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# GSM/UMTS/LTE Mobile Communications Systems Appraisal of Quality of Service Performance evaluation of mobile services and GSM, UMTS and LTE coverage, in Lisbon Metropolitan Area (NUTS II)

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Mobile Communications Systems  
**GSM / UMTS / LTE**

Appraisal of Quality of Service

**Executive summary**

Performance evaluation of mobile services and GSM,  
UMTS and LTE coverage, in  
Lisbon Metropolitan Area (NUTS II)

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## **ABBREVIATIONS AND ACRONYMS**

<b>AMU</b>	Moderately Urban Area.
<b>APN</b>	Access Point Name.
<b>APR</b>	Predominantly Rural Area.
<b>APU</b>	Predominantly Urban Area.
<b>CEPT</b>	European Conference of Postal and Telecommunications Administrations.
<b>CoDec</b>	Encoder/Decoder.
<b>CPICH RSCP</b>	Common Pilot Channel, Received Signal Code Power – Radio signal level received by a mobile terminal (UMTS).
<b>CS</b>	Circuit Switched.
<b>CSFB</b>	Circuit Switched Fallback.
<b>ECC</b>	Electronic Communications Committee.
<b>EPS</b>	Evolved Packet System – Optimised system of commutation of packets of 4G networks, arising from the evolution of 3G/UMTS systems, characterised by high data debits, low latency and enabling multiple technologies in the access radio network.
<b>ETSI</b>	European Telecommunications Standards Institute.
<b>FCT</b>	Fundação para a Ciência e a Tecnologia, I.P.
<b>FTP</b>	File Transfer Protocol.
<b>GigaPIX</b>	Portuguese point of exchange of traffic between IP networks.
<b>GSM</b>	Global System for Mobile communications – Second generation mobile communications system (2G).
<b>HTTP</b>	Hyper Text Transfer Protocol.
<b>INE</b>	National Statistics Institute.
<b>ITU</b>	International Telecommunications Union.
<b>LTE</b>	Long Term Evolution – Fourth generation mobile communications system (4G).
<b>MIMO</b>	Multiple Input Multiple Output – Technology based on the use of multiple broadcasters and multiple receptors (antennas) to improve the performance of radio communications.
<b>MOS</b>	<i>Mean Opinion Score</i> Mean Opinion Score – Quality index that quantifies the effort required to perceive a communication of the end-to-end type. Its thresholds are 0 (zero) when there is no communication, and 5 (five) when the communication is perfect.
<b>NUTS</b>	Nomenclature of Territorial Units for Statistical Purposes.
<b>PDP</b>	Packet Data Protocol.
<b>POLQA</b>	Perceptual Objective Listening Quality Assessment – Algorithm used in the analysis of the audio quality of a voice communication (ITU-T Recommendation P.863 (01/2011)).
<b>PS</b>	Packet Switched.
<b>RF</b>	Radio Frequency.
<b>RSRP</b>	Reference Signal Received Power – Radio signal level received by a mobile terminal (LTE).
<b>RxLev</b>	Received signal level – Radio signal level received by a mobile terminal (GSM).
<b>Scanner RF</b>	Measurement equipment that enables collecting radio signal levels for each channel of a frequency band.
<b>SIM</b>	Subscriber Identity Module – SIM Card.
<b>SMS</b>	Short Message Service.
<b>SMSC</b>	Short Message Service Centre.
<b>TCP/IP</b>	Transmission Control Protocol / Internet Protocol.
<b>TIPAU</b>	Categories of Urban Areas, for statistical purposes.
<b>UMTS</b>	Universal Mobile Telecommunications System – Third generation mobile communications system (3G).
<b>USIM</b>	UMTS Subscriber Identity Module – USIM Card.
<b>WCDMA</b>	Wideband Code Division Multiple Access – Technology used in the radio component of UMTS communications systems.



## **I. EXECUTIVE SUMMARY**

Most individual and business consumers use electronic communications services, namely telephony, messages and data, supported by GSM/UMTS/LTE mobile communications systems, to meet their daily communication needs, including emergency and security communications. In these mobile communications systems, service quality, from the user perspective, is of enormous importance, in particular due to the radio nature of the access, the mobility they offer and their manifestly high penetration/use.

ANACOM, pursuant to duties and powers established in its articles of association, carries out studies in Portugal to assess, from a user perspective, the quality of electronic communication services supported by mobile communications systems present in the market, in order to provide the consumers with impartial information on the performance of these services.

The studies present an assessment of the performance of mobile, voice and data services, and of radio coverage of GSM, UMTS and LTE interfaces, provided by MEO, NOS and Vodafone. The aim is to investigate the user's experience in terms of accessibility, retention and integrity of the services. To this end, calls are established and conversations are simulated to appraise the voice service, files are transferred, web pages are downloaded and YouTube videos are downloaded to appraise the data services, and the presence and levels of radio networks are checked to appraise coverage.

This test campaigns are carried out according to the methodology approved by ANACOM after broad consultation of the market. Measurements are performed systematically, with standardised procedures and without human intervention or decision, under the same conditions for the various operators, allowing objective and comparative performance analysis.

In the sampling approach followed, the set of mobile communications carried out in the mainland territory is considered as the universe, with the mobile voice call and the mobile data session being the statistical units considered. The sample is based on two stratification levels. The first separates the mainland territory into NUTS II, followed by a breakdown by NUTS III.

This third study<sup>1</sup> covers the NUTS II region of the Lisbon Metropolitan Area, with the fieldwork having taken place between 20 May and 5 June 2020. This involved making 972 voice calls, 6,550 data sessions and 589,937 radio signal measurements, corresponding to approximately

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<sup>1</sup> The previous studies covered the NUTS II regions of the Alentejo and North, and are available at <https://www.anacom.pt/render.jsp?contentId=1499096> <https://anacom.pt/render.jsp?contentId=1528014>



324 voice calls, 364 data sessions and 65,549 radio signal measurements, by indicator and operator. The tests covered 285 kilometres.

The main results observed in the Lisbon Metropolitan Area (NUTS II) are detailed by indicator, broken down by operator, in *Section 5*, pointing to the following aspects:

- The radio coverage of the mobile communications systems of the operators analysed show a good overall performance. The highest performance is observed in GSM, with insignificant differences between operators. In UMTS and LTE technologies, the performances are lower and the differences between operators are more significant, in particular showing a better performance of Vodafone.
- Voice services presented a good overall performance in all operators, with no differences being observed between operators with respect to capacity to establish and retain calls. The integrity of the conversation and the average time required to establish a call revealed differences between operators, although of little relevance from a user perspective.
- Data services also presented a good overall performance, with no differences being observed between operators with respect to capacity to establish and retain data sessions, in all the services analysed.

Good average data transfer speeds were observed in file transfers, in download and upload, with some differences of performance being observed between operators. A very high variability of this indicator is also observed, with maximum speeds of 153.41 Mbps and 62.23 Mbps and minimums of 0.205 Mbps and 0.713 Mbps, respectively for download and upload.

The internet browsing service shows reasonable average time of transfer of web pages, both reference and public, with the differences between operators being insignificant.

In turn, the YouTube Video Streaming service shows good overall performance without significant differences between operators.

Data transmission latency shows reasonable levels, albeit with some variability, and minor differences being observed between operators.

*Table 1* summarises the differences observed between operators, and whenever possible, the respective position (from best to worst performance).

Table 1 – Summary of differences between operators

			MEO vs. Vodafone	NOS vs. MEO	Vodafone vs. NOS	1st place best performance	2nd place	3rd place worse performance		
Voice Service	mobile ↔ mobile	Affordability of the Service		=	=	=	MEO / NOS / Vodafone	---	---	
		Call Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---	
		Time of Establishment of Calls		≠	≠	≠	Vodafone	NOS	MEO	
		Audio Quality		≠	≠	≠	Vodafone	NOS	MEO	
Data Services	Transfer of Files	download	Data Session Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---
			Data Transfer Speed		≠	=	≠	Vodafone	MEO / NOS	---
		upload	Data Session Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---
			Data Transfer Speed		≠	≠	=	NOS / Vodafone	MEO	---
	Internet Browsing	reference	Data Session Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---
			Web Page Transfer Duration		≠	=	≠	MEO / NOS	Vodafone	---
		public	Data Session Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---
			Web Page Transfer Duration		=	≠	≠	NOS	MEO / Vodafone	---
	YouTube Video Streaming	Data Session Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---	
		Time before Viewing		≠	≠	=	NOS / Vodafone	MEO	---	
		Duration of Interruptions		=	=	=	MEO / NOS / Vodafone	---	---	
		Video Resolution		=	=	=	MEO / NOS / Vodafone	---	---	
		Video Quality		=	=	=	MEO / NOS / Vodafone	---	---	
	Latency	Data Session Termination Ratio		=	=	=	MEO / NOS / Vodafone	---	---	
		Latency		≠	≠	≠	Vodafone	NOS	MEO	
	Radio Coverage	GSM, UMTS & LTE	GSM Signal Level		≠	≠	≠	NOS	MEO	Vodafone
UMTS Signal Level			≠	≠	≠	Vodafone	NOS	MEO		
LTE Signal Level			≠	≠	≠	Vodafone	NOS	MEO		



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