GSM Mobile Networks

Quality of Service Survey

Global Study

(Mainland Portugal)

September / October 2005

Index

Appendix – Individual results, results by urban agglomeration and road axel.

I EXECUTIVE SUMMARY

I.I FRAMEWORK

Autoridade Nacional de Comunicações (ANACOM) carried out during 2005 a survey on the quality of the GSM mobile services provided by operators OPTIMUS, VODAFONE and TMN, by analyzing technical parameters that translate the quality perception from the consumer's standpoint.

Although new approaches have been made to the performed analysis, such as studies of long calls and the evaluation of the short message service (SMS), the framework of the studies made during the last 5 years was kept for the "Global Study", providing an indicator of the evolution of GSM mobile networks.

The selection of locations for measurements in this "Global Study" followed criteria related namely with the highest service usage rates, i.e., larger urban agglomerations and main road axels. Another criterion of the same importance was the geographical distribution of locations as to include inland regions. This approach means a richer sample, avoiding the effect of results exclusively based on measurements on the most densely populated areas of Lisbon and the northern coastline.

Thus, tests were made in all of mainland Portugal's district capitals, and the collection area was broadened to the metropolitan areas of greatest Lisbon and Porto and to mainland's main road axels.

Regarding previous years, another road axel – *Lisbon-Leiria (A8)* – was added to the sample, and the road axel *Lisbon-Castelo Branco (A23)* was stretched to Guarda.

The population of the urban agglomerations that make up the selected sample stand for 41.7% of the total Portuguese population, according to the results of the last Census (2001 Census).

Data collection took place on working days, during normal working hours, between 19 September and 20 October 2005. 14,139 test calls were made, corresponding to about 213 hours of measurements along 8,693 kilometres.

Using a representative sample provided global results by operator, on urban agglomerations and on road axels, with a maximum precision error below 2%, for a 95% confidence level.

Three mobile network indicators of capital importance were analyzed, considering the quality

perspective from the user/consumer's standpoint:

a. **Coverage**;

b. **Accessibility**;

c. **Audio Quality**.

This survey's methodology is based on automatic end-to-end tests, thus identifying the quality of service on the field and providing the most realistic perspective on the networks' performance, from the user's standpoint.

In view of these services' penetration rate, of the diversity of the terminal equipment that is used, and given the users' subjective views themselves, it is impossible to rigorously reproduce each consumer's conditions of interaction with the networks. The results of this study must thus be understood as an indicator of the networks' behaviour. Their transposition/extrapolation to specific situations requires some prudence, at the risk that biased conclusions might be taken.

Technical and methodological options of this study directly influenced its results and must be taken into account when analyzing the results, namely the following:

- It used **EFR Dual-Band terminal equipment**;

- Tests were exclusively based on a **technical solution** (equipment + software) and performed in a totally **automatic** way, thereby setting homogenous conditions for the monitoring of the 3 operators and eliminating the subjectivity inherent to the human user;

- Tests were carried out in **moving vehicles and with outdoor antennas**;

- A compromise **conversation time** of **110 seconds** was used to simultaneously analyze accessibility and audio quality in conversations. That time is close to the average conversation time of communications using the networks under analysis, in the second quarter of 2005, a criterion used to select the conversation time for the tests;

- The results of the study only reflect the behaviour of the networks on the places and moments of the measurements;

- On the other hand, operators are permanently improving their networks. The technical interventions necessary for these improvements can cause momentary degradations of the service in the geographic area of intervention.

I.II MAIN CONCLUSIONS

This survey's results show that the GSM mobile networks have good coverage and performance levels.

Indicator precision, at a 95% confidence level:						
	2000	2001	2002	2003	2004	2005
Accessibility	0.28%	0.22%	0.19%	0.24%	0.28%	0.28%
Poor Audio Quality	0.10%	0.05%	0.05%	0.12%	0.11%	0.12%
Acceptable Audio Quality	0.45%	0.29%	0.28%	0.55%	0.57%	0.58%
Good Audio Quality	0.45%	0.29%	0.28%	0.55%	0.58%	0.58%
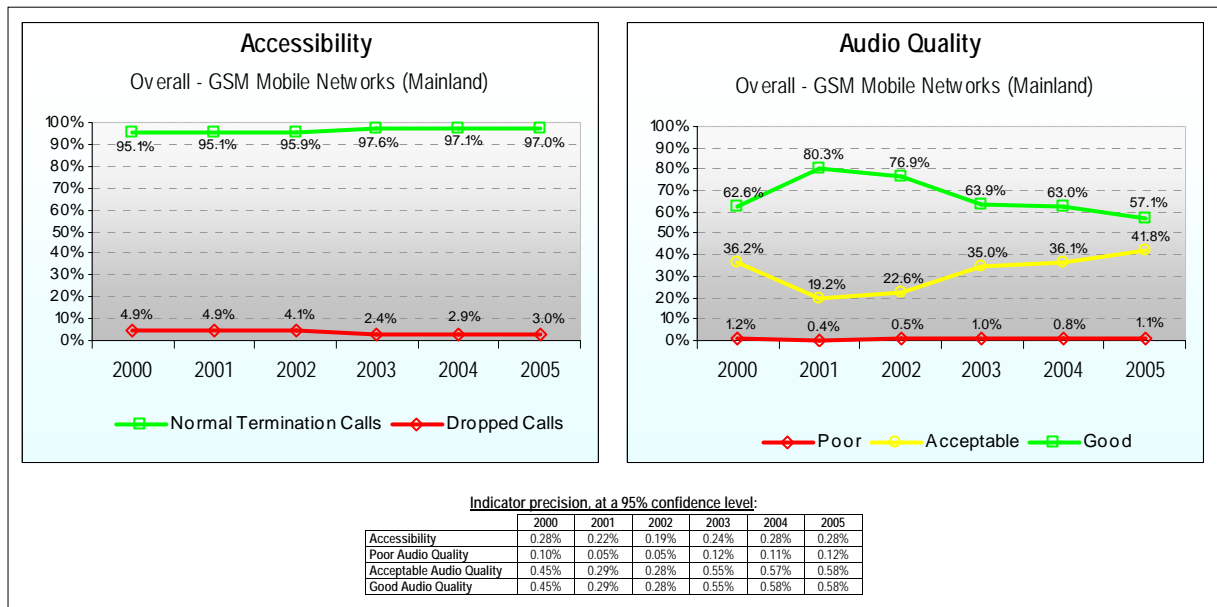
Figure 1 – Evolving performance of the GSM mobile networks, in Mainland Portugal.

The levels reached by the *Accessibility* indicator are very good, maintaining the trend of the latest years. 97% of test calls on urban agglomerations and road axels were successfully made and adequately kept during the conversational phase, ending normally by disconnection, at the end of the pre-established time.

Regarding the *Audio Quality* indicator, about 99% of test calls had good or acceptable average values. Only around 1% of the reached values were poor or bad. However, this indicator's decay trend since 2002 continues.

The performance of mobile networks concerning the *Accessibility* indicator does not show significant differences between urban agglomerations and road axels.

In the latest years, the *Audio Quality* indicator suffered a stronger degradation in urban agglomerations

than on road axels. Thus, on the latest studies, this indicator's levels are worse in urban agglomerations.

Figure 2 – Evolving networks' performance in urban agglomerations.

Figure 3 – Evolving networks' performance on road axels.

The Coverage indicator has good levels, both in the urban zones and on the road axels that were analyzed, as shown on the maps in the appendix.

Accessibility — OPTIMUS

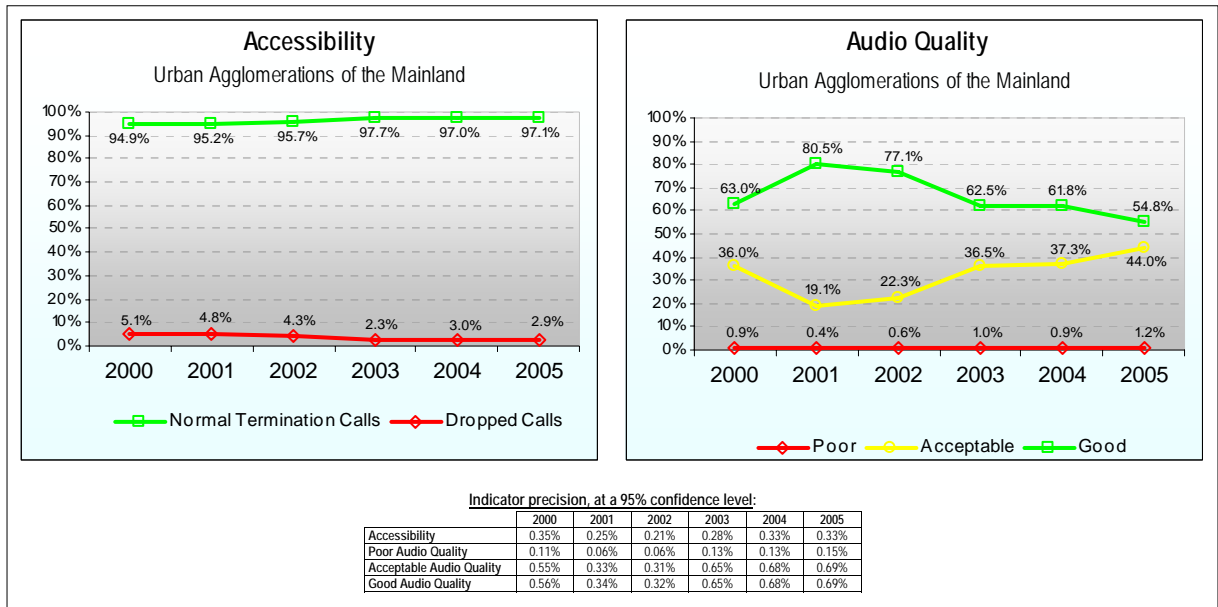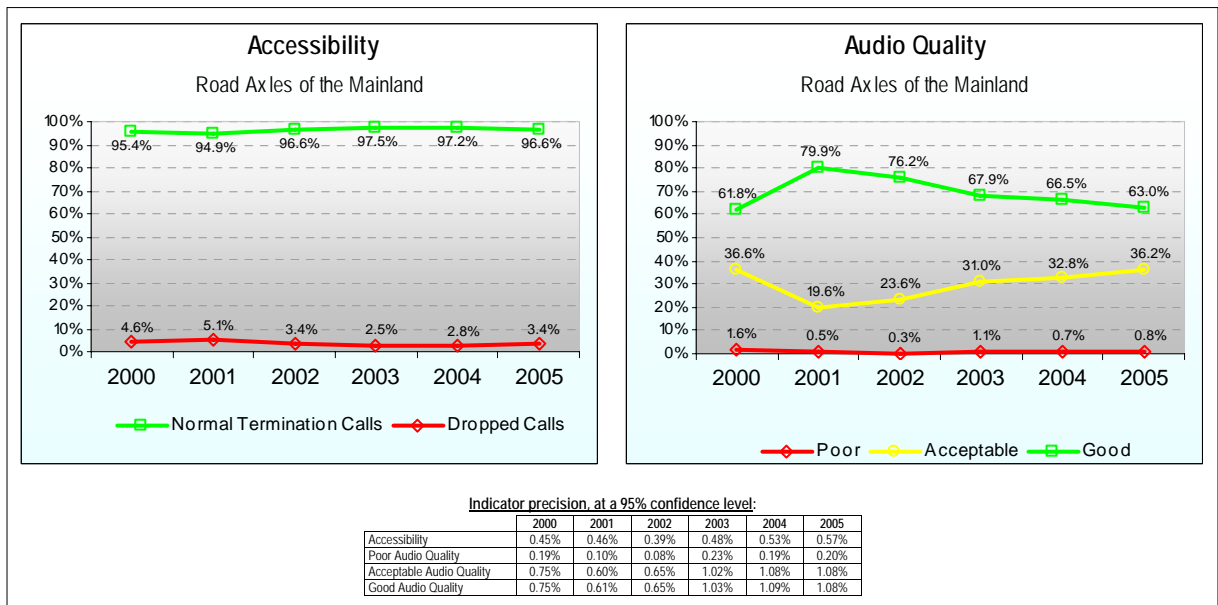|	2000	2001	2002	2003	2004	2005
Normal Termination Calls	95.8%	96.2%	97.1%	98.3%	97.8%	97.1%
Dropped Calls	4.2%	3.8%	2.9%	1.7%	2.2%	2.9%

Audio Quality — OPTIMUS

	2000	2001	2002	2003	2004	2005
Good	73.8%	81.9%	78.5%	64.6%	63.3%	56.0%
Acceptable	25.7%	17.7%	21.2%	35.0%	35.9%	42.4%
Poor	0.5%	0.4%	0.3%	0.4%	0.8%	1.5%

Accessibility — VODAFONE

	2000	2001	2002	2003	2004	2005
Normal Termination Calls	95.7%	96.1%	95.5%	97.4%	97.2%	97.0%
Dropped Calls	4.3%	3.9%	4.5%	2.6%	2.8%	3.0%

Audio Quality — VODAFONE

	2000	2001	2002	2003	2004	2005
Good	54.2%	80.6%	78.2%	64.9%	66.0%	55.8%
Acceptable	44.5%	19.0%	21.2%	34.6%	33.3%	43.3%
Poor	1.3%	0.4%	0.6%	0.5%	0.7%	0.9%

Accessibility — TMN

	2000	2001	2002	2003	2004	2005
Normal Termination Calls	93.8%	93.1%	95.5%	97.2%	96.2%	96.8%
Dropped Calls	6.2%	6.9%	4.5%	2.8%	3.8%	3.2%

Audio Quality — TMN

	2000	2001	2002	2003	2004	2005
Good	59.8%	78.5%	74.1%	62.3%	59.8%	59.4%
Acceptable	38.4%	21.0%	25.3%	35.5%	39.1%	39.8%
Poor	1.7%	0.5%	0.6%	2.2%	1.0%	0.8%

Indicator precision, at a 95% confidence level:

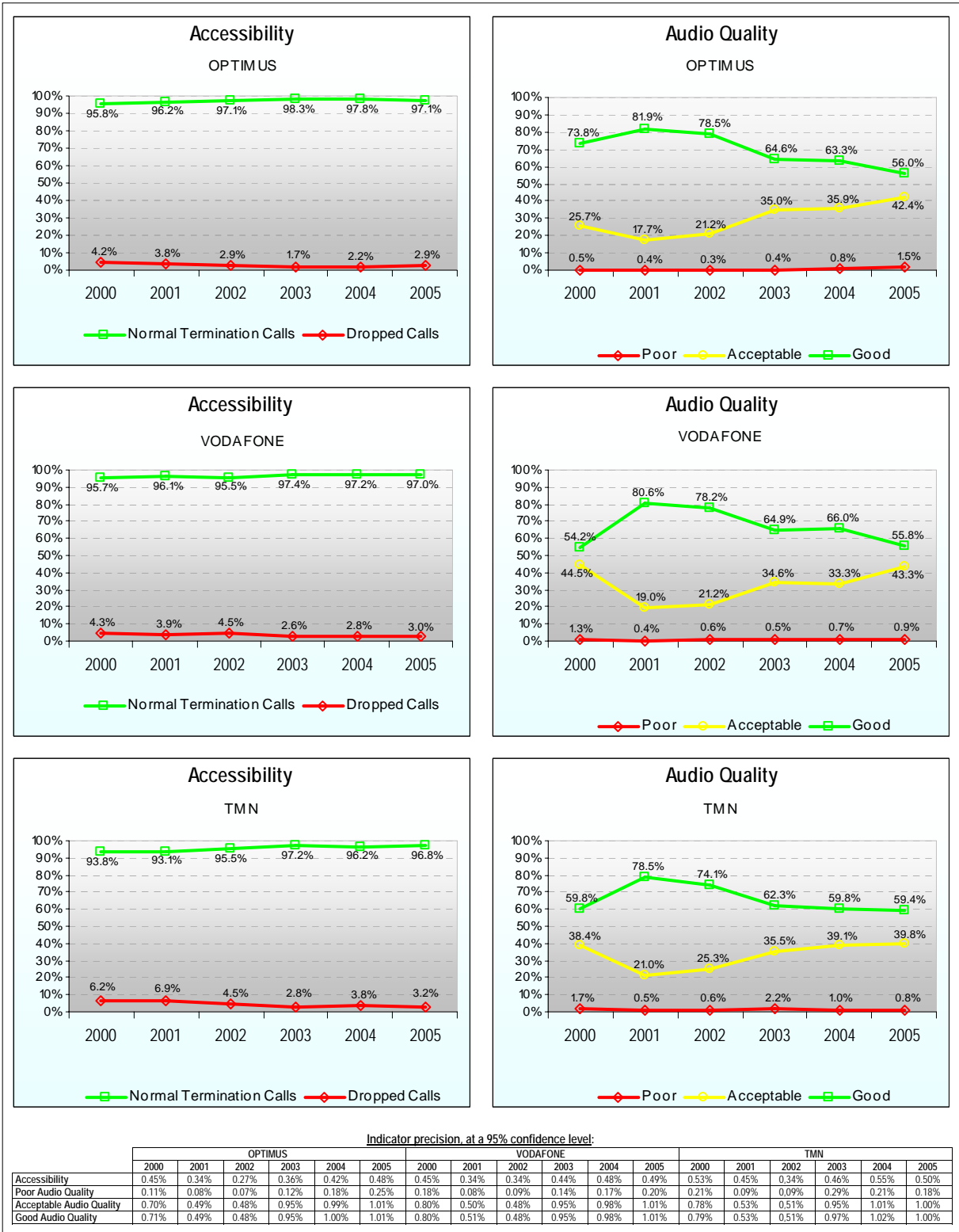|	OPTIMUS						VODAFONE						TMN					
	2000	2001	2002	2003	2004	2005	2000	2001	2002	2003	2004	2005	2000	2001	2002	2003	2004	2005
Accessibility	0.45%	0.34%	0.27%	0.36%	0.42%	0.48%	0.45%	0.34%	0.34%	0.44%	0.48%	0.49%	0.53%	0.45%	0.34%	0.46%	0.55%	0.50%
Poor Audio Quality	0.11%	0.08%	0.07%	0.12%	0.18%	0.25%	0.18%	0.08%	0.09%	0.14%	0.17%	0.20%	0.21%	0.09%	0.09%	0.29%	0.21%	0.18%
Acceptable Audio Quality	0.70%	0.49%	0.48%	0.95%	0.99%	1.01%	0.80%	0.50%	0.48%	0.95%	0.98%	1.01%	0.78%	0.53%	0.51%	0.95%	1.01%	1.00%
Good Audio Quality	0.71%	0.49%	0.48%	0.95%	1.00%	1.01%	0.80%	0.51%	0.48%	0.95%	0.98%	1.01%	0.79%	0.53%	0.51%	0.97%	1.02%	1.00%

Figure 4 – Evolving overall networks' performance by operator.

The analysis to the global results of this survey shows that differences between operators are not significant for all of the studied indicators. The same is true for the analysis to the results in urban agglomerations.

On road axels, VODAFONE and TMN didn't show important performance differences regarding the several studied indicators. Neither did OPTIMUS regarding *Coverage* and *Accessibility*, although it had worse results in the *Audio Quality* indicator.