

Pursuant to Article 24 paragraph (1), indent 3, and related to Article 109, paragraph (2), of the Law on Electronic Communications ("Official Gazette of the Republic of Macedonia" no. 39/2014, 44/2015, and 193/2015), on 25.4.2017, the Director of the Agency for Electronic Communications adopted the

RULEBOOK
on the quality parameters of public electronic communications services, the manner and procedure for controlling and measuring, the content, form and manner of disclosing information related to the quality of public electronic communication services

Article 1
Subject Matter

(1) This Rulebook prescribes the quality parameters of public electronic communications services, the manner and procedure for controlling and measuring, the content, form and manner of disclosing information related to the quality of public electronic communication services by the Agency for Electronic Communications, hereinafter: the Agency.

(2) The Agency shall control and measure the quality parameters of public electronic communication services, defined in this Rulebook, and particularly the following public electronic communication services:

- publicly available fixed telephony services
- public available mobile telephony services
- public data transmission services
- services performed via broadcasting of DVB-T signal.

Article 2
Obligation of the operators pertaining to the quality of public electronic communication services

(1) The Operator has to ensure the quality of public electronic communications services in accordance with the Law on Electronic Communications and these Rulebook.

(2) The Operator has to provide service usage with minimum level of quality in accordance with the declared quality parameters, as defined in Article 3 of this Rulebook.

(3) When performing the measurements, the Agency shall take into account all documents referring to the quality parameters of the Body of European Regulators of Electronic Communications (BEREC), the standards and/or technical specifications of the European Telecommunication Standardisation Institute (ETSI), the European Standardisation Committee (CEN), the European Committee for Electrotechnical Standardization (CENELEC), the International Telecommunication Union (ITU), the International Standardisation Organisation (ISO), the International Electrotechnical Commission (IEC), and the European Conference of Postal and Telecommunications Administrations (CEPT).

Article 3
Information on the quality of services provided by the operators

(1) The Operator has to submit the data concerning the quality parameters of the public electronic communication services to the Agency, and to publish them on its website within 30 days after the expiry of the relevant period for submitting the report.

(2) The quality parameters of public electronic communications services, referred to in paragraph (1) of this Article, are presented in Appendix 1, Appendix 2, and Appendix 3, which are an integral part of this Rulebook.

(3) The Operator shall, upon request from the Agency, submit the data referred to in paragraph (1) of this Article within 15 days of the request receipt.

(4) The Agency may task the Operator of public electronic communications services to provide a minimum quality of service in accordance with the Law on Electronic Communications and this Rulebook. Said tasking may refer to improving a specific parameter, after the median values of the

defined parameters have been obtained, following the conducted measurements on the territory of Macedonia, and the publication of the National Report on populated areas and the National Report on test routes, in accordance with this Rulebook. The National Report shall be prepared as median value of measured values of the defined quality parameters of all measurements made for the populated areas and test routes as defined in this Rulebook.

Article 4

- (1) The Agency shall regularly measure the quality parameters of the public electronic communications services, as well as measure the quality parameters of public electronic communication services pursuant to a dispute, if needed, initiated by a subscriber or end user.
- (2) The operators have to provide conditions so as to enable the Agency to control and measure the quality parameters of public communication services provided to their subscribers or end users.
- (3) In case of initiated dispute before the Agency, referring to the quality parameters of the services provided by the Operator to the subscriber or end user, for which both parties have entered into contract, it shall be required to provide access to the terminal equipment for the Agency's experts, in order to allow them to verify whether the parameters are in compliance with those stipulated in the contract.

Article 5

Monitoring of public electronic communications services for internet access via cable network

- (1) In order to monitor the use and development of broadband access services, the Agency will implement a system to monitor the quality parameters of internet access services.
- (2) The purpose of the system for monitoring the quality parameters of internet access services is to provide:
 - transparency of the internet access quality for end users, and
 - monitoring of internet access quality in terms of potential service degradation.
- (3) The system shall be an appliance, with parts of the system placed at the internet traffic exchange point, at each operator with an international agreement for internet connection, and at the panel of end user volunteers.
- (4) The system will allow the measurement of quality parameters within the Operator's network (on-net) and its connections with other operators (off-net).

Article 6

Transparency of internet access quality for end users via cable network

- (1) Via the system for measuring the quality parameters (web access or application modules installed on terminal devices), subscribers shall be able to conduct individual measurements of informative nature on the service quality received from the operators.
- (2) The results of these measurements, along with the data entered by the user, will be used for preparing summary statistics that will be published on the Agency's website.

Article 7

Quality parameters of public electronic communications services for internet access via cable network

The Agency and the operators shall perform measurements of these minimum quality parameters of public electronic communications services for internet access at IP level:

No.	Parameter	Definition	Determination of value and unit
1.	Transmission speed	Speed of data transfer achieved separately for uploading and downloading of certain test files, between a remote site and the user's computer (ETSI EG 202 057-04 section 5.2)	Minimum and average value Expressed in Mbit/s or kbit/s

2.	Delay	Delay is half of the time in milliseconds required for an ICMP Echo Request/Reply (Ping) to a valid IP address. (ETSI EG 202 057-04 section 5.5)	Mean value Expressed in ms
3.	Delay variation	For a pair of IP packets, delay variation is the difference between the delay in one direction, measured for two consecutive packets. (as defined in ITU-T Recommendation Y.1540 section 6.2.4 and the calculation method based on ITU-T Recommendation Y.1541 Annex II)	Mean value Expressed in ms
4.	Packet loss ration	The packet loss ratio is the total number of packets lost on the egress, and the total number of packets sent for the concerned population. (ITU-T Rec. Y.1540 section 6.4)	Mean value Expressed in $\times 10^{-3}$

Article 8

Measurement of quality parameters of public electronic communications services for internet access via cable network

- (1) The operators with international contracts for internet interconnection have to provide conditions so as to enable the Agency to install the system modules, by providing the adequate hardware infrastructure, power supply, static IP address, as well as full protection of the system with sufficient internet access capacity. They should enable their subscribers, and the subscribers of all other operators to whom they are providing internet access, remote access to the module, as well as unrestricted communication between the system for measuring the quality parameters and the module, via internet.
- (2) The operators without international contracts for internet interconnection, and with contracts for internet access with domestic operators, have to provide for their subscribers access to the system for measuring the quality parameters and to provide sufficient capacity via the operator with whom they have signed a contract, for access to the system for measuring the quality parameters and its module.
- (3) The operators should not, via their deep packet inspection systems or in any other way, give priority or block packets of the subscribers to the system for measurement of the quality parameters. The deep packet inspection system shall analyse, classify, and filter the packets transmitted via the operator's network.
- (4) The service quality and quality parameters concerning the interconnection points with international operators and web services accessed by subscribers shall not be subject of the control referred to in this Rulebook, except with regard to the restrictions of services implemented by the operators.

Article 9

Measuring of quality parameters of public electronic communication services provided via mobile communication network

The Agency shall, by using measuring equipment, conduct regular measurements of the quality parameters of public communications service provided via mobile communication network.

Article 10

- (1) The quality parameters defined in this Rulebook apply to all operators offering public electronic communication services through their own mobile communication networks with one or more Mobile Network Codes (MNCs). If the operator has multiple identification codes (MNC codes), then the quality parameters defined in the Rulebook apply to each MNC separately.
- (2) In the event of a dispute initiated by a subscriber or end user, the quality parameters defined in this Rulebook that refer to the operator with whom the subscriber contract is entered into shall be

measured, regardless of whether the operator owns its own or is leasing a mobile communication network.

Article 11

Quality parameters of public electronic communication services provided via mobile communication network

(1) The Agency shall measure the following quality parameters of public communication services provided via mobile communication network, as defined in Appendix 4 of this Rulebook, an integral part thereof:

a) technology-dependent parameters:

- measured signal level (individually by technology)

b) service-dependent parameters:

- Voice services:

- o network availability,
- o service accessibility (percentage of failed calls),
- o service sustainability (percentage of interrupted calls),
- o call set-up time
- o speech quality

- Data transmission:

- Service Access Failure Ratio (SAFR) (%)
- Service Session Failure Rate (SSFR) (%)
- Data transmission speed over radio communication network (GPRS, EDGE, 3G, LTE and 4G)
- Time share where the measured telephone has operated within individual technologies (GSM, UMTS, and LTE)

(2) The Operator shall be obliged to provide the following types of technical conditions free of charge: SIM cards without any restrictions on voice and data restrictions, IVR voice numbers, FTP/HTTP data server, to be used for the purpose of measuring the quality parameters of public communication services. The Operator shall not assign any priorities to the SIM cards designated for use in measuring the quality parameters of public electronic communications services and/or to the IMEI number of the mobile phones used by the Agency for this purpose.

(3) The Operator shall be obliged to provide for the Agency, upon a request from the latter, option to attach files with various size, larger than 1024 MB, to the FTP/HTTP server of the former for the purpose of measuring data transmission speeds, for a period not exceeding 7 days from the date of the request.

(4) The Operator shall be obliged to provide FTP/HTTP functionality of the data transfer servers and to maintain them in order to enable uninterrupted operation while AEC performs the measurements. AEC will inform the operators of the start of the measurements used for creation of the National Report.

Article 12

Test routes and/or test locations

(1) Quality parameters measurements shall be conducted in populated areas with over 15000 inhabitants as defined in Appendix 7, or on the test routes defined in Appendix 6 or at stationary points.

(2) The recommendations of ETSI EG 202 057 shall be taken into account when creating the test routes and test locations.

(3) Specific test routes may include locations where the Operator has not declared network coverage, and shall be defined in Appendix 6 of this Rulebook. In such case, the measurements would enable the service users easy access to the quality parameters, signal level, and the technology used by the Operator to provide the services, as well as comparison between two or more operators.

- (4) The results obtained from the completed measurements may be compared only if the same measuring methodology has been used.
- (5) Test location measurements of quality parameters may be conducted at locations where the Operator has declared network coverage and where the service user expects to have service reception. Such measurements shall be conducted in order to verify the conditions contained in the contract between the Operator and the end user.
- (6) The measurements referred to in paragraph (5) of this Article shall be conducted in accordance with the methodologies prescribed in Appendix 5 of this Rulebook.

Article 13

Measuring DVB-T signal quality parameters

(1) The Agency shall also measure the signal of the digital terrestrial television (DVB-T). The signal of the signal of the digital terrestrial television has to comply with the norms stated in the Final Acts of the Regional Radiocommunication Conference on planning the digital terrestrial broadcasting services in regions 1 and 3, for frequency bands 174-230 MHz and 470-862 MHz (RRC-06). The Agency for Electronic Communications shall perform the DVB-T signal quality measurements as per the following recommendations: ITU-R SM.1447, ITU-R SM.1875, ITU-R BT.1735, as well as the Spectrum Monitoring Handbook 2011 edition, Chapters 4.11 and 5.2.

(2) The Agency shall measure the following quality parameters for digital terrestrial television (DVB-T):

- SFN channel and demodulation
- Transmitter identification
- Geographic coordinates of the measurement point
- Cumulative strength of electric field - signal level (E)
- Modulation Error Rate (MER)
- Bit Error Rate Before Viterbi (CBER)
- Bit Error Rate after Viterbi (VBER).

Hereinafter, wherever BER is mentioned it shall refer to BER after Viterbi decoding.

The results of the measurements and the values of the quality parameters shall be presented on a map on the Agency web site at the following link: www.komuniciraj.mk (Appendix 8).

Article 14

Measuring methodologies

The Agency shall develop measuring methodologies that will be used to measure the quality parameters of public electronic communication services provided via public mobile communication networks. Said methodologies to be used for measuring are provided in Appendix 5 of this Rulebook.

Article 15

Submission of network coverage data

(1) The operators of owned mobile communication networks shall be required to submit quarterly to the Agency, within 30 days after the end of quarter, network coverage data (coverage of territory and coverage of population for which the current data issued by the State Statistics Office or RM is used) for their respective networks as per the instructions provided in Appendix 3 of this Rulebook, as well as data on the network coverage as per the authorisation for use of radiofrequencies.

(2) Network coverage parameters and network coverage maps that are submitted by the operators to the Agency are defined in Appendix 3.

Article 16

Publishing the measurement data

(1) The Agency shall publish the data of its own measurements on the website, including a statistical overview, broken down by inhabited area, as per Appendix 7 and by test route as per Appendix 6 of this Rulebook, and by operator, showing the number of conducted measurements used in the analysis. The measurement data shall be presented in such a way as to be easily read and understood by the reader.

(2) The published measurement data will enable the citizens easy insight in the quality parameters, signal level, and the technology used by the Operator to provide the services, as well as comparison between two or more operators. The Agency will publish the measurement data at national level, by inhabited area, and by test route. The Agency will publish the measurement results of DVB-T at stationary points.

(3) In case it is established during the measurements that in a specific area the Operator does not have network coverage or the measured signal level is lower than the level defined in Appendix 3 of this Rulebook, such area shall be designated by the Agency as area with no network coverage by the Operator, and said Operator shall be informed thereof in order to correct the coverage map, or correct the coverage so as to correspond to the coverage presented on the map.

(4) The layout and the format of the reports of the Agency's own measurements of the quality of services provided by the operators are enclosed as Appendices 8 and 9 of this Reulbook.

Article 17 **Entry into force**

This Rulebook shall enter into force on the day of its publication in the Official Gazette of the Republic of Macedonia. Upon entry into force of this Rulebook, the Rulebook shall be published on the Agency web-site, and the Rulebook published in the "Official Gazette of Republic of Macedonia no. 185/2014 and 121/2015 shall cease to be valid.

Upon its entry into force, the Rulebook shall be published on the Agency's website.

No. 0101-1430/2
Skopje, April 25th, 2017

Director
Sasho Dimitrijoski, sig. affixed

APPENDIX 1

QUALITY PARAMETERS OF PUBLIC ELECTRONIC COMMUNICATION SERVICES

Operators shall have to submit the measurements of all service quality parameters listed in Appendix 1 to the Agency of Electronic Communications. The measurements of service quality parameters listed in Appendix 1 shall be conducted following the manner and procedure established in the integral parts of ETSI EG 202 057, and in accordance with the tables in Appendix G.

The following parameters should be measured and included in an annual report submitted to the Agency:

I. Quality parameters of public electronic communications services via fixed access network

- time for establishing the initial access to a public communication network at fixed location;
- time for initial connection to broadband access services;
- call set-up time;
- number of failed calls;
- number of faults in the subscriber line;
- time to recovery from fault in a fixed subscriber line;
- number of faults on a fixed line subscriber line remedied the next business day; number of complaints of subscribers to broadband access services
- number of subscriber complaints pertaining to the bill amount;
- response time of the operator service;
- response time of the info-service.

II. Quality parameters for publicly available telephony services via public mobile communication network

- number of subscriber complaints;
- number of subscriber complaints pertaining to the bill amount;
- response time of the operator service;
- end-to-end SMS delivery time.

III. Quality parameters for public services for data transmission via public mobile communication network

- number of successful log-ins, and
- number of complaints of subscribers to mobile broadband access services.

QUALITY PARAMETERS OF PUBLIC VOICE SERVICES OVER FIXED NETWORKS		
Definition	Measurement	Period for submitting a report to AEC
Time for establishing the initial access to a public communication network at fixed location		
Duration from the moment when the Operator providing the service received a request for a valide service, up to the moment when the service has become available to the end user. This includes cases of installing a new access line; existing line is transferred to another user; or the existing line is upgraded.	<ul style="list-style-type: none"> ➤ % of completed requests up to the date agreed upon with the user; ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-1 	<ul style="list-style-type: none"> ➤ Annually
Time of initial connection to fixed (wired) broadband access services		

Time of initial connection to fixed broadband access services refers to the time from the date of the application until the date of service activation. Mean time of connection for all new requests received during the year should be stated.	<ul style="list-style-type: none"> ➤ The total number of requests for new connections at annual level, and the mean time for initial connection are submitted 	<ul style="list-style-type: none"> ➤ Annually
Call set-up time		
Time period beginning at the moment when the information for call set-up has been received by the network and ending when the caller has received a signal for a busy-line or ringing at the side of the callee.	<ul style="list-style-type: none"> ➤ Mean value (in seconds); ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-2 	<ul style="list-style-type: none"> ➤ Annually
Number of failed calls (%)		
Ratio of failed calls and total call attempts within a specified time period. Failed call shall be a call attempt to an existing telephone number, where the caller does not get a busy-line or ringing tone, nor a response within 30 seconds from the moment when the information for the number required for call set-up has been received by the network.	<ul style="list-style-type: none"> ➤ % of failed calls; ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-2 	<ul style="list-style-type: none"> ➤ Annually
Number of faults in the subscriber line		
Report on the faults per subscriber line shall be the number of degraded services, reported by the user, and attributed to the Operator providing the service or any other public communication network. Faults in any of the equipment on the subscriber's side are excluded.	<ul style="list-style-type: none"> ➤ Number of reported faults annually, and average number of subscriber lines for the same year; ➤ The measurement to be conducted in accordance with ETSI EG 202 057-1 	<ul style="list-style-type: none"> ➤ Annually
Time to recovery from fault on fixed subscriber lines		
Time period beginning at the moment when the user has notified the Operator providing the service of a fault, up to the moment when the service has been restored to a normal operating mode.	<ul style="list-style-type: none"> Time to recovery from valid faults on the access line (in hours); ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-1 	<ul style="list-style-type: none"> ➤ Annually
Number of faults on a fixed subscriber line remedied the next business day		
Number of faults on a fixed subscriber line remedied the next business day refers to the number of reported faults removed by the end of the next business day (excluding weekends and holidays)	<ul style="list-style-type: none"> ➤ Number of faults on a fixed subscriber line remedied the next business day 	<ul style="list-style-type: none"> ➤ Annually
Number of complaints of subscribers to broadband access services		
Number of subscriber complaints pertaining to (wired) broadband access services includes all complaints related to the provision of fixed (wired) broadband services received during the year, regardless of the validity and subject matter of the complaint.	<ul style="list-style-type: none"> ➤ The number of complaints per year, and the average number of subscribers to (wired) broadband access services for the same year have to be submitted 	<ul style="list-style-type: none"> ➤ Annually
Number of subscriber complaints pertaining to the bill amount (%)		
Part of the bills for which the subscriber have submitted	<ul style="list-style-type: none"> ➤ % of the bills for which 	<ul style="list-style-type: none"> ➤ Annually

valid complaints with regards to the amount	the subscriber has submitted a complaint related to the amount	
Response time of the operator service		
Duration from the moment when the information for the number required for call set-up has been received by the network, up to the moment when the Operator has responded to the user for the purpose of providing the requested service. Automatic services are excluded.	<ul style="list-style-type: none"> ➤ Mean time to response by the operator service ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-1 	➤ Annually
Response time of the info-service		
Duration from the moment when the information for the number required for call set-up has been received by the network, up to the moment when a human operator or an automatic voice response system has responded to the user for the purpose of providing the information on the requested number.	<ul style="list-style-type: none"> ➤ Response time of the info-service; ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-1 	➤ Annually

QUALITY PARAMETERS FOR PUBLIC MOBILE COMMUNICATION SERVICES VIA RADIO COMMUNICATION NETWORK		
Definition	Measurement	Period for submitting a report to AEC
Number of subscriber complaints		
Number of all complaints related to the provision of mobile services (including voice, SMS and data) received during the year regardless of their validity	<ul style="list-style-type: none"> ➤ The number of complaints per year, and the average number of subscribers for the same year have to be submitted 	Annually
Number of subscriber complaints pertaining to the bill amount		
Part of the bills for which the subscriber have submitted valid complaints with regards to the amount	<ul style="list-style-type: none"> ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-3 	➤ Annually
Response time of the operator service		
Duration from the moment when the information for the number required for call set-up has been received by the network, up to the moment when the operator has responded to the user for the purpose of providing the requested service. Automatic services are excluded.	<ul style="list-style-type: none"> ➤ Mean waiting time of the subscriber 	➤ Annually
SMS delivery time		
The end-to-end SMS delivery time shall be time period beginning with the moment of sending the SMS from the terminal equipment and ending with the receipt of the same SMS at another terminal equipment.	<ul style="list-style-type: none"> ➤ Mean value in seconds for sending and receiving SMS; ➤ The measurement has to be conducted in accordance with ETSI EG 202 057-2 	➤ Annually

QUALITY PARAMETERS FOR PUBLIC SERVICES FOR DATA TRANSMISSION VIA RADIO COMMUNICATION NETWORK

Definition	Measurement	Period for submitting a report to AEC
Number of successful log-ins		
Number of successful log-ins to the internet, when both the access network and the IAP network are available and fully functional.	<ul style="list-style-type: none"> ➤ % of successful log-ins ➤ [ETSI EG 202 057-4] 	<ul style="list-style-type: none"> ➤ Annually
Number of complaints of subscribers to mobile broadband access services		
Number of complaints of subscribers to mobile broadband access services refers to the number of complaints pertaining to the provision of mobile broadband services, regardless of the complaint's validity and the subject matter.	<ul style="list-style-type: none"> ➤ The number of complaints, and the average number of subscribers have to be submitted 	<ul style="list-style-type: none"> ➤ Annually

APPENDIX 2

Operators shall have to publish their own measurements for a portion of the quality parameters for the services listed in Appendix 2. The parameters that have to be measured and submitted as quarterly reports to the Agency shall include:

I. Quality parameters for public mobile telephony services via radio communication network

- network coverage;
- service accessibility - percentage of failed calls;
- call set-up time;
- service sustainability - percentage of interrupted calls;
- transmitted SMS messages.

II. Quality parameters of public services for data transmission via cable network for broadband internet access

- availability in the telephony exchange resources;
- network latency;
- bandwidth utilisation;
- data transmission speed over the cable network for broadband internet access.

III. Data transmission speed over radio communication network (3G, LTE and 4G)

QUALITY PARAMETERS FOR PUBLIC MOBILE COMMUNICATION NETWORK			
Definition	-Declared level	Target value	Period for submitting a report to AEC
Network coverage			
Declared signal levels by the network operator. Threshold values for network coverage: GSM: RxLev > -95dBm RxQual < 4 UMTS: CPICH RSCP > -105dBm и CPICH Ec/No > -12 dB At receiver height between 1.7-3 m	GSM		Territory %
	Good: RxLev > -85 dBm		Population %
	Acceptable: -95 dBm < RxLev ≤ -85 dBm		quarterly
	Poor: -103 dBm < RxLev ≤ -95 dBm		quarterly
	Unacceptable: RxLev ≤ -103 dBm		quarterly
	UMTS		
	Good: CPICH RSCP > -95 dBm		quarterly
	Acceptable: -105 dBm < CPICH RSCP ≤ -95 dBm		quarterly
	Poor: -115 dBm < CPICH RSCP ≤ -105 dBm		quarterly
	Unacceptable: CPICH RSCP ≤ -115 dBm		quarterly
Service accessibility - percentage of failed calls			
Failed call shall be a call attempt to a valid number, within the coverage area, whereby the call is not answered, nor the caller has received a busy-line or a ringing tone for access within 30 seconds from the moment when the network has received the last digit of the callee's number.	$\left(\frac{\text{count of attempts to access a traffic channel} - \text{count of successfully accessed traffic channels}}{\text{count of attempts to access a traffic channel}} \right) * 100$ ETSI EG 202 057-3 Separate values for the count of attempts to access a traffic channel and the count of successfully accessed traffic channels are submitted	➤ The percentage of failed national and international calls < 2%	➤ quarterly
Call set-up time			
The call set-up time may be defined as a time interval between the moment when the user has sent a request for connection, and the moment when the caller has received "ALERTING" that the call has been set-up.	➤ Average call set-up time	➤ Average delay after dialing the number at nominal network load for national calls; <ul style="list-style-type: none"> ○ Mobile to mobile: < 7s; ○ Mobile to fixed: < 5s. 	➤ quarterly
Service sustainability - percentage of interrupted calls			
Percentage of calls that have been successfully established and has been allocated a traffic channel, interrupted before being terminated by the end user, and the reason thereof premature interruption in the Operator's network.	➤ $(\text{Interrupted Calls} / \text{Successful Calls}) * 100\%$ Separate values for interrupted calls and	➤ < 2% during busy hour; ➤ < 1% throughout the whole month	➤ quarterly

	successful calls are submitted		
Interrupted calls per base station The data is submitted in an excel spreadsheet	➤ (Interrupted Calls / Successful Calls)*100%	≤3 calls per base station	➤ quarterly
Transmitted SMS messages			
Count of SMS messages transmitted during ≤ 2 min	➤ (count of SMS messages transmitted during ≤ 2 min / total count of transmitted SMS messages) * 100%	> 95 %	quarterly
Data transmission speed over radio communication network (UMTS and LTE)			
Average data transmission speed achieved when downloading particular files between the operator and the user terminals.	➤ Average data transmission speed (application layer) via radio communication networks for all users by operator (Mbps): showing the average data transmission speed (at application layer) via radio communication network (in Mbps) in the time interval of the measurement referring to the specific concerned cell as its full available capacity, and not per single user.		quarterly
Percentage of time where the customer premises equipment has been active in specific technologies (GSM, UMTS and LTE)			
Volume of data transferred by technology (GSM, UMTS and LTE) for each MNC individually	Volume of transferred data by specific technology (GSM, UMTS and LTE) for each MNC individually		quarterly
Number of customer premises equipment (users) in the network supporting LTE technology for each MNC individually			quarterly
Number of users who have used the service for the data transmission via LTE technology for each MNC individually			quarterly
Average volume of data transferred by subscriber by technology for each MNC individually	The average volume of transferred data shall be total volume of data transferred per technology/number of subscribers per technology (for each MNC individually)		quarterly

QUALITY PARAMETERS OF PUBLIC SERVICES FOR DATA TRANSMISSION VIA CABLE NETWORK FOR BROADBAND INTERNET ACCESS			
Definition	Measurement	Mandatory target value	Period for submitting a report to AEC
Network availability			
The network availability is a measure for the extent of availability of the access network, in circumstances without faults and power supply disruptions. The duration of network outages, including the switching equipment, multiplexers, and routers, is thereby measured. All announced outages due to network maintenance and upgrades shall be excluded.	<ul style="list-style-type: none"> ➤ Availability of access network resources 	<ul style="list-style-type: none"> ➤ > 99.9% 	<ul style="list-style-type: none"> ➤ quarterly
Network latency			
Duration from the moment when a data packet has been sent to a test server, up to the moment when the receipt message for that packet has been received.	<ul style="list-style-type: none"> ➤ Delay variation (ms) 	<ul style="list-style-type: none"> ➤ Local traffic $\leq 50\text{ms}$; ➤ International traffic $\leq 300\text{ms}$ 	<ul style="list-style-type: none"> ➤ quarterly
Bandwidth utilisation			
The bandwidth utilisation shall be defined as ratio of achieved data speed and maximum throughput that may be provided via specific communication channel, used by the Operator providing internet access to connect with another operator	<ul style="list-style-type: none"> ➤ Bandwidth utilisation (%) 	<ul style="list-style-type: none"> ➤ $\leq 90\%$ 	<ul style="list-style-type: none"> ➤ quarterly
Data transmission speed via cable network for broadband internet access			
Data transmission speed achieved when downloading and uploading specific test files between the Operator and the user's terminal device.	<ul style="list-style-type: none"> ➤ Data transmission speed via cable network for broadband internet access (kbps/Mbps) 	<ul style="list-style-type: none"> ➤ ≥ 512 kbps upload; ➤ ≥ 2 Mbps download 	

APPENDIX 3

Methodology for submission of public mobile communication network coverage files - map coverage files

The operators have to submit their coverage maps in the following format:

The map coverage files shall be submitted in an electronic format with the following properties:

1. Nomenclature: Operator name_Technology_Date(yyyymm).zip

2. Technical properties

- Signal reception level (defined colour map):

- GSM

- Good (RxLev > -85dBm, blue- $RGB(0,0,255)$);
- Acceptable ($-95dBm < RxLev \leq -85dBm$, green- $RGB(0,128,128)$);
- Outdoor coverage ($-103dBm < RxLev \leq -95dBm$, red- $RGB(255,0,0)$);
- Unacceptable ($RxLev \leq -103dBm$, transparent)

Definition of network coverage (threshold value for network coverage):

- RxLev > -95dBm

- UMTS

- Good (CPICH RSCP > -95dBm, light blue- $RGB(51,102,255)$);
- Acceptable ($-105dBm < CPICH RSCP \leq -95dBm$, light green- $RGB(51,204,204)$);
- Outdoor coverage ($-115dBm < CPICH RSCP \leq -105dBm$, red- $RGB(255,0,0)$);
- Unacceptable ($CPICH RSCP \leq -115dBm$, transparent)

Definition of network coverage (threshold value for network coverage):

- CPICH RSCP > -105dBm and
- EcNo > -12dB

- LTE

- Levels higher than -100dBm RSRP > -100dBm shall be defined with good signal $RGB(0,0,255)$);
- Acceptable ($-110dBm < RSRP \leq -100dBm$, green- $RGB(0,128,128)$);
- Outdoor coverage ($-115dBm < RSRP \leq -110dBm$, red- $RGB(255,0,0)$);
- Unacceptable ($RSRP \leq -115dBm$, transparent)

Definition of network coverage (limit value where network coverage shall be deemed as existent):

- RSRP > -110 dBm

- DVB-T

- Levels higher than $56dBm\mu V/m$, Rx level > $56dBm\mu V/m$ shall be defined with blue signal $RGB(0,0,255)$);
- For other areas there will be no network coverage (transparent)

- Resolution-pixel size (grid cell)= 50m x 50m
- Coverage probability within the pixel = min. 50% (in case the planning application has this option)
- Map coverage files should be limited by the borders of the Republic of Macedonia (if the Operator does not have such border map, it will be provided accordingly)
- The following background layers have to be used for prediction in the coverage file: DTM/DEM (Digital Terrain Model/Digital Elevation Model) with minimum resolution of 50m, Radio Clutter Data for the whole territory of Macedonia and other spatial data at disposal to the Operator for the purpose or more accurate coverage prediction

3. Data format
 - Raster image or grid format
 - ASCII txt, GeoTIFF (tiff + tfw file), Vertical Mapper Grid, Map Infomap
 - Projection/Date/Coordinate System – WGS 84, UTM 34N, metric
4. BSFF (Base Station File Format) – Format for submitting the base station locations and their properties:

Manual for file creation:

General structure:

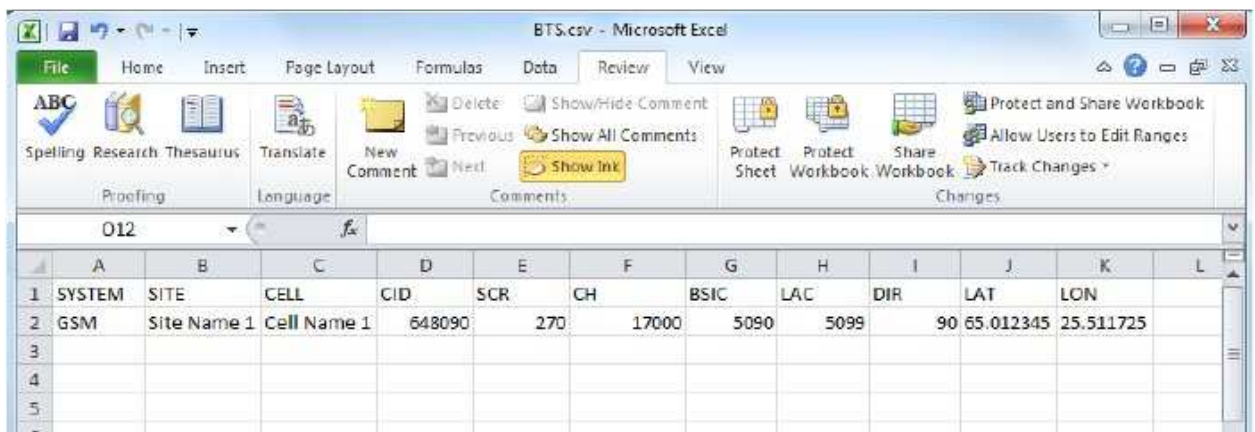
First line in the file shall contain the **keywords** defining the order of the parameters in the next lines. Keywords are separated by a semicolon or a tab character and are defined in the tables below.

The other lines in the file shall contain the cell definitions. Each line shall describe one cell and shall contain a parameter set describing it, as well as the cell location data. There are mandatory and optional parameters for the location and the cell. The location and cell parameters shall be separated by a semicolon or a tab character.

Creation of BTS files:

The BTS files may be created in MS Excel, as provided in the example below, saved in .CSV format, and then the change the .CSV format into the .nbf extension.

Example:



Please find below the required and optional parameters for UMTS and GSM cells:

UMTS cell parameters

MANDATORY PARAMETERS with a 28-bit Cell ID

Parameter	Keyword	Type	Description
System	SYSTEM	String	UMTS
Site Name	SITE	String	Location name
Cell Name	CELL	String	Specific cell identification. If there is no distinctive cell identification, the 28-bit cell ID may be used.
Channel Number	CH	Integer	UARFCN. Values ranges: UMTS 850: 4357-4458, 1007, 1012, 1032, 1037, 1062, 1087

			UMTS 900: 2935-3090 UMTS 1900: 9662-9938, 412, 437, 462, 487, 512, 537, 562, 587, 612, 637, 662, 687 UMTS 2100: between 10550 and 10850 UMTS 2100 AWS: 1535-1740, 1887, 1912, 1937, 1962, 1987, 2012, 2037, 2062, 2087
Scrambling Code	SCR	Integer	Values range between 0 and 512
Cell ID	CID	Integer	Cell ID. 28-bit Cell ID ("UC-Id" in 3GPP) is a concatenation of RN-ID and C-ID
Antenna Direction	DIR	Integer	Values range between 0 and 360

MANDATORY PARAMETERS with a 16-bit Cell ID and RNC ID

Parameter	Keyword	Type	Description
System	SYSTEM	String	UMTS
Site Name	SITE	String	Location name
Cell Name	CELL	String	Specific cell identification. If there is no distinctive cell identification, the 28-bit cell ID may be used.
Channel Number	CH	Integer	UARFCN. Values ranges: UMTS 850: 4357-4458, 1007, 1012, 1032, 1037, 1062, 1087 UMTS 900: 2935-3090 UMTS 1900: 9662-9938, 412, 437, 462, 487, 512, 537, 562, 587, 612, 637, 662, 687 UMTS 2100 between 10550 and 10850 UMTS 2100 AWS: 1535-1740, 1887, 1912, 1937, 1962, 1987, 2012, 2037, 2062, 2087
Scrambling Code	SCR	Integer	Values range between 0 and 512
Cell ID	CID_16	Integer	Cell ID. 16-bit Cell ID. C-ID
RNC ID	RNCID	Integer	RNC ID. The 12-bit RNC identity. Cell-ID (28 bit)=RNCID (12 bit)+CI (16 bit).
Antenna Direction	DIR	Integer	Values range between 0 and 360

OPTIONAL PARAMETERS

Parameter	Keyword	Type	Description
LAC	LAC	Integer	Location Area Code. Values range between 0 and 65535
RAC	RAC	Integer	Routing Area Code. Values range between 0 and 255
URA	URA	Integer	UTRAN Registration Area

RNC ID	RNCID	Integer	Radio Network Controller ID.
Antenna Height	HEIGHT	Integer	Values range between 0 and 1000
Antenna Tilt	TILT	Float	Values range between -90 and 90
Antenna Beam Width	BEAM	Integer	Values range between 1 and 360
Cell Range	RANGE	Integer	In meters
Cell Type	TYPE	String	NORMAL or REPEATER
Neighbor Cell Name	NCELL_n	String	Specific identification of the n-th adjacent cell.
User-defined column name	User defined	String	Text

Example with a 28-bit Cell ID:

```
SYSTEM;SITE;LAT;LON;CELL;CH;BSIC;CID;SCR;DIR;NCELL_1;NCELL_2;NCELL_3
UMTS;Site Name 1;65.066053;25.458366;Cell Name
1;10838;;123811;96;0;NEMO1;NEMO2;NEMO3
UMTS;Site Name 1;65.066053;25.458366;Cell Name
2;10838;;123758;2;0;NEMO4;NEMO5;NEMO6
UMTS;Site Name 1;65.056053;25.458366;Cell Name
3;10838;;123769;4;90;NEMO7;NEMO8;NEMO9
```

Example with a 16-bit Cell ID:

```
SYSTEM;SITE;LAT;LON;CELL;CH;BSIC;CID_16;RNC_ID;SCR;DIR;NCELL_1;NCELL_2;NCELL_3
UMTS;Site Name 1;65.066053;25.458366;Cell Name
1;10838;;58275;1;96;0;NEMO1;NEMO2;NEMO3
UMTS;Site Name 1;65.066053;25.458366;Cell Name
2;10838;;58222;1;2;0;NEMO4;NEMO5;NEMO6
UMTS;Site Name 1;65.056053;25.458366;Cell Name
3;10838;;58233;1;4;90;NEMO7;NEMO8;NEMO9
```

GSM cell parameters

MANDATORY PARAMETERS

Parameter	Keyword	Type	Description
System	SYSTEM	String	GSM
Site Name	SITE	String	Location name
Cell Name	CELL	String	Specific cell identification. If there is no distinctive cell identification, a combination of LAC and CID may be used.
Channel Number	CH	Integer	ARFCN. Values range between 0 and 1024
BSIC (dec)	BSIC	Integer	Base Station Identity Code in a decimal format. Values range between 0 and 63
Cell ID	CID	Integer	Cell identification. Values range between 0 and 65535

LAC	LAC	Integer	Location Area Code. Values range between 0 and 65535
Antenna Direction	DIR	Integer	Values range between 0 and 360

OPTIONAL PARAMETERS

Parameter	Keyword	Type	Description
RAC	RAC	Integer	Routing Area Code. Values range between 0 and 255
Antenna Height	HEIGHT	Integer	Values range between 0 and 1000
Antenna Tilt	TILT	Float	Values range between -90 and 90
Antenna Beam Width	BEAM	Integer	Values range between 1 and 360
Cell Range	RANGE	Integer	In meters
Cell Type	TYPE	String	NORMAL or REPEATER
Neighbour Cell Name	NCELL_n	String	Specific identification of the n-th adjacent cell.
User-defined column name	User defined	String	Text

Example:

```
SYSTEM;SITE;LAT;LON;CELL;CH;BSIC;CID;LAC;DIR;NCELL_1;NCELL_2;NCELL_3
GSM;Site Name 1;65.066053;25.458366;Cell Name
1;64;1;12500;65231;0;NEMO1;NEMO2;NEMO3
GSM;Site Name 1;65.066053;25.458366;Cell Name 2;41;1;12501;
65231;90;NEMO5;NEMO6;NEMO7
GSM;Site Name 1;65.066053;25.458366;Cell Name 3;2;1;12502;
65231;45;NEMO8;NEMO9;NEMO10
```

APPENDIX 4

MANDATORY VALUES OF MEASURED QUALITY PARAMETERS OF PUBLIC MOBILE COMMUNICATION SERVICES VIA RADIO COMMUNICATION NETWORK THE PARAMETERS ARE MEASURED ON TEST ROUTES AND LOCATIONS WITH MOBILE MEASURING EQUIPMENT			
Definition	Measurement	Mandatory target value	
Measured signal level*			
Registered signal level by the mobile device for the duration of the predefined test route. The measurements are done for each technology individually.	<ul style="list-style-type: none"> ➤ Signal strength at various frequency bands ➤ GSM: Good: RxLev > -85dBm Acceptable: -95dBm < RxLev ≤ -85dBm Outdoor coverage: -103dBm < RxLev ≤ -95dBm Unacceptable: RxLev ≤ -103dBm ➤ UMTS: Good: CPICH RSCP > -95 dBm Acceptable: -110dBm < CPICH RSCP ≤ -100dBm Outdoor coverage: -115dBm < CPICH RSCP ≤ -110Bm Unacceptable: CPICH RSCP ≤ -115dBm 		
Voice transmission – irrespective of technology used for service provision			
Network availability			
Network availability – duration of time when the mobile device detects signal coverage irrespective of technology, as minimum condition to begin using a specific service.	(Time when the mobile device detects signal coverage/total time of the measurement)*100%	Above 99%	
Service accessibility - percentage of failed calls			
Failed call shall be a call attempt to a valid number, within the coverage area, whereby the call is not answered, nor the caller has received a busy-line or a ringing tone for access within 30 seconds from the moment when the network has received the last digit of the callee's number.	((Total number of call attempts – number of successfully established calls)/(Total number of call attempts))*100%	Percentage of unsuccessful calls < 2%	
Call set-up time			
The call set-up time may be defined as a time interval between the moment when the user has sent a request for	Average call set-up time	Mean value of delay after dialling the number of the	

connection, and the moment when the caller has received “ALERTING” that the call has been set-up.		total number of measurements1: <ul style="list-style-type: none"> ○ Mobile to mobile: < 7s; ○ Mobile to fixed: < 5s. 													
Service sustainability - percentage of interrupted calls															
Percentage of calls that have been successfully established and has been allocated a traffic channel, interrupted before being terminated by the end user, and the reason thereof premature interruption in the Operator’s network.	(Interrupted Calls / Successful Calls)*100%	< 2%													
Speech quality															
Speech quality MOS scores are registered, obtained from measurements in accordance with ITU-T-P.800 MOS scale according to G.107: <ul style="list-style-type: none"> • The MOS evaluation is combined with an E-model, that is to say, the R transmission factor is ascertained. • This factor takes into account the following criteria when evaluating the voice: <ul style="list-style-type: none"> • Basic signal-to-noise ratio • Simultaneous impairment factor • Delay impairment factor • Equipment impairment factor • Advantage factor 	MOS scale according to G.107: <table border="1" style="width: 100%;"> <tr> <td>Very satisfied</td> <td>4.34 - 5.00</td> </tr> <tr> <td>Satisfied</td> <td>4.03 - 4.33</td> </tr> <tr> <td>Some users are satisfied</td> <td>3.60 - 4.02</td> </tr> <tr> <td>Many users are not satisfied</td> <td>3.10 - 3.59</td> </tr> <tr> <td>Almost all users are not satisfied</td> <td>2.58 - 3.09</td> </tr> <tr> <td>Not recommended</td> <td>1.00 - 2.57</td> </tr> </table>	Very satisfied	4.34 - 5.00	Satisfied	4.03 - 4.33	Some users are satisfied	3.60 - 4.02	Many users are not satisfied	3.10 - 3.59	Almost all users are not satisfied	2.58 - 3.09	Not recommended	1.00 - 2.57		Values are of informative nature
Very satisfied	4.34 - 5.00														
Satisfied	4.03 - 4.33														
Some users are satisfied	3.60 - 4.02														
Many users are not satisfied	3.10 - 3.59														
Almost all users are not satisfied	2.58 - 3.09														
Not recommended	1.00 - 2.57														
Data transmission															
Percentage of failed attempts to establish an incoming HTTP connection															
Probability that a subscriber may not establish a HTTP connection to a link providing the service.	Failed attempts to establish a HTTP connection / Total number of attempts to establish a HTTP connection	<=20	Pertains only to measurements related to disputes between subscribers and operators												
Service Session Failure Rate (SSFR) (%)															
Ratio between established HTTP sessions and sessions not terminated by user	HTTP sessions not terminated by the user / Successfully initiated HTTP sessions	<=4	Pertains only to measurements related to disputes between subscribers and operators												
Data transmission speed over radio communication network (GPRS, UMTS, and LTE)															
Average data transmission speed achieved when downloading a 1024MB test file between the Operator and the user’s terminal device via FTP download	Average data transmission speed (Application Layer) over public radio communication network (Mbps) within the measuring interval	> 20 Mbps	Data transmission speed by inhabited area												
Average data transmission speed achieved when downloading a 1024MB test file between the Operator	Average data transmission speed (Application Layer) over public radio	> 10 Mbps	Data transmission speed by test route (road sections)												

and the user's terminal device via FTP download	communication network (Mbps) within the measuring interval		
Percentage/share of time where the measured telephone has operated by individual technology (GPRS, UMTS, and LTE)			
Percentage/share of time where the measured telephone has operated by individual technology (GSM, UMTS, and LTE)	Percentage of time where the measured telephone has operated by individual technology	>=10% (minimum limit value for the percentage of time where the telephone has operated in LTE technology for each MNC)	
DVB-T signal Electric field strength of DVB-T signal and BER			
Electric field strength of DVB-T signal measured at a radio receiver at stationary points Bit Error Rate (BER)	Cumulative electric field strength Bit Error Rate after Viterbi - VBER	E >= 56 dBµV/m	Information on the electric field strength of a DVB-T signal will be shown on a map, including information on the measured data, channel, operator name, transmitter, allotment zone, MER, BER and coverage information

* Graphic overview of measured quality parameters, as presented in the table of this Appendix in an electronic format and having the following properties:

1. Technical properties

Signal reception level (defined colour map):

GSM

- o Good (RxLev > -85dBm, blue-RGB (0,0,255));
- o Acceptable (-95dBm < RxLev ≤ -85dBm, green-RGB(0,128,128));
- o Outdoor coverage (-103dBm < RxLev ≤ -95dBm, red-RGB(255,0,0));
- o Unacceptable (RxLev ≤ -103dBm, white-RGB(255,255,255))

UMTS

- o Good (CPICH RSCP > -95dBm, light blue-RGB (51,102,255));
- o Acceptable (-105dBm < CPICH RSCP ≤ -95dBm, light green-RGB(51,204,204));
- o Outdoor coverage (-115dBm < CPICH RSCP ≤ -105dBm, red-RGB(255,0,0));
- o Unacceptable (CPICH RSCP ≤ -115dBm, white-RGB(255,255,255))

LTE

- Levels higher than -100dBm RSRP > -100dBm shall be defined with good signal RGB (0,0,255));
- Acceptable (-110dBm < RSRP ≤ -100dBm, green-RGB(0,128,128));
- Outdoor coverage (-115dBm < RSRP ≤ -110dBm, red-RGB(255,0,0));
- Unacceptable (RSRP ≤ -115dBm, white-RGB(255,255,255))

DVB-T

- Good DVB-T signal (E >= 56dBµV/m and BER <= 2*10⁻⁴), dark blue RGB (0,0,255));
- Acceptable DVB-T signal (E >= 56dBµV/m and BER > 2*10⁻⁴), light blue RGB (0,155,255));
- No coverage (E < 56dBµV/m), red RGB (255,0,0);

2. Data formats: .kml, .kmz, map info.

APPENDIX 5

METHODOLOGIES

The measurement methodologies for measuring public mobile network services shall observe the specifications defined in ETSI TS 102 250. Same measuring equipment, and measuring terminals are used for all operators. The measurements use the so called window methodology. The window can comprise only voice methodology, only voice quality measuring methodology, only data transfer methodology or combination thereof.

- Service quality measuring methodology - transmission of voice
 - o Benchmarking
 - All operators shall be measured simultaneously.
The window shall adhere to the following conditions:
 - To generate a call:
 - Call setup time – 30 sec;
 - Call duration
 - Scenario 1-90 sec.;
 - Scenario 2–120 sec.;
 - Pause between calls - 10 sec.
 - Window duration shall be 30 sec + 120 sec + 10 sec.
 - o Initiated dispute by subscribers or end users
 - OUTDOOR methodology - the measurements shall be conducted in the vicinity of the address in the contract of the subscriber or end user, who has initiated the dispute.
 - The window shall adhere to the following conditions:
 - Call setup time – 30 sec;
 - Call duration – 90 sec.;
 - Pause between calls – 10 sec.
 - Only Mobile Originated Call (MOC) shall be established.
 - The duration of the measurement should not be less than 120 minutes.
 - Window duration shall be 30 sec + 90 sec + 10 sec.
- Service quality measuring methodology – data transmission
 - o Methodology for measuring data transmission speed via public mobile communication network (GSM, UMTS, and LTE) using the FTP protocol
 - o Benchmarking
 - All operators shall be measured simultaneously.
 - Data transmission speed achieved when downloading test files between the Operator and the user's terminal device.
 - Call setup time shall be 30 sec.
 - The pause between two consecutive packet sessions shall be 15 sec.
 - The data transmission speed over the radio communication network shall be measured downstream at the Application Layer via radio communication network, using the HTTP protocol, of test files available on a HTTP server:
 - The test file shall be 5MB for measurement in populated areas.
 - The test file shall be 1MV for test routes.
 - Between each test file transfer in a session there will be a 5-second pause.
 - The time window shall consist of the time for establishing the

connection + default time for downloading the file. The time window shall be 90 seconds.

Initiated dispute by subscribers or end users

- Only the operator against whom complaint has been submitted shall be measured.
- Data transmission speed achieved when downloading test files between the Operator and the user's terminal device.
- Call setup time shall be 30 sec.
- The pause between two consecutive packet sessions shall be 15 sec.
- The data transmission speed over the radio communication network shall be measured downstream at the Application Layer via radio communication network, using the HTTP protocol, of test files available on a HTTP server:
- The test file shall be 1MB for test routes.
- Between each test file transfer in a session there will be a 5-second pause.
- The time window shall consist of the time for establishing the connection + default time for downloading the file. The time window shall be 90 seconds.
- The number of measured sessions shall not be less than 50.

Service quality measuring methodology – voice quality

- MOS rating - Mean Opinion Score - ITU defines it as values on a predefined scale, under which the entity (designated person) assesses, at its discretion, the performance of the transmission via telephone system, both conversing and listening to the voice material.
 - The system used by the Agency to capture the MOS is based on a POLQA algorithm. Perceptual Objective Listening Quality Assessment (ITU-T Rec. P.863) for obtaining a MOS-LQO score.
MOS-LQO – is an objective evaluation of the voice quality, and the scoring is done by generating calls and recording the MOS-LQO values.
 - The calls are generated using a Nemo Outdoor application for measuring the voice quality using a POLQA algorithm.
 - For generating calls, the scenario of "Methodology for measuring the quality of service transmission of voice" is used, including 3 handsets, application for voice communication and comparison - Nemo Media Router and Nemo Voice Server, with the option for mutual communication, in order to record and play the MOS-LQO values.
- o Voice quality is measured in the following directions:
- mobile device - server (outgoing);
 - or mobile device – mobile device;
- o Mobile to fixed or mobile to mobile call is established, and the MOS-LQO values are recorded in both directions:
- User side – mobile device (outgoing) – score obtained by the NMR at the mobile device.

Methodology for measuring a DVB-T signal

- All DVB-T operators shall be measured in stationary points with horizontally polarised antenna at 10m height above ground.
- Stationary measuring points are selected so as not to have a direct obstacle (object, tree, etc.) In close proximity, i.e. having direct visibility with the transmitting point if the terrain allows it
- In cities, the DVB-T signal is measured at multiple fixed points distributed in a 500m x 500m grid
- In small settlements the measurement is performed at one fixed point or at more than one point if it is a larger settlement
- The following data is recorded: operator name, transmitter location name, allotment zone name, name of the measuring point, geographic coordinates of the measuring point (WGS

84) and the measurement date

- The following is measured: SFN channel, cumulative electric field strength of the DVB-T signal, MER (error correction error), BER before Viterbi, BER after Viterbi.

Initiated dispute by subscribers or end users

- Only the operator against whom complaint has been submitted shall be measured.
- OUTDOOR methodology - the measurements shall be conducted in the vicinity of the address in the contract, as physically close as possible for the vehicle to access, of the subscriber or end user, who have initiated the dispute.

APPENDIX 6

Test routes

Test routes:

Highways and main roads:

- Section 1: Border with R. of Serbia (Tabanovce) – Kumanovo – Miladinovci – Veles – Gevgelija – Border with R. of Greece (Bogorodica) (176 km);
- Section 1': Prilep – Gradsko - Veles, Kumanovo – border with R. of Serbia (Tabanovce) (200 km);
- Section 2: Border with the R. of Bulgaria (Deve Bair) - Kriva Palanka – Stracin - Romanovce (Kumanovo) – Miladinovci – ring road Skopje – Tetovo – Gostivar – Kičevo – Podmolje – Struga – border with R. of Albania (Kjafasan) (298km);
- Section 3: Crossroads Podmolje – Ohrid – Kosel – Resen – Bitola – Prilep – Veles – Štip – Kočani – Delčevo - border with R. of Bulgaria (Ramna Niva) (318km);
- Section 3': Border with R. of Albania (Sv. Naum) - Ohrid - Kosel - Resen - section Bitola (cross-roads Kukurečani) - border with the R. of Greece (Medžitlija) (127 km);
- Section 4: Border with R. of Kosovo (Blace) – cross-roads Stenkovec – ring road Skopje– Petrovec – cross-roads Veles – Sv. Nikole – Štip – Radoviš – Strumica – border with R. of Bulgaria (Novo Selo) (205km);

Regional roads:

- Section 5: Bitola – Demir Hisar – Kičevo – Makedonski Brod – Prilep (140 km);
- Section 6: Gevgelija – Bogdanci – Star Dojran – Valandovo – Strumica – Berovo – Pehčevo – Delčevo (139 km);
- Section 7: Stracin – Kratovo – Probištip – cross-roads Krupište – Kočani – Vinica – Berovo (118 km);
- Section 8: Drenovo – Kavadarci – Negotino – Pepelište – Štip – Sveti Nikole – Kumanovo (140 km);
- Section 9: Border with the R. of Kosovo (Jažince) - Tearce – Jegunovce – Ratae – Džepčište – Tetovo – Popova Šapka – Tetovo – Gostivar – Mavrovi Anovi – Debar – Struga (230 km);
- Section 10: border with R. of Greece (Markova Noga) - Makazi – Carev Dvor – Oteševo – Stenje – Oteševo - Trpejca (80km);

The Agency may create other routes aside from the above mentioned.

APPENDIX 7

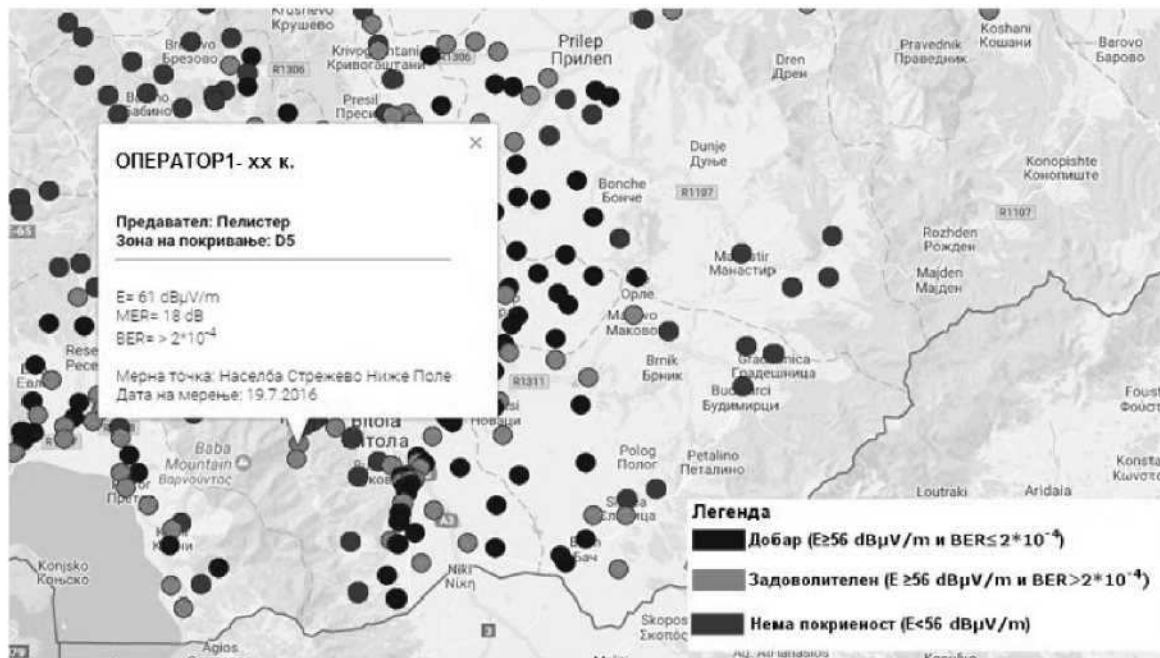
The following table provides the inhabited places with information on the minimum number of calls according to the last official Population Census in the Republic of Macedonia:

Inhabited Places - Municipalities with more than 15000 inhabitants	Number of inhabitants	Minimum number of calls
Skopje	506926	2028
Kumanovo	108048	432
Tetovo	90650	363
Gostivar	83018	332
Kičevo	30403	122
Debar	20483	82
Ohrid	53006	212
Struga	64956	260
Bitola	92905	372
Prilep	75898	304
Vinica	19938	80
Štip	48578	194
Veles	54955	220
Strumica	56533	226
Kočani	38058	152
Kavadarci	38968	156
Negotino	19414	78
Radoviš	28870	115
Sveti Nikole	17966	72
Kriva Palanka	20257	81
Gevgelija	22846	91
Brvenica	15885	64
Delčevo	17505	70
Bogovinje	28997	116
Želino	24390	98
Lipkovo	27058	108
Vrapčište	25399	102
Ilinden	15894	64
Probištip	16193	65
Resen	16825	67
Studeničani	17246	69
Tearce	22454	90

APPENDIX 8

Report on DVB-T measurements

The Agency shall publish the DVB-T measurements in the stationary points on the web site www.komuniciraj.mk on a map including information on: name of DVB-T operator, SFN channel, transmitter, allotment zone, cumulative electric field strength [dBfV/m], MER (dB), BER after Viterbi, name of measurement point, date of measurement and information of coverage.



APPENDIX 9

National Report on the Service Quality Situation

The Agency shall draft a report on the service quality situation for inhabited settlements, test routes and national report on operators of mobile communication networks/services in Republic of Macedonia in the following format:

REPORT ON THE SERVICE QUALITY SITUATION FOR INHABITED PLACE
XXXXXX/TEST ROUTE XXXXXX/NATIONAL
OPERATORS OF MOBILE COMMUNICATION NETWORKS/SERVICES IN REPUBLIC OF
MACEDONIA

Drafted by Department for Controlling and Monitoring of Radio Frequencies

As per the Rulebook on the quality parameters of public electronic communication services, the manner and procedure for controlling and measuring, the content and manner of publishing information related to the quality of public electronic communication services, the Agency for Electronic Communications shall control and measure the quality parameters of public electronic communication services, and in accordance with Article 16 of this Rulebook shall publish them on www.komuniciraj.mk.

In accordance with the work schedule and the tasks of the Department for Controlling and Monitoring of Radio Frequencies, publishing of such data shall be divided by inhabited settlement/test route - the inhabited settlements have been provided by the State Statistical Office of Republic of Macedonia from the last Census in R. of Macedonia.

In accordance with Appendix 6/Appendix 7 of the above mentioned Rulebook, the Agency shall publish the data of its own measurements for the quality parameters by test route/inhabited settlement for each network of the operators.

Short description of equipment used for measurement and post-processing, as follows:

- The measurements and measurement equipment are compliant with the technical specifications defined in ETSITS 102 250;
- Sophisticated equipment has been used, and for user experience simulations combined with hardware/software solution for generating, analysis and processing of data;
- Methodologies used to measure the service quality parameters are explained in details in Appendix 5 Benchmarking of the Rulebook on the quality parameters of public electronic communication services, the manner and procedure for controlling and measuring, the content and manner of publishing information related to the quality of public electronic communication services Remark:
 - For generating a call, Scenario 2 of Appendix 5 of said Rulebook has been used
 - While creating a packet session for measuring the service quality – data transfer, 1024MB file has been used
 - Mandatory target values of the parameters in the figures pertain to the National Report

Pursuant to the Rulebook on the quality parameters of public electronic communication services, the manner and procedure for controlling and measuring, the content and manner of publishing information related to the quality of public electronic communication services, the following tables show the summary results obtained during the measurements performed.

Period when the measurements were performed: xx.xx.xxxx-xx.xx.xxxx

The distribution of generated calls by inhabited settlement has been obtained by a proportional division taking into account the population density per given municipality, and the data taken from the State Statistical Office of Republic of Macedonia.

Inhabited Settlement	Inhabitants	Minimum number of calls	Completed calls Operator 1	Completed calls Operator 2	Completed calls Operator 3
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