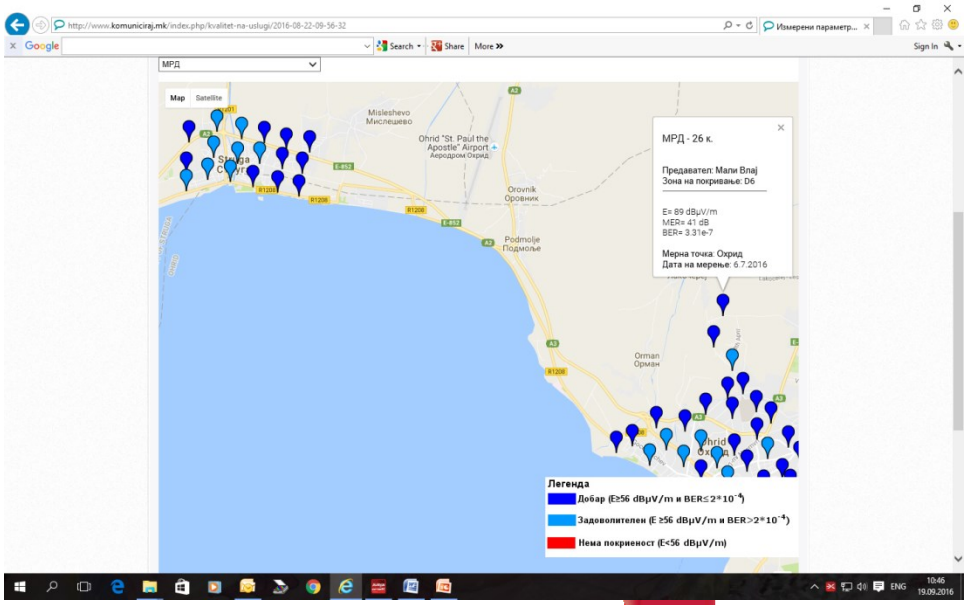
- SFN frequency channel
- Field strength-level signal (E)
- MER (Modulation Ratio Rate)
- BER (Bit Error Rate)
- CBER (BER Before Viterbi)
- VBER (Channel Bit Error Rate)

The results of the measurements are displayed by operator and territory

Criteria for coverage:

- ✓ Good signal (E ≥ 56 dBμV/m and BER ≤ $2*10^{-4}$)-dark blue
- ✓ Satisfactory signal (E ≥ 56 dBμV/m and BER > $2*10^{-4}$)-light blue
- ✓ No coverage (E < 56 dBμV/m)-Red

Reports and Maps

www.komuniciraj.mk

www.aec.mk