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THE QUALITY OF MOBILE SERVICES (VOICE AND SMS) IN MOZAMBIQUE

A PROPOSED METHODOLOGY TO EFFECTIVELY APPLY APPROPRIATE QUALITY OF SERVICE STANDARDS

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EXECUTIVE SUMMARY

The unprecedented growth in telecommunications technologies and markets has increased the variety of services and providers available to customers. Customers are becoming more sophisticated and demanding as competition is driving down prices for advanced services. Price therefore is no longer the only decision-making factor when a customer choose a provider or operator, but also quality. However, unlike prices which can easily be compared between operators, information on Quality of Service (QoS) is not that readily available. Therefore, to support and to protect customers, national regulators, through regulation, force operators to publish certain quality standards as a measurement of QoS and to adhere to them. From this it is evident that this intervention by regulators is only required because of a lack of competition, for in a market that is highly competitive self-regulation of QoS amongst the operators would be vital in order to survive.

Internationally, QoS is measured and reported in a wide variety of ways depending on the circumstances of each country or region. In Mozambique, the National Regulator, the National Telecommunication Institute of Mozambique (INCM), is responsible for regulating the QoS, specifically mobile services, based on a comprehensive regulatory framework.

In terms of an analysis of international benchmarking and best practices it can be concluded that the current framework, although being comprehensive and adhering to best practices, may not be relevant in all aspects and be impractical to implement. This mainly refers to the number of Key Quality Indicators (KQI's) to be measured, their relevance and the way it is envisaged to enforce penalties. This is especially true when compared to the regional approach, which is more pragmatic and the emphasis is more towards creating a cooperative environment, whereby operators are willingly contributing as they realize it is also for their benefit, rather than a punitive approach. This may be one of the reasons why the implementation of the regulatory framework in Mozambique has not yet really come off the ground.

Based on this analysis, a methodology was proposed that is far more simpler, relevant and practical, and which includes quarterly KQI reporting by the operators, annual field testing to verify this reporting and also the introduction of a Customer Satisfaction Survey to also serve to verify the technical reporting, but also to provide an unbiased report on the customer service experience. The proposals can all be accommodated within the structure of the existing regulatory framework as it is flexible enough, through a change in the applicable KQI's in the annex, without changing the legislation itself. It is also flexible enough to accommodate the change in approach on penalties, as this only requires a change in emphasis on how the stipulations of the legislation are applied.

Cognizance is also taken of the capacity constraints of INCM in implementing the proposed methodology and certain specific support and training proposals are recommended in this regard.

With the proposed methodology it is believed that the necessary buy-in and acceptance from the operators will be obtained and that this will ensure that ultimately the customers will have access to unbiased and reliable information to the quality of mobile services in Mozambique, which will contribute towards the growth of this important segment of the market.

INTRODUCTION

In recent years there has been a remarkable growth in the telecommunications sector in Mozambique. In 1997, the introduction of mobile telephony by the company (MCEL) resulted in a dramatic increase in access to telecommunications services. The opening of the competition in the telecommunications sector attracted new operators; VODACOM and MOVITEL. The new operators in the market have resulted in the reduction of the call charges and also a higher access to services for the population. However, the levels of Quality of Service provided by these operators are perceived to be failing to meet the needs of their users, especially in large cities and in the peak hours.

The provision of a good level Quality of Service (QoS) and Quality of Experience (QoE) in the mobile ecosystem ranks as one of the top priorities and issues of the telecommunications sector.

In view of that and in order to establish a level playing field for the different stakeholders in assessing the overall performance of the telecommunications operators and after extensive consultations and analysis a legal instrument has been developed where all substantive and relevant issues, pertaining to quality of services are enshrined. These issues are encapsulated and outlined in the Decree nº. 6/2011 of the 3rd of May, *the Regulation on Quality of Services in the Public Telecommunications*.

In order to implement the provisions of the above mentioned decree, the National Telecommunication Institute of Mozambique (INCM), as the national regulator, has undertaken a study, aiming at developing a working methodology to evaluate on a comparable and an equitable basis the quality of services provided by the three mobile operators.

The general objective of the technical assistance is to improve the QoS, enabling telecommunication access, voice calls, SMS inter-networking and intra-networks provided with less cost. The specific objective is, through the study, to develop a methodology for effective QoS standards for the mobile telecommunication sector (voice, SMS and data) that conforms to INCM standards, local laws and local circumstances (Decree nº. 6/2011), and based on the proposals and recommendations of the study, provide the necessary training to INCM to become fully operational and effective in discharging its responsibilities in this regard.

The purpose of this document is to provide an overview of the study and is structured in such a way as to, firstly, provide a brief background as to the economic, regulatory and policy and telecommunications environments; secondly, provide an overview of what are the best international and regional practices as to the monitoring of the QoS in mobile ecosystems, followed by an analysis of the current Mozambican QoS Regulatory Framework and its relevance, before finally based on the analysis, propose an appropriate methodology for applying the framework.

BACKGROUND

The economic environment and its linkage with the sector:

The Mozambican economy represents a number of extremes, - large disparities in population dispersion and economic activity, heavy dependency on donations support and primary commodities, large-scale poverty and a considerable deficiency in infrastructure development.

Since 1987, the government embarked on a series of macroeconomic reforms designed to stabilize the economy. These steps combined with donor assistance and with relative political stability have led to dramatic improvements in the country's growth rate. Mozambique grew at an average annual rate of nine percent for most of the past decade, one of Africa's strongest performances, but in spite of these positive developments the future.

This growth rhythm of the economy is expected to be maintained or may even increase with a massive influx of investment already identified. These projects, presently under implementation or consideration, will mostly be private sector driven, and are mainly associated with the exploitation of valuable natural resources, particularly coal and petro gas.

According to a World Bank Report, the country has also managed to make impressive strides in terms of poverty reduction and the achievement of the MDG targets.

Despite its impressive progress in both economic growth and poverty reduction, Mozambique remains one of the poorest countries in the world and macro-economic management will therefore still represent considerable challenges. Fifty-four percent of Mozambicans still live below the poverty line and access to basic infrastructure services are below regional averages. To maintain high rates of economic growth, reduce poverty, and make development sustainable, Mozambique needs to continue improving the provision of infrastructure services and substantially increasing the connectivity of people and markets to ensure the linkages between the new influx of investments and the national economy.

It is expected that the authorities will in future continue with attempts to strike a balance between curbing inflation and still allowing the economy to grow, which is essential to address the issue of poverty and to ensure a stable macroeconomic environment that is conducive to sustainable and robust long-term growth. These efforts may however be complicated due to Mozambique's exposure to commodity prices, as higher commodity prices may lead to higher inflation, but also to stronger gains in the local currency.

It is clear that for some time still to come; volatility in the market can still be expected. Given the close relationship between the performance of the economy and the performance of the mobile business these trends are expected to have a significant impact on the development of the sector.

The Policy and Regulatory environment:

A key problem area is the uncertainty in sector policy and the unpredictability as regards the regulatory environment resulting from this uncertainty.

At the beginning of the previous decade, various initiatives were launched to develop a coherent sector policy and strategies. Since that time a few ad hoc attempts were made in addressing glaring deficiencies,

but which obviously failed in addressing the core of the problem. Over this period market conditions have changed, technologies have evolved to the extent that the current framework is no longer relevant. However, INCM has launched an initiative with the support of the World Bank to review the sector strategies and the outcome of this assignment is expected by the end of 2012. It is expected that this study will address the pertinent underlying issues within the sector, amongst which is the determination or delineation of government's role within the sector.

As a result of this, INCM recently started with a revision of the telecommunication law to be able to deal with issues such as convergence, unified licensing, technology neutrality, competition regulation, procedures for SMP, SIM card registration and the market structure.

The Telecommunications and Mobile Ecosystem:

The only provider of fixed line telephony is TDM with a penetration of about 2%. TDM has a nation-wide broadband backbone network on fibre which supports their main service offerings of ADSL and leased line services.

The number of internet users has almost tripled over the last two years and they are serviced by a number of ISP's. More than a third of internet accesses are used in workplaces, while about 30% are used via educational institutions such as schools and universities.

Since the advent of competition in the market in 2003 the mobile market is one of the fastest growing with a Cumulative Average Growth Rate (CAGR) of more than 40%, although the penetration currently is only about 35%.

There are currently three licensed mobile operators, MCEL which started in 1997, VODACOM which started in 2003 and MOVITEL which started in 2012. All three operators have national coverage (refer to Annex A for current coverage maps) and are operating both 2G and 3G networks, the latter mainly in the metropolitan areas. The market is characterised by a high concentration of subscribers in the main metropolitan areas, in some isolated development poles and a very low density in the outlying areas. These subscribers are predominantly prepaid subscribers demanding mainly voice and SMS services, although the demand for data services are increasing, again mainly in the metropolitan areas. Resultantly, ARPU's are relatively low and is under pressure due to the increase in competition.

BENCHMARKING AND BEST PRACTICES

The unprecedented growth in telecommunications technologies and markets has increased the variety of services and providers available to customers. Customers are becoming more sophisticated and demanding as competition is driving down prices for advanced services. Price therefore is no longer the only decision-making factor when a customer choose a provider or operator, but also quality. However, unlike prices which can easily be compared between operators, information on QoS is not that readily available. Therefore, to support and to protect customers, national regulators, through regulation, force operators to publish certain quality standards as a measurement of QoS and to adhere to them. From this it is evident that this intervention by regulators is only required because of a lack of competition, for in a market that is highly competitive self-regulation of QoS amongst the operators would be vital in order to survive.

Internationally, QoS is measured and reported in a wide variety of ways depending on the circumstances of each country or region. These measurements can either be objective based on a set of measurable more technical parameters, or subjective based on gauging customer satisfaction through surveys, or a mix of the two. However, QoS is predominantly measured in the following ways:

- Key Quality Indicators (KQI's)

  These indicators measure QoS in such a way that the results can be compared across operators and time periods. These indicators are formulated by national regulators and, usually after public consultation, enacted into regulations. The sets of indicators can vary depending on local conditions, definitions, measurement guidelines and the expected level of quality and can relate both to technical issues and customer service experience.

  To ensure validity and comparability of the information obtained, data is gathered over a specified, recurrent period and the norm is for operators to gather this information and provide it to the regulators on a regular basis. The specifications of these indicators and the measurement thereof are subjects that have been much researched and standardised. The ITU is a leading institute in this regard.

- Live testing

  Live testing is another way of measuring QoS and is usually done on an ad hoc basis by the operators themselves due to the costs involved. These tests are normally done by specialist third parties for the operators and consist of a drive test during which specific parameters of a network are measured along specific routes or locations and during specific times.

  The information obtained in this way provides a good measurement of the quality performance of a network at any given point in time. Sometimes national regulators also make use of this method, through specialist third parties, to obtain an independent and unbiased performance measurement of a given network.

- Customer surveys

  Another way of measuring QoS is through customer surveys. Because of its more subjective nature, many operators are already using this tool themselves to pinpoint weak points in the quality of their service offering and in their customers' experience. For regulators this method also provides an additional cross-check on indicator-based measurements, especially if weaknesses are indicated on both sets of measurements.

The information obtained from the QoS measurements are presented and reported on in different ways. The general approach from regulators is to compel operators to submit their data to the regulator and also to publish their results on their respective websites, but the shortcoming of this approach is that customers do not have access to comparable data at a single source. To overcome this regulators often do a comparable analysis of the data obtained from the operators and, sometimes after correlation with the data obtained from live testing, publish the information publically.

Compliance to the regulations is also enforced in many different ways across the world depending on specific conditions and regulations. The general approach in terms of non-compliance, however, is based on the following measures depending on the degree of non-compliance:

- Public publication of QoS measurement results;
- Consultations with operators and the issuing of reprimands;
- Issuing of directives;
- Imposition of penalties;
- Requiring operators to compensate their customers;
- Imposition of embargos to persistent violators (no Government contracts);
- License revocation as a last resort; but
- The ultimate objective should be to encourage Self Regulation.

The approached followed within the region in managing QoS with the mobile ecosystem in general is based on international best practices. This is true for all aspects of managing QoS programmes in the individual countries within the region, in terms of the regulatory frameworks of what should be measured, how, when and how the data should reported and the actions for non-compliance.

For instance, through a series of workshops and seminars as an initiative of the ITU, regional regulators and stakeholders have developed the following set of parameters or KQI's as being relevant in measuring QoS within the mobile ecosystem within the region:

- Service Supply Time
- Fault Report Rate
- Fault Repair Rate
- Call Center Answer Time
- Billing and Tariff Accuracy
- Completed Calls

- Dropped Calls
- Blocked Calls
- Speech Quality (MOS, PESQ)
- SMS Message Transmission Success Rate
- Call Set-up Time
- Handover Success Rate
- Geographic Coverage
- Received Signal Strength (RxLv)
- Received Signal Quality (Rx Qual)
- Mobile data

THE MOZAMBICAN QoS REGULATORY FRAMEWORK

The basis of the Mozambican QoS regulatory framework is the Decree nº. 6/2011. This regulation has been developed based on international and regional best practices. For more detail on the Decree, refer to Annex B.

As such, the regulation do contain all the elements of international best practice in this regard, but being so comprehensive it may lack relevancy to local conditions in certain aspects and may therefore not be so practical to implement. The regulation does take cognizance of the fact that the QoS strategy should be flexible to cater for technological advancements in that all the KQI's are contained in an annexure which from time to time should be updated without changing the Decree itself. The following tables reflect an extract from the relevant annexure from the Decree pertaining to the current KQI's of the mobile ecosystem:

TABLE 1: CURRENT KQI's IN DECREE – MOBILE SERVICE

MOBILE TELEPHONY SERVICE

Quality of Service parameters	Quality Service Indicators	Objectives of Quality
		Time of Resolution
Billing	1.1 Wrong billing Montly Charge	5 working days
	1.2 Wrong billing of value of calls and SMS	3 hours
	1.3 Billing of non completed calls	3 hours
	1.4 Billing of non delivered SMS	3 hours
	1.5 Billing of calls for more time than actual duration	3 hours (except billing of Roaming)
Suspension	2.1 Pre paid	Customer of prepaid card can't be deactivated if within three months of card not used or recharged. In the event that same situation remains 2 next months client loses telephone number
	2.2 Post paid	Customers of post paid cards, can be suspended if:
		They have not paid of one bill
		Through previous notice (SMS, telephone, email) 10 days before due date:
		After line is suspended, operators should allow calls reception for 5 days counted since the date of suspension
Netowork Performance	3.1 Percentage of calls successfully established during peak hour	95%
	3.2 percentage of calls completed during peak hour	95%
	3.3 Mean time to establish a call during peak hour	10 seconds - international call
		5 seconds - national call
	3.4 Percentage of lost calls during peak hour	5%
	3.5 Percentage of traffic congestion during peak hour	5%
	3.6 Load of capacity during peak hour in HLR, VLR, BSC, MSC	80%
	3.7 Mean quality voice during conversation same network	90% of samples over 3 in MOS scale
	3.8 Percentage of delivery of SMS during peak hour	90%
	3.9 Mean time to deliver SMS	10 seconds
Network faults	4.1 Time to solve interference between cells	3 hours
	4.2 Time to solve faults within a geographic area with several base stations with effect on traffic	8 hours except serious situations
	4.3 Time to solve faults in base station with impact in traffic	8 hours in rural areas
		2 hours in urban areas
		Exeptionally night faults or in locations of difficult access
Service coverage	5.1 Exteriors	- 85 dBm (GSM)
		- 100 dBm (UMTS)
	5.2 Interiors	- 100 dBm (GSM)
		- 105 dBm (UMTS)
	5.3 Inside vehicles	- 90 dBm (GSM)
		- 100 dBm (UMTS)
	5.4 railways	- 85 dBm (GSM)
		- 100 dBm (UMTS)
Customer complaints - call center	6.1 Mean time to answer calls	80% of calls should be answered in 60 seconds
	6.2 Percentage of calls abondoned	10% of total calls
	6.3 Mean time to wait for personal attention in attention centers	20 minutes
Complaints	7.1 Number of daily complaints related to blocking of network for outgoing and incoming calls	10 complaints
	7.2 Number of daily complaints related to delivery of SMS and MMS	10 complaints
	7.3 Number of daily complaints related to wrong performance in recharging credit for calls and SMS	10 complaints
	7.4 Number of daily complaints related to voice mail	2 complaints

From the above table, Items 1.2 through to Items 1.5 specify a remedial time of 3 hours. This is not realistic especially considering that in most cases customers would not even be aware that such a failure has occurred. A more practical measurement is to state that billing complaints should be less than 2% per month per 100 subscribers and that all billing complaints should be resolved in less than 5 days.

Items 2.1 and 2.2 will in practice be difficult to manage, especially as it is known that one operator has already "a number for life" policy. This is in any event a commercial aspect which should rather be dealt with between the operator and the subscriber as part of the service conditions, than in a regulation.

Item 3.6, relating to the load performance of all the core network components may be difficult to measure and also superfluous considering that a failure in these elements will impact severely on all the other network performance indicators.

Items 4.1 to 4.3 relating to Network Faults again are difficult to measure and data obtained may be unreliable and contentious. Again, these may be superfluous as any failure in this regard will impact on the main network performance indicators.

Regarding Coverage, Item 5.4, pertaining to railways, this item is again superfluous as this scenario is already covered under Exterior Coverage.

All the items under Item 7, relating to complaints, are not practical to measure, especially per geographic area. These items should rather be accommodated in a Customer Satisfaction Survey.

TABLE 2: CURRENT KQI's IN DECREE - INTERCONNECTION

INTERCONNECTION SERVICE WITH A FIXED NETWORK

Quality of Service parameters	Quality Service Indicators	Objectives of Quality
BILLING	1.1 Mean ratio complaints on billing	2% of deviation can't be ? 2%
	1.2 Mean time to solve complaints about billing	? 5 days
FAULTS	2.1 Percentage of faults	1% of the total of irterconnected operators
	2.2 Mean time to fix faults	? 12 hours
Initial provision of service	3.1 Time to negotiate interconnection agreement	25 days
	3.2 Initial connection	5 days
Disconnection	4.1 Disconnection rate percentage	? 1% of the total of irterconnected operators in the reference period
	4.2 Time to solve about disconnected circuits	? 1 working day
Network performance	5.1 Successful calls rate	95%
	5.2 Satisfaction rate in service provision	95%
	5.3 Temporary circuit	99.9%

INTERCONNECTION SERVICE WITH A MOBILE NETWORK

Quality of Service parameters	Quality Service Indicators	Objectives of Quality
FAULTS	1.1 Percentage of faults	1% of the total of irterconnected operators
	1.2 Mean time to fix faults	? 1 hours
Initial provision of service	2.1 Time to negotiate interconnection agreement	25 days
	2.2 Initial connection	5 days
Network performance	3.1 Successful calls rate	95%
	3.2 Rate of retained calls	95%
	3.3 Rate of successful transmission and SMS delivery	95%
	3.4 Availability rate	98.0%
BILLING	5.1 Mean ratio complaints on billing	2% of deviation can't be ? 2%
	5.2 Mean time to solve complaints about billing	? 5 days
Disconnection	4.1 Disconnection rate percentage	? 1% of the total of interconnected operators in the reference period
	4.2 Time to solve about disconnected circuits	? 1 working day

Regarding the indicators related to interconnection service with a fixed network, Item 2.2 would be difficult to measure and control, while Items 3.2, 4.1 and 4.2 do not really have any relevance. The same

can be said about Items 1.2, 2.2, 4.1 and 4.2 of the indicators relating interconnection service with a mobile network.

Regarding the reporting of data, the stipulations of the Decree are very much in line with benchmarking and international best practices.

However, when considering the stipulations of the Decree pertaining to the enforcement of compliance (Chapter 3 of the Decree), it is evident that they are substantially different from international best practices. Firstly, it is clear that the overriding approach is that of being punitive, secondly, it does not recognize that adherence is an interactive process, and thirdly, that the ultimate aim should be self-regulation.

From the benchmarking analysis, especially with regard to regional best practices, it is evident that the approach to get operators to adhere to the stipulations of the decree is more based on establishing a regime that is acceptable by all, that is practical and realistic in what it requires and which operators accept that longer-term adherence would ultimately benefit them, rather than on the approach of "you have to adhere, else you would be penalized". As mentioned, the Mozambican Decree is based on the latter approach. Although in Article 23 of the Decree, provision is made for operators to provide reasons for non-adherence, but it does not describe how this submission will form part of the punitive, or in total absence, a remedial process. Furthermore in Articles 24, it proposes the suspension of the activation of new customers under certain conditions. This is not only impractical, but also will serve no benefit in rectifying the situation and on the contrary can even aggravate it even more.

PROPOSED METHODOLOGY

The basic objective of the proposed methodology is to, based on benchmarking and best practices, recommend certain adjustments to the existing framework as contained in the Decree, in order for the entire process of ensuring an adequate Quality of Service and Experience in the mobile ecosystem to be more cooperative, fair, equitable and practical. The proposed methodology can be broken down into the following actions:

- Measurement and reporting:
    - In terms of the foregoing benchmarking analysis it was concluded that the parameters for measurement in Annex 1 of the existing Decree are in the most cases inappropriate and difficult to measure. It is therefore proposed that the KQI's in Annex C be used for determining the Quality of Service in the mobile eco system. The definition and measurement of these KQI's should be based on the European Telecommunications Standard Institute (ETSI) specifications (ETSI EG 202 057-3). These proposed KQI's should be presented by INCM to the operators in a workshop context and agreed upon before incorporation into the relevant Annex in the Decree. The measurement of these KQI's by the operators should be done on a quarterly basis and reported to INCM and published on their respective websites as foreseen in the existing Decree.

- To verify these quarterly measurements from the operators, it is proposed that INCM should conduct an annual Comparative Field Test by an independent third party, the terms of reference of which are reflected in Annex D. The results of this field test must be published publically by INCM.
- Based on international best practices, it is also proposed that INCM should consider the inclusion of Customer Satisfaction Surveys as a measurement of QoE. These surveys should assist in providing improved objectivity in measuring certain aspects of a customer's experience of a service that sometimes are difficult to measure with a single parameter or indicator. Furthermore, these surveys can also be used to verify the measurements obtained from the KQI's as weaknesses identified in the surveys should also be present in low-levels of the relevant indicator data. Some of the operators are already using these surveys to support their operational decision-making. An example of such a questionnaire is attached as Annex E.

  Although the Decree makes provision for customer surveys, it does not detail any approach or process for this. It is therefore proposed that INCM convene a workshop with the operators to discuss this proposal in terms of the content of the questionnaire, the calculation of a Customer Satisfaction Index for comparison, the frequency thereof, the practicality of how the survey will be conducted and by whom and the publication of the results. After finalisation this process can be included in the relevant annex of the Decree.

- Analysis and comparison of data:

  It is the responsibility of INCM to analyse all the data obtained and to compare it to the relevant benchmarks. In this regard it is proposed that the responsible personnel in INCM should be supported by external technical assistance for the analysis of the data obtained at the first round of each of the above proposed measurements, i.e., after the first quarter of receiving the KQI's, after the first Field Test and after the first Customer Satisfaction Survey.

- Compliance with the stipulations of the Decree:

  After analysis and comparison of the data with the required benchmarking or KQI's, the next action of INCM is to address the deviations or non-compliances. In this regard the proposed methodology deviates considerably from the approach of the existing Decree, although it can still be accommodated within the stipulations of the Decree.

  Firstly, the existing Decree defines infringements or deviations and immediately after that determines the penalties for these infringements. In terms of best practice the approach is somewhat different. Once an infringement has been identified a process is launched with the following steps:

  - Consultation with respective operator and agreement of remedial action;
  - Upon failure of remedial action after agreed upon period, the issuing of a Reprimand;
  - Successive failure after reprimand and agreed upon period for remedial action, invoking of the stipulations of the Decree (penalties); and
  - Successive failure after penalties, revoking of license.

RECOMMENDATIONS AND FOLLOW-UP

6.1 Due to the dynamic nature of the mobile environment, it is suggested that all measurement parameters should be reviewed on a regular basis to ensure relevancy, objectivity and practicality.

6.2 It is recommended that the measurement indicators as contained in Annex 1 of the Decree pertaining to the mobile eco system, be replaced by those in Annex C of this report, based on ETSI specifications.

6.3 INCM should in a workshop context, obtain the consensus of all the operators on these indicators and how they should be measured and reported upon.

6.4 INCM should also with the cooperation of the operators finalize the implementation of a Customer Satisfaction Survey as proposed.

6.5 External technical support should be acquired to assist INCM with the analysis and comparison of data after the first cycle of each of the proposed measurement methods in order to establish a proforma approach.

6.6 In terms of managing the compliance to the stipulations of the Decree, it is proposed that INCM should adopt the approach as outlined in paragraph 5, based on best practice, and which will assist in creating an environment where in the achievement of certain levels of QoS and QoE is a driving force for operators from an operational excellence point of view out of their own consideration, rather than a punitive process to be managed by the regulator.

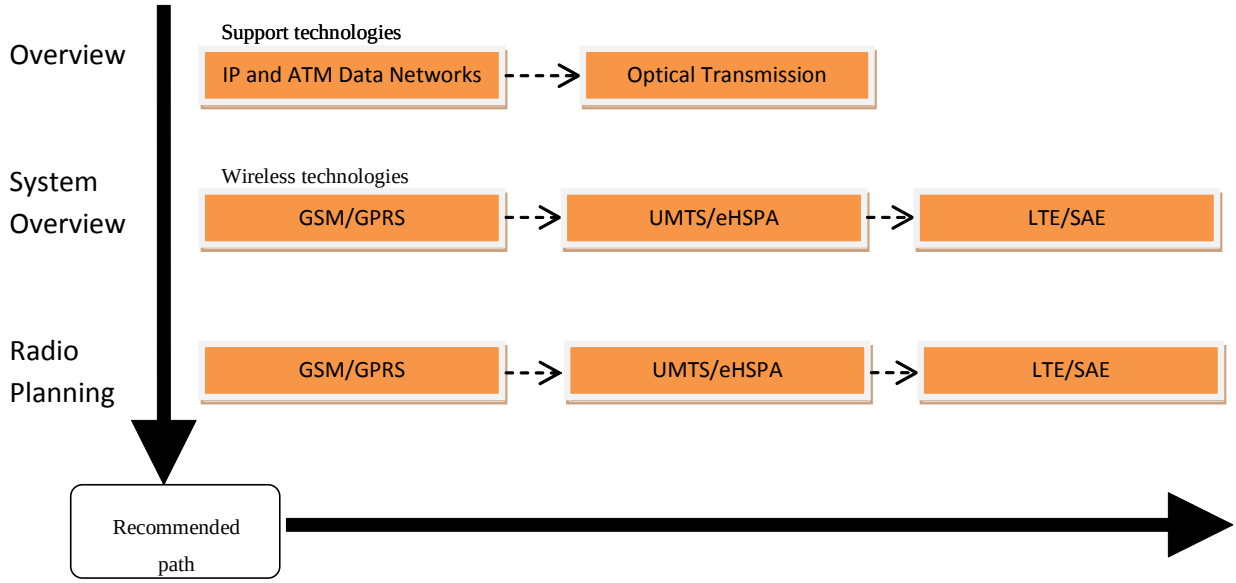
TRAINING PROGRAM

The proposed training program for INCM staff is aimed at empowering the Department of Telecommunications of the Regulator to diligently carry out its mission. The strategy approach adopted in the methodology calls upon INCM to be capable in procuring and assessing the QoS offered by the operators. These functions can be further developed based on the procurement guidelines for field test measurements and customer satisfaction service discussed in annexes D and E of this document. They will serve as templates for INCM.

However, in order for INCM to successfully accomplish this mission it will require an in-house expertise and knowledge in basic telecommunications. The building blocks of the program are illustrated in the figure below. They encompass 3 main domains: a general overview with a description of the main

supporting technologies, with a focus on the state of the art IP and optical transmission platforms aimed at providing the INCM staff with the baseline understanding of the telecoms ecosystem. The system overview is designed to provide an understanding of the mobile ecosystem and its main standards and their evolution path namely GSM/GPRS, UMTS/HSDPA and the future LTE technologies.

FIGURE 1: TRAINING REFERENCE MODEL FOR INCM



The radio planning domain will deepen the knowledge of the relevant staff of the INCM in matters related with radio planning which is the cornerstone of the mobile ecosystem. Most of the KQI's of the mobile services are intrinsically linked with the radio component of the mobile ecosystem. This block will further enhance and substantiate the essence of the training requirements in matters pertaining to understanding the nature of field test measurements and the relevance of most of the KQI's submitted by the operators and measured by INCM itself.

For each individual block a detailed course program has been developed in Annex F. The structure of each course is based on both theoretical and practical exercises outlining the target audience, content of the course and duration.

ANNEX A

MOBILE COVERAGE IN MOZAMBIQUE

(To be provided separately by INCM)

ANNEX B

DECREE nº. 6/2011

Terça-feira, 3 de Maio de 2011 — I SÉRIE — Número 17

BOLETIM DA REPÚBLICA

PUBLICAÇÃO OFICIAL DA REPÚBLICA DE MOÇAMBIQUE

5.º SUPLEMENTO

IMPRENSA NACIONAL DE MOÇAMBIQUE, E.P.

AVISO

[illegible]

SUMÁRIO

Conselho de Ministros:

Decreto n.º 6/2011:

Aprova o Regulamento sobre Qualidade de Serviços Públicos de Telecomunicações.

Decreto n.º [illegible]/2011:

[illegible] (CNETP).

Decreto n.º [illegible]/2011:

Cria o Instituto de Educação [illegible], abreviadamente designado por IEDA.

CONSELHO DE MINISTROS

Decreto n.º 6/2011

de 3 de Maio

Tornando-se necessário estabelecer parâmetros, indicadores e metas de qualidade dos serviços públicos de telecomunicações, o Conselho de Ministros, ao abrigo do disposto na alínea b) do artigo 6 da Lei n.º 8/2004, de 21 de Julho, decreta:

Artigo 1. É aprovado o Regulamento sobre Qualidade de Serviços Públicos de Telecomunicações, em anexo ao presente Decreto, dele fazendo parte integrante.

Art. 2. Os parâmetros, indicadores e metas de qualidade de serviço [illegible] nos termos e condições das licenças de telecomunicações já atribuídas passam a reger-se pelo disposto no presente Decreto.

Art. 3. Compete ao Instituto Nacional das Comunicações de Moçambique (INCM) zelar pelo cumprimento do disposto no presente Decreto.

Art. 4. O presente Decreto entra em vigor 180 dias após a sua publicação.

Aprovado pelo Conselho de Ministros, aos 25 de Janeiro de 2011.

Publique-se.

O Primeiro-Ministro, *Aires Bonifácio Baptista Ali.*

Regulamento sobre Qualidade de Serviços Públicos de Telecomunicações

CAPÍTULO I

Disposições Gerais

ARTIGO 1

Objecto

O presente Regulamento estabelece o regime jurídico aplicável aos níveis de qualidade de serviço [illegible] pelos operadores e prestadores de serviços públicos de telecomunicações e define os parâmetros e as metas de qualidade para cada serviço no âmbito do presente Regulamento.

ARTIGO 2

Âmbito

1. O presente Regulamento é aplicável a todos os operadores e prestadores, públicos e privados, de serviços públicos de telecomunicações desde que exerçam sua actividade há mais de um ano no território nacional.

2. O disposto no presente Regulamento aplica-se aos seguintes serviços:

a) Telefonia fixa;

b) Telefonia móvel celular;

c) Interligação;

d) Circuitos alugados;

e) Dados;

f) *Internet.*

ANNEX C

PROPOSED KQI's FOR MEASUREMENT OF QoS IN MOBILE ECO SYSTEM

MOBILE TELEPHONY SERVICE

Quality of Service Parameters	Quality Service Indicators	Objectives of Quality
Billing	1.1 Percentage of claims of wrong billing	10%
Network Performance	3.1 Percentage of calls successfully established during peak hour	95%
	3.2 Percentage of calls completed during peak hour	95%
	3.3 Mean time to establish a call during peak hour	10 seconds - international call
		5 seconds - national call
	3.4 Percentage of lost calls during peak hour	5%
	3.5 Percentage of traffic congestion during peak hour	5%
	3.6 Mean quality voice during conversation same network	90% of samples over 3 in MOS scale
	3.7 Percentage of delivery of SMS during peak hour	90%
	3.8 Mean time to deliver SMS	10 seconds
Service coverage	5.1 Exteriors	- 85 dBm (GSM)
		- 100 dBm (UMTS)
	5.2 Interiors	- 100 dBm (GSM)
		- 105 dBm (UMTS)
	5.3 Inside vehicles	- 90 dBm (GSM)
		- 100 dBm (UMTS)
Customer complaints - call center	6.1 Mean time to answer calls	80% of calls should be answered in 60 seconds
	6.2 Percentage of calls abondoned	10% of total calls
	6.3 Mean time to wait for personal attention in attention centers	20 minutes

INTERCONNECTION SERVICE WITH A FIXED NETWORK

Quality of Service Parameters	Quality Service Indicators	Objectives of Quality
Billing	1.1 Mean ratio complaints on billing	2% of deviation
	1.2 Mean time to solve complaints about billing	? 5 days
Faults	2.1 Percentage of faults	1% of the total of interconnected operators
Initial provision of service	3.1 Time to negotiate interconnection agreement	25 days
Network performance	5.1 Successful calls rate	95%
	5.2 Satisfaction rate in service provision	95%
	5.3 Temporary circuit	99.9%

INTERCONNECTION SERVICE WITH A MOBILE NETWORK

Quality of Service Parameters	Quality Service Indicators	Objectives of Quality
Faults	1.1 Percentage of faults	1% of the total of interconnected operators
Initial provision of service	2.1 Time to negotiate interconnection agreement	25 days
Network performance	3.1 Successful calls rate	95%
	3.2 Rate of retained calls	95%
	3.3 Rate of successful transmission and SMS delivery	95%
	3.4 Availability rate	98.0%
Billing	5.1 Mean ratio complaints on billing	2% of deviation
	5.2 Mean time to solve complaints about billing	? 5 days

DATA SERVICE

Quality of Service Parameters	Quality Service Indicators	Objectives of Quality
Time to furnish Service	1.1 Provision of initial connection	3 working days
Faults	2.1 Percentage of faults	2% of total of clients of period related
	2.2 Time to repair faults in customers line	24 hours urban zones, 48 hours rural zones
Billing	3.1 Percentage of claims of billing	2% of total of clients of period related
	3.2 Period to solve billing claim	5 days
Quality Transmission of Information	4.1 Upstream and downstream band	In peak hour the upstream and downstream have to be 95% related to contracted capacity by customer with idependence to circuit or packet switching applied
	4.2 Capacity to transfer data	Should be over 70% of specification in contract with customer
	4.3 Mean delay in the transmission of packets (latency)	Should be specified in contract of customer
	4.4 Rate success information transfer	95%

ANNEX D

BENCHMARKING AND POST-DRIVE-TEST ANALYSIS FOR INCM

1. Purpose of this document

The purpose of this document is to define the requirements for a **benchmarking and post-drive-test analysis for INCM.** It is intended that at the final of the exercise an extensive and detailed report is being submitted by an independent institution with regard to quality of mobile services on the targeted areas.

2. Project mandate

INCM is the regulatory authority in Mozambique tasked amongst others to oversee the performance of the different players in the Mozambican market**.** The mobile services have experienced a tremendous growth and relevance over the last years becoming the main and the most used ICT asset in Mozambique. The provision of a good level Quality of Service (QoS) and Quality of Experience (QoE) in the mobile ecosystem ranks as one of the top priorities and issues of the telecommunications sector.

In view of that and in order to establish the level playing field for the different stakeholders in assessing the overall performance of the telecommunications operators and after extensive consultations and analysis a legal instrument has been developed where all substantive and relevant issues, pertaining to quality of services are enshrined. These issues are encapsulated and outlined in the Decree 6/2011.

In order to implement the provisions of the above mentioned decree, INCM has undertaken a study, aiming at developing a working methodology to evaluate on a comparable and an equitable basis the quality of services provided by the three mobile operators.

As part of the methodology it is required that a comparative benchmarking analysis, through field drive tests in selected areas should be conducted by an independent entity.

The ultimate goal of the exercise is to test and validate the proposed methodology and concomitantly, provide INCM with hands on experience and training in assessing the quality of services KPI's.

3. Scope of Work

The intention is to engage an independent engineering consultancy expert to perform drive test benchmarking for the three mobile operators in Mozambique, namely mcel, Vodacom and Movitel. In addition, the selected expert will provide post–drive test analysis of the networks highlighting the main differences between them.

3.1 Location(s) and the scope of the drive test

In view of the limited scope and purpose of the task it was considered that this exercise is a pilot one, covering only Maputo and Matola urban areas and the national highway N4 up to Ressano Garcia, evaluating both 2G and 3G voice and data networks.

INCM will indicate the QoS KPI's to be measured within the provisions of the Decree 6/2011 (See the list below).

The important major and minor roads as well as areas of strategic importance should be included in drive routes. The routes will be designated by **INCM** for the purpose of focusing the exercise on areas of customer relevance and sensitivity.

The route planning and logistics will be agreed before the commencement of the project. **INCM** will bear the costs of labor and, where applicable the travel and accommodation costs in the above mentioned locations.

It is important that **INCM** and the selected Bidder exchange the route information prior to the start of the project in order to prevent any delays or misunderstanding regarding the project scope.

3.2 Duration of the project

3.2.1. Duration of the field drive test exercise

The duration of the drive test exercise will be limited to **10 weekdays** assuming an 8-hour workday. However, **INCM** and the selected Bidder may agree through mutual consent a change in the days and hours in which the drive tests are conducted for the purpose of achieving the desired project outcome.

The Bidder is expected to indicate the resources (including respective CV's) that will be allocated to the project.

3.2.2 Duration of the post-processing and analysis

The duration of the post-processing, analysis and report creation is expected to take place **5 weekdays** after completion of the drive test exercise. At the end of the project, selected Bidders should also submit an aggregated and final report with the full list of findings and take part in a training session for the **INCM** personnel.

The Bidder is expected to indicate the tools and resources that will be allocated to the project to perform this task.

3.3 Equipment configuration

The Bidder is required to use for benchmarking solution a voice quality testing based on NEMO Outdoor equipment.

3.3.1 GSM/UMTS Voice Testing

The Bidder are requested to indicate the typical setup for testing Network-A, Network-B and Network-C that will be applied for the benchmarking in order to measure the voice quality. These setups must distinguish scenarios for long and short duration calls.

3.3.2 GSM/UMTS Data Testing

The Bidder will have to present the setup for the typical equipment configuration for data testing of Network-A, Network-B and Network-C. The tests must follow a sequence of file upload and download to and from a designated FTP server as well as Ping tests to designated IP addresses. The mobile phones will be replaced by GSM/UMTS data cards.

3.3.3 Summary of Equipment Required

The Bidder will have to list the summary of the equipment required and that will be used for the benchmarking exercise. The basic requirements from **INCM** are the following:

Type	Quantity	Responsibility
Laptops	3	Bidder
Nemo Test Mobiles + Licenses	9	Bidder
GSM/UMTS Data Cards	3	Bidder
SIMs + Airtime	4 **mcel** + 4 Vodacom + 4 Movitel	**Mcel, Vodacom and Movitel**

3.3 Key Performance Indicators

KPI	Formula Typically Used
Call Drop Rate	DCR = (Total Dropped Calls / Total Call Setups)*100
Call Setup Rate	CSSR= 100 – (Nr of Blocked Calls / Total Nr of Call Attempts)
Call Completion Rate	CCR = 100 – Drop Call Rate
Handover Success Rate	HOSR = 100 – ((Nr of Handover Failures / Total Nr of Handover Attempts)*100)
Packet Call Setup Rate	Packet Call Setup Rate = 100 – ((Packet Call Setup Failures / Total Packet Call Attempts)*100)
Packet Drop Rate	Packet Call Drop Rate = Packet Calls Dropped / Total Nr of PDP Context Activations
Average RLC Throughput	The data throughput will be shown on a graphical distribution for uplink and downlink separately
Voice Quality Indication	Mean Opinion Scope Type (MOS)

3.5 Resources

3.5.1 Drive test engineers (On-site)

The Bidder will have to provide drive test engineers who will manage/operate the equipment and communicate with the **INCM and mobile operators** radio quality teams regarding the drive test routes, SIMs, transportation logistics and others. The Bidder is expected to indicate the number of engineers that will be involved in the activity.

3.5.2 Post-processing engineer (Off-site)

Bidder engineers skilled with NEMO, ACTIX and MapInfo should post-process at Bidder's premises the data collected. This process must involve extracting the data from the numerous logfiles according to geographic (GPS) and time (timestamps) reference points. The data will then be sorted into the relevant KPIs and map based as well statistical graphs will be presented.

The Bidder will have to confirm the availability of such processing tools at their premises. This exercise should be done in conjunction with **INCM** as part of the training of their staff.

3.5.3 Analysis engineer (Off-site)

The Bidder will provide a skilled GSM/UMTS optimization engineer to analyze the data and pinpoint areas in the network coverage, high rates of dropped calls, poor call setup, high levels of congestion and severe levels of interference. The Bidder should make suggestions on how these network problems could be resolved. However, it will be **INCM's** responsibility to use these suggestions within the provisions of the Decree 6/2011.

3.6 Deliverables

3.6.1 Drive test log files containing the tested routes and associated test case data.

3.6.2 An unbiased report showing the benchmarked results of **mcel,** Vodacom and Movitel

3.6.3 An analysis report identifying the weak areas of each of the three operators.

3.6.4 An action plan for **INCM** to derive further value from the data collected within the provisions of the decree.

4. Sample Reports

Bidders are requested to include two sample reports that illustrate the format of the tangible deliverables, as such:

1. GSM/UMTS Voice Retainability
    a. Call Retainability Counts
    b. Call Drop Rate
    c. Call Completion Rate
    d. Voice quality
2. Geographical Indication of Drop Rates
    a. Dropped Calls
3. Geographical indication of Voice Quality
4. Geographical indication of Time Advance
5. Geographical indication of MS power level
6. Geographical indication of FER (Frame Erasure Rate)
7. Packet channel coding

8. GSM/UMTS Voice Accessibility
    a. Call Accessibility Counts
    b. Call setup time
9. Geographical Indication of Blocked Calls
    a. Blocked Calls
10. GSM/i-RAT handover, Inter-vendor Handover Statistics
    a. Blocked Calls
11. GSM/i-RAT handover, Inter-vendor Statistics Handover
    a. Handover Counts
    b. Handover Successful Rate
12. Geographical Indication of Handover Failures
    a. Handover Failures
13. GSM/UMTS Received Signal Plots
    a. RxLev SUB
    b. RxQUal SUB
    c. Carrier to Interference Radio
    d. Pillot Pollution
    e. RSCP
    f. EcNo
    g. Modulation codes distribution
    h. BLER DL
    i. Audio quality MOS DL
14. GSM/UMTS Packet Call Accessibility Counts
    a. Packet Call Accessibility Counts
    b. Packet Call Setup Success Rate
15. Geographical Indication of Packed Setup Failures
    a. Packet Setup Failure
16. GSM/UMTS Indication of Packet Retainability
    a. Packet Call Retainability Counts
17. Geo graphical Indication of Dropped Packed Calls
    a. Dropped Packed Calls (including FTP cut-off)
18. GSM/UMTS Data Throughput
    a. Throughput Distribution
    b. RLC sessions
    c. Applications sessions
    d. PDP, FTP, HTTP statistics
    e. Spreading factor usage
    f. CQI distribution

19. Geographical Throughput Graphs
    a. RL C Throughput
20. Ping Distribution Statistics

Graphical presentation of findings must also be included on the report, including recommendations.

5. Project Governance

This Statement of Work provides an overview to governance model. Any proposed changes to the Scope of Work can be proposed by the Bidders and will be evaluated by **INCM**. Bidders are fully responsible for the selection of resources as **INCM** will be provided with a turnkey solution.

5.1 Change Request Management

The principles of the process are that **INCM** will approach selected Bidder Project Manager to request any required changes to the Scope of Work. The project Manager will complete the Change Request with input from **INCM** representatives regarding requirements. The Change Request is analyzed for technical and commercial impact with options evaluated. The Change Request requires approval by all parties. The approved Change Request documentation (as signed by the parties) is then appended to the existing Statement of Work to form the revised Statement of Work for the Project.

5.2 Communication Plan

Selected Bidder will ensure that clear an effective communication will be maintained throughout the lifecycle of the engagement. All binding routine communication will be between the Consultant of **INCM** and Project Manager for the Bidder by email or by phone followed by a summary email of agreed actions. Commercial communications will be between the selected Bidders allocated Account Manager and **INCM** consultant and **INCM** Project Managers should be included in the communication.

5.3 Quality Assurance

Project quality assurance will be maintained by a regular cross check balance on activities along with risk logs.

5.4 Project Library

Selected Bidder will maintain a Project Library for the duration of the Project. This library will contain a record of all project documents and correspondence and must be handed over to **INCM** at the end of the project.

6. Commercial Offer and Proposed Start Date

6.2 Price for the Service

Item	Quantity	Amount (USD)
2G/3G benchmarking Service	1	
Detailed Post-Processing (off-site)	1	
Analysis and Troubleshooting (off-site)	1	
Voice Quality Measurements	1	
Logistic costs (drive test vehicle rental)	1	
Total		

6.2Terms

- Prices in USD exclude shipping, customs, excise and withholding taxes
- Payment of these taxes will be **INCM** responsibility
- Quotation valid until end xx Xxxxxx 20XX

- Payment must be made in 30 days from date of invoice
- Invoiced amounts are excluding any country specific withholding or industrial taxes
- Commencement of work will be agreed between parties

6.3 Commencement and delivery

- The project will commence within one week of receipt of the purchase order
- The targeted date for the project start will be the first week of October
- Analysis and reporting will be done at selected Bidder offices and will take place on completion of the drive test activity
- Troubleshooting will take place after the initial analysis is complete
- Excepted duration0 for the project will be 10 weekdays plus 5 days for final processing and aggregated report submission.

ANNEX E

EXAMPLE OF QUESTIONS FOR CUSTOMER SATISFACTION SURVEY

LOYALTY – SEGMENTO VOZ **Questionário Nº [AUTOMÁTICO]: '____'____'____'____'____'**

HORA DE ÍNICIO: ____: ____ [AUTOMATICO] DATA: ____: ____ [AUTOMATICO]

Bom dia/ Boa tarde. Sou entrevistador de uma empresa de Estudos de Mercado, xxxxxxxx e nós estamos a realizar um estudo de satisfação de clientes com as telecomunicações móveis. Importa-se de responder a um questionário? Desde já agradeço a sua colaboração. Gostaria de lhe assegurar que todas as suas respostas serão confidenciais sendo os dados tratados como um todo e nunca individualmente.

D.1. REGISTAR SEXO:

Masculino 1

Feminino 2

D.2. Importa-se de me dizer qual é a sua idade?

'____'____' Anos

[Programador: Carregar na:]

Menos de 15 anos.....1 ➔ **Agradecer e terminar a entrevista**

15 a 24 anos .....2 ➔ **CONTINUAR**

25 a 34 anos .....2 ➔ **CONTINUAR**

35 a 44 anos .....2 ➔ **CONTINUAR**

45 a 54 anos .....3 ➔ **CONTINUAR**

55 ou + anos .....3 ➔ **CONTINUAR**

CAIXA 1: ESTRUTURA DO REGISTO DE DISTRITO/CAPITAL PROVINCIAL

[OPÇÕES SÃO PROGRAMADAS DIRECTAMENTE NO PDA DE ACORDO COM DIVISÕES ADMINISTRATIVAS MOÇAMBICANAS]

MAPUTO CIDADE

- **BAIRRO1. → CONTINUAR**
- **BAIRRO2. → CONTINUAR**
- **…**

MAPUTO PROVÍNCIA

- **MATOLA**
  - **BAIRRO1 → CONTINUAR**
  - **BAIRRO2 → CONTINUAR**
  - **…**
- **DISTRITO1→ AGRADECER E TERMINAR**
- **DISTRITO2→ AGRADECER E TERMINAR**
- **…**

SOFALA

- **BEIRA CIDADE**
  - **BAIRRO1 → CONTINUAR**
  - **BAIRRO2 → CONTINUAR**
  - **…**
- **DISTRITO1 → AGRADECER E TERMINAR**
- **DISTRITO2→ AGRADECER E TERMINAR**
- **…**

NAMPULA

- **NAMPULA CIDADE**
  - **BAIRRO1 → CONTINUAR**
  - **BAIRRO2 → CONTINUAR**
  - **…**
- **DISTRITO1→ AGRADECER E TERMINAR**
- **DISTRITO2→ AGRADECER E TERMINAR**
- **…**

OUTRAS PROPÍCIAS

- **CAPITAL PROVINCIAL → CONTINUAR**

- **DISTRITO1 → AGRADECER E TERMINAR**
- **DISTRITO2→ AGRADECER E TERMINAR**
- **…**

P.0. Gostaria de lhe começar por perguntar se tem telemóvel?

Sim .....1 → **CONTINUAR**

Não .....2 → **AGRADECER E TERMINAR**

P.1. Quais os operadores de telemóvel que utiliza atualmente?

mcel 1

Vodacom 2

Movitel 3

Outro: Qual? _____ 98

CAIXA 1:

SE VÁRIOS FORNECEDORES NA P.1 FAZER P.1A

CASO CONTRÁRIO VERIFICAR QUOTAS

P.1.A. E qual desses é o operador que utiliza preferencialmente? **(REGISTAR UMA SÓ RESPOSTA)**

mcel 1

Vodacom 2

Movitel 3

Outro: Qual? _____ 98

CAIXA 2: VERIFICAR QUOTAS:

VER OPERADOR USADO PREFERENCIALMENTE - SE QUOTA DISPONÍVEL CONTINUAR SENÃO, AGRADECER E TERMINAR

REGISTAR OPERADOR:

MCEL.....1

VODACOM.....2

MOVITEL.....3

TODO O QUESTIONÁRIO SERÁ FEITO EM FUNÇÃO DO OPERADOR ASSOCIADO À QUOTA COM EXCEÇÃO DA PERGUNTA P.1.B E P.1C. QUE É PARA TODOS OS OPERADORES UTILIZADOS NA P.1

P.1.B. E, qual o tipo de contrato que tem com a **[MOSTRAR OPERADOR DE MÓVEL EM ANÁLISE]**?

Pré-pago.....1

Pós-Pago/Contrato.....2

P.1.B.1 E, qual o tipo de contrato que tem com a ? **[Programador: Fazer para todos os operadores que o inquirido utiliza na P.1 não mencionadas na P.1.A]**

(RESPOSTA ÚNICA POR LINHA)

	Pré-pago	**Pós-Pago/Contrato**
mcel	1	2
Vodacom	1	2
Movitel	1	2

P.1.C. E, qual o valor aproximado que gasta por mês em telemóvel? **[Programador: Fazer para todos os operadores que o inquirido utiliza na P.1]**

mcel..... '_____' MTN

Vodacom..... '_____' MTN

Movitel ..... '_____' MTN

P.1.D. E, consegue controlar o seu consumo de chamadas/sms? **[Nota para o entrevistador:** O objetivo desta pergunta é perceber se a pessoas sabe quanto consome em média por dia]

Sim .....1 → **P.1.D.1**

Não .....2 → **Recargas**

P.1.D.1 Como é que costuma controlar o seu consumo de chamadas/sms? **[Registar tudo o que o inquirido disser]**

_____

IMAGEM

P.2. Gostaria de lhe colocar agora algumas questões gerais sobre operadores de telemóveis da … **[MOSTRAR OPERADOR DE MÓVEL EM ANÁLISE]**. Vou ler-lhe uma série de aspectos e, para cada um deles, gostaria que me dissesse até que ponto se aplicam ou não à… **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Por favor utilize uma escala de 0 a 10, em que 0 significa "não se aplica nada", e 10 significa "aplica-se totalmente". Não se esqueça que pode usar números intermédios, **[Registe 99 se NS/NR]**

LER "A **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]** …"

RODAR AS FRASES

1 • …é simpática ..... '_____' '_____'

2 • …é honesta ..... '_____' '_____'

3 • …é sinónimo de elevada qualidade ..... '_____' '_____'

4 • …é dinâmica ..... '_____' '_____'

5 • …é fiável / de confiança ..... '_____' '_____'

6 • …é líder neste mercado ..... '_____' '_____'

7 • …é moderna ..... '_____' '_____'

8 • …é inovadora ..... '_____' '_____'

9 • …é muito conhecida ..... '_____' '_____'

10 • …é sólida no mercado ..... '_____' '_____'

11 • …tem sucesso económico ..... '_____' '_____'

12 • …tem uma boa imagem pública ..... '_____' '_____'

P.2A. Pensando numa forma geral na … **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]** e utilizando a escala anterior, diga-me por favor até que ponto a frase que lhe vou ler se aplica a esta empresa: "Em termos gerais, a… **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]** é um operador móvel com uma imagem muito positiva".

• Em termos gerais como avalia a imagem global..... '_____' '_____'

LEALDADE

P.3. Vou agora ler-lhe um conjunto de frases e, para cada uma delas, gostaria que me dissesse até que ponto se aplicam à… **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Para tal, peço-lhe que utilize esta escala já sua conhecida (escala de 0 a 10, em que 0 significa "não se aplica nada", e 10 significa "aplica-se totalmente". Não se esqueça que pode usar números intermédios, **[Registe 99 se NS/NR].** **(LER NOVAMENTE A ESCALA AO INQUIRIDO)**

RODAR AS FRASES

A **[MOSTRAR OPERADOR MOVEL EM ANÁLISE]**

1 • …presta um serviço que compensa o que tenho de pagar

2 • …irá ser recomendada por mim a familiares, amigos e conhecidos

3 • …é uma empresa na qual confio

4 • …tem produtos e serviços que me convencem

5 • … tem consideração por mim enquanto Cliente

6 • …é uma operadora da qual sou cliente há muito tempo

7 •…é operadora da qual utilizo/Consumo mais produtos/serviços

8 • …é uma operadora da qual continuarei a utilizar e a comprar os produtos/serviços no futuro

9 • …fará com no futuro que aumente ou, pelo menos, mantenha a atual utilização que faço dos produtos/serviços

‘_____’ ‘_____’

‘_____’ ‘_____’

‘_____’ ‘_____’

‘_____’ ‘_____’

‘_____’ ‘_____’

‘_____’ ‘_____’

‘_____’ ‘_____’

SATISFAÇÃO COM ASPECTOS RELACIONADOS COM O OPERADOR

P.4. Gostaria agora de saber até que ponto se encontra satisfeito(a) com alguns aspectos relacionados com a **[MOSTRAR OPERADOR DE MÓVEL EM ANÁLISE]**. Para tal, peço-lhe que utilize uma escala de 0 a 10, em que 0 significa "estou totalmente insatisfeito, e 10 significa "estou totalmente satisfeito". Não se esqueça que pode usar números intermédios, **[Registe 99 se NS/NR]**

Vamos começar por falar em aspectos relacionados com a **"Eficiência do Operador".**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … a rapidez do operador na resolução dos

problemas surgidos..... '_____' '_____'

2 • … a facilidade de contacto com o operador

(linha de apoio, email)..... '_____' '_____'

3 • … a honestidade e seriedade do operador..... '_____' '_____'

P.4.A. E, em termos globais, até que ponto está satisfeito com a **Eficiência do Operador: [MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com a **Eficiência do Operador**..... '_____' '_____'

P.5. Vamos agora falar em aspectos relacionados com a **"Cobertura"** do operador. **(RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO INQUIRIDO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … a cobertura em locais onde utiliza o telemóvel para realizar chamadas .....'_____' '_____'

2 • … a qualidade no estabelecimento da ligação .....'_____' '_____'

3 • … a qualidade durante a ligação (ser capaz de ouvir com clareza) .....'_____' '_____'

P.5.A. E, em termos globais, até que ponto está satisfeito com a **Cobertura** da **[MOSTRAR OPERADOR DE MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com a **Cobertura** ..... '_____' '_____'

P.6. Pensando agora nos aspectos relacionados com os **"Preços"** praticados pela **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Por favor utilize a mesma escala de satisfação. **(RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO ENTREVISTADO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … o valor da mensalidade ou do carregamento .....'_____' '_____'

2 • … o preço de aquisição do pacote inicial da **[MOSTRAR OPERADOR]**‘_____’ ‘_____’

P.6.A. E, em termos globais, até que ponto está satisfeito com os **Preços** praticados pela **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com os **Preços** praticados ..... ‘_____’ ‘_____’

Caixa 5: **Verificar P1C para o operador principal.** **Se pós-pago/contrato continua com a P.7 senão passa para a P.8**

P.7. Recebe fatura mensal?

Sim 1

Não 2

Caixa 6: **Se recebe fatura mensal continuar com P7A senão passar para P.8**

P.7.A Vamos agora falar em aspectos relacionados com as **“Faturas”** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. **(RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO INQUIRIDO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … a exactidão das facturas ..... '_____' '_____'

2 • … a pontualidade na recepção das facturas ..... '_____' '_____'

3 • … a clareza e detalhe da informação

fornecida na factura ..... '_____' '_____'

P.7.B. E, em termos globais, até que ponto está satisfeito com as **Faturas** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com as **Faturas** ..... '_____' '_____'

P.8. Gostaria de saber se, no último ano, recorreu à linha de Apoio ao Cliente dos operadores da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**?

Sim 1

Não 2

P.8.1 Gostaria de saber se, no último ano, recorreu à linha de Apoio ao Cliente dos operadores de telemóvel que utiliza?

[Programador: O inquirido só pode ter recorrido à linha de apoio ao cliente se for cliente do operador – verificar operadores não referenciados na P.1.A]

	Sim	**Não**
Vodacom	1	2
mcel	1	2

Movitel 1 2

CAIXA 7:

Se o inquirido contactou o apoio ao cliente da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]** no último ano, então fazer as restantes alíneas da P.8.A, caso contrário saltar para P.9

P.8.A Pensando agora nos aspectos relacionados com a **"Linha de Apoio ao Cliente"** do **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Por favor utilize a mesma escala de satisfação. Não se esqueça que pode usar números intermédios da escala. **(RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO INQUIRIDO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … facilidade de chegar ao assistente com capacidade técnica para resolver

Os seus problemas ..... '_____' '_____'

2 • … o número de contactos necessários

para a resolução dos problemas..... '_____' '_____'

3 • … o empenho em propor novas soluções/serviços ..... '_____' '_____'

4 • … a competência e preparação técnica

dos assistentes, isto é, a capacidade de resolução dos

problemas surgidos ..... '_____' '_____'

5 • … o tempo de espera até ser atendido ..... '_____' '_____'

6 • … a adequação da solução apresentada

pelo assistente às suas necessidades..... '_____' '_____'

7 • … a amabilidade de simpatia dos assistentes..... '_____' '_____'

8 • … a clareza na resposta às informações

solicitadas ..... '_____' '_____'

P.8.B. E, em termos globais, até que ponto está satisfeito com a **Linha de Apoio ao Cliente** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com a **Linha de Apoio ao**

Cliente ..... '_____' '_____'

P.9. – Diga-me por favor, dirigiu-se no último ano a alguma loja da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**?

Sim 1

Não 2

P.9.1 Diga-me por favor, dirigiu-se no último ano a alguma loja dos operadores de telemóvel que utiliza?

[Programador: O inquirido só pode ter recorrido à linha de apoio ao cliente se for cliente do operador – verificar operadores não referenciados na P.1.A]

	Sim	**Não**
Vodacom	1	2
mcel	1	2
Movitel	1	2

CAIXA 8:

Se o inquirido visitou uma loja **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]** no último ano, então fazer as restantes alíneas da P.9.A, Caso contrário saltar para P.10

P.9.A Vamos agora falar de aspectos relacionados com as **"Lojas"** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Por favor utilize a mesma escala de satisfação. Não se esqueça que pode usar números intermédios. **(RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO INQUIRIDO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … o número de vezes que precisou de ir à loja

para a resolução dos problemas..... '_____' '_____'

2 • … a capacidade de resolução dos

problemas surgidos ..... '_____' '_____'

3 • … o empenho em propor novos pacotes/serviços..... '_____' '_____'

4 • … a competência e preparação técnica ..... '_____' '_____'

5 • … o tempo de espera até ser atendido ..... '_____' '_____'

6 • … a amabilidade e simpatia do funcionário..... '_____' '_____'

7 • … o número de lojas e a sua localização..... '_____' '_____'

P.9.B. E, em termos globais, até que ponto está satisfeito com as **Lojas** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com as **Lojas** ..... '_____' '_____'

P.10. Vamos agora falar de aspectos relacionados com a **"Informação de Produtos / Campanhas"** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Por favor utilize a mesma escala de satisfação. Não se esqueça que pode usar números intermédios. **(RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO INQUIRIDO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … as informações de produtos/ campanhas

na página web do operador..... '_____' '_____'

2 • … as informações de produtos/ campanhas

enviadas por SMS / e-mail ..... '_____' '_____'

3 • … as campanhas televisivas do

operador ..... '_____' '_____'

4 • … campanhas em painéis/ folhetos/material

informativo..... '_____' '_____'

P.10.A. E, em termos globais, até que ponto está satisfeito com a **Informação de Produtos / Campanhas** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com a **Informação de**

Produtos / Campanhas.....‘_____’ ‘_____’

P.11. Gostaria de saber se já alguma vez consultou a **“Página Web/ Site”** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**?

Sim 1

Não 2

P.11.1 Gostaria de saber se já alguma vez consultou a **“Página Web/ Site”** dos operadores de telemóvel que utiliza?

[Programador: O inquirido só pode ter recorrido à linha de apoio ao cliente se for cliente do operador – verificar operadores não referenciados na P.1.A]

	Sim	**Não**
Vodacom	1	2
mcel	1	2
Movitel	1	2

CAIXA 9:

Se o inquirido consultou a página Web do **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**, então fazer as restantes alíneas da P.11.A, caso contrário saltar para P.12

P.11.A Vamos agora falar de aspectos relacionados com a **“Página Web/ Site”** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**. Por favor utilize a mesma escala de satisfação. Não se esqueça que pode usar números intermédios, **[Registe 99 se NS/NR] (RELEMBRAR, CASO SEJA NECESSÁRIO, A ESCALA AO ENTREVISTADO. LER CADA ASPECTO E REGISTAR UMA RESPOSTA POR LINHA)**

RODAR AS FRASES

"Até que ponto se encontra satisfeito com…"

1 • … a facilidade em utilizar os serviços disponíveis

na página Web ..... '_____' '_____'

2 • … a diversidade dos conteúdos informativos

disponíveis na página Web..... '_____' '_____'

3 • … a facilidade de navegação da página ..... '_____' '_____'

4 • … o dinamismo e inovação da página..... '_____' '_____'

5 • … a consulta da Factura Electrónica ..... '_____' '_____'

P.11.B. E, em termos globais, até que ponto está satisfeito com a **Página Web/ Site** do **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação Global com a **Página Web/ Site** ..... '_____' '_____'

P.12. E, em termos gerais, até que ponto está satisfeito com o **Desempenho Global** da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**? Por favor utilize a mesma escala de satisfação.

• Satisfação com o **Desempenho global**..... '_____' '_____'

DADOS DE CARACTERIZAÇÃO

D.1. Há quanto tempo é que o(a) Sr(a) é cliente da **[MOSTRAR OPERADOR MÓVEL EM ANÁLISE]**

Há menos de 1 mês..... 1

Há mais de 1 mês mas menos de 3 meses (entre 1 a 3 meses) 2

Há mais de 3 meses mas menos de 6 meses (entre 3 a 6 meses)..... 3

Há mais de 6 meses mas menos de 1 ano (entre 6 meses a 1 ano) 4

Há mais de 1 ano mas menos de 3 anos (entre 1 a 3 anos)..... 5

Há mais de 3 anos mas menos de 6 anos (entre 3 a 6 anos) 6

Há mais de 6 anos mas menos de 10 anos (entre 6 a 10 anos) 7

Há mais de 10 anos..... 8

Outras respostas. Especificar:_____ 98

Ns/Nr..... 99

D.2. O(A) Sr.(a) tem telefone fixo em sua casa?

SIM 1

NÃO..... 2

NS/NR 9

D.3.1 E tem acesso à internet? **[Programador: Carregar automaticamente no caso das entrevistas em CAPI]**

SIM ..... 1 → **D.3A1**

NÃO..... 2 → **D.4**

NS/NR ..... 9 → **D.4**

D.3A.1 Qual ou quais as redes que utiliza? **(NÃO SUGERIR NADA. VÁRIAS RESPOSTAS POSSÍVEIS)**

[Programador: Se mais que 1 resposta na D3A1 fazer D3B1 senão D4]

D.3B.1 Qual é a rede que mais utiliza? **(NÃO SUGERIR NADA. REGISTAR APENAS UMA RESPOSTA)**

	D3A	**D3B**
	(VÁRIAS RESPOSTAS POSSÍVEIS)	**(1 SÓ RESPOSTA)**
Vodacom	1	2
mcel	1	2
TDM	1	2
TvCabo	1	2
Kwicknet (Teledata)	1	2
iburst	1	2
Clubnet	1	2
EmilNet	1	2
Satcom	1	2
Comzatel	1	2
Intra	1	2
Virconn	1	2
Tropical Web	1	2
In	1	2

D.4. O(A) Sr.(a) tem algum Serviço de Televisão paga em sua casa?

SIM ..... 1 → **D.4A**

NÃO..... 2 → **D.5**

NS/NR ..... 9 → **D.5**

D.4A. Qual é o seu operador de televisão paga? **(NÃO SUGERIR NADA. UMA SÓ RESPOSTA)**

TV Cabo 01

DSTV.....02

ZAP.....03

Startimes.....04

Outros: Qual? 98

_____

Ns/Nr.....99

ST.1. Qual o Nível de escolaridade mais elevado que o(a) Sr(a) concluiu? **(APENAS 1 RESPOSTA)**

Alfabetização.....1

Ensino Primário 1o Grau 2

Ensino Primário 2o Grau 3

Ensino Secundário Geral 1o Ciclo 4

Ensino Secundário Geral 2o Ciclo 5

Ensino Técnico Elementar.....6

Ensino Técnico Básico.....7

Ensino Técnico Médio 8

Curso de Formação de Professores 9

Superior 10

ST.2. Importa-se de me dizer qual é exactamente a sua ocupação ou actividade profissional principal? (Insista para que a resposta seja o mais detalhada possível)

_____

ST.3. Qual a profissão actual do(a) Sr.(a)?

(SE TIVER MAIS QUE UMA PROFISSÃO, FALAR NA PRINCIPAL) (UMA SÓ RESPOSTA)

Trabalhador por conta própria .....1 ➔ **PASSAR PARA ST.6**

Trabalhador por conta de outrém .....2 ➔ **PASSAR PARA ST.8**

Desempregado.....3 ➔ **PASSAR PARA ST.4**

Aposentado / Reformado .....4 ➔ **PASSAR PARA ST.5**

Doméstica / Responsável pelas compras e faz a lida da casa.....5 ➔ **PASSAR PARA ST.13**

Estudante .....6 ➔ **PASSAR PARA ST.13**

ST.4. E anteriormente qual era a profissão do(a) Sr.(a)?

(Se tiver mais que uma profissão, falar na principal) (UMA SÓ RESPOSTA)

Trabalhador por conta própria .....1 ➔ **PASSAR PARA ST.6**

Trabalhador por conta de outrém .....2 ➔ **PASSAR PARA ST.8**

Nunca trabalhou .....3 ➔ **PASSAR PARA ST.13**

ST.5. E anteriormente qual era a profissão do(a) Sr.(a)?

(Se tiver mais que uma profissão, falar na principal) (UMA SÓ RESPOSTA)

Trabalhador por conta própria .....1 ➔ **PASSAR PARA ST.6**

Trabalhador por conta de outrém .....2 ➔ **PASSAR PARA ST.8**

(Trabalhadores por conta própria)

ST.6. Mais especificamente, a profissão do(a) Sr.(a) é / era…? **(LER - UMA SÓ RESPOSTA)**

Profissional liberal (médico, advogado, arquitecto, engenheiro, contabilista,

economista, artista, fotógrafo, decorador, professor…).....1 ➔ **PASSAR PARA ST.13**

Patrão / proprietário de empresa / loja, artesão, outros

trabalhadores por conta própria .....2 ➔**PASSAR ST.7**

Agricultor / pescador.....3 ➔ **PASSAR PARA ST.13**

Ns / Nr .....7 ➔ **PASSAR PARA ST.13**

ST.7. E por quantos empregados o(a) Sr.(a) é / foi responsável?

0 a 5 empregados..... 1

6 ou mais empregados..... 2

(Trabalhadores por conta de outrém)

ST.8. Mais especificamente, a sua profissão é / era…? **(LER - UMA SÓ RESPOSTA)**

Profissão técnica, científica e artística por conta de outrém

(médico, advogado, arquitecto, engenheiro, contabilista, economista, artista,

fotógrafo, decorador, professor…).....1 ➔ **PASSAR PARA ST.13**

Quadro superior (administrador, presidente, director de empresa, gerente).....2 ➔ **PASSAR ST.9**

Quadro médio (director de departamento, chefe de serviços, chefe de secção) .....3 ➔ **PASSAR ST.9**

Outro trabalhador por conta de outrém não manual (escriturário, técnico,

empregado de balcão, vendedor, polícia,…) .....4 ➔ **PASSAR ST.10**

Trabalhador manual (capataz, encarregado operário, trabalhador agrícola,

canalizador, carpinteiro, sapateiro, pintor, motorista…) .....5 ➔**PASSAR ST.11**

ST.9. E por quantos empregados o(a) Sr.(a) é / foi responsável? **(APENAS 1 RESPOSTA)**

0 a 5 empregados..... 1

6 ou mais empregados..... 2

PASSAR PARA A SENÃO ST.13

ST.10. E o(a) Sr(a). trabalha a maior parte do tempo num escritório? **(APENAS 1 RESPOSTA)**

Sim..... 1

Não 2

PASSAR PARA A SENÃO ST.13

ST.11. E o(a) Sr(a). trabalha como capataz / encarregado ou tem poder de supervisão? **(APENAS 1 RESPOSTA)**

Sim..... 1 ➔ **PASSAR PARA ST.13**

Não ..... 2 ➔ **PASSAR PARA ST.12**

ST.12. E o(a) Sr(a). recebeu alguma formação "formal" para adquirir as competências específicas para o trabalho que executa?

(APENAS 1 RESPOSTA)

Sim..... 1

Não 2

ST.13. Importa-se de me dizer o seu estado civil: **(APENAS 1 RESPOSTA)**

Solteiro (a).....1

Casado (a).....2

Viúvo (a) 3

Outro.....98 Especifique_____

ST.14. Das seguintes classes sociais de rendimento, diga-me na qual é que se enquadra o seu **rendimento mensal**.

(APENAS 1 RESPOSTA)

Menos de 5.000 MTN	1
De 5.000 a 10.000 MTN	2
De 10.001 a 15.000 MTN	3
De 15.001 a 20.000 MTN	4
De 20.001 a 30.000 MTN	5
De 30.001 a 50.000 MTN	6
De 50.001 a 100.000 MTN	7
De 100.001 a 200.000 MTN	8
De 200.001 a 500.000 MTN	9
Mais de 500.000 MTN	10
Não Sabe/Não Responde	99

AGRADECER E TERMINAR

NOME ENTREVISTADO: _____ CONTACTO TELEFÓNICO:_____

ENTREVISTADOR: _____ N.º: '____'____'____'____'____'

ANNEX F

DETAILED TRAINING PROGRAMME

Table of Contents – IP AND ATM DATA NETWORKS

Target

Telecommunications Engineers and Telecommunications Technical Staff

Objectives

To provide understanding concerning IP, Ethernet and ATM protocols and VoIP and IPTV services.

Prerequisites

Basic telecommunications knowledge

Contents

I – Telecommunications Fundamentals

- Course Organization
- Standardization International Bodies, OSI Model
- Switching and Addressing
- Broadcast and non-broadcast networks
- Network Topologies and Hierarchy
- Network Elements

II – TCP / IP

- Introduction
- OSI Model vs. TCP/IP model
- TCP/IP protocol
- IP addressing and sub networks
- Routing and multicasting IP
- Rerouting IP
- IPv6

III – Ethernet

- Introduction
- Network Elements in a Ethernet network
- Ethernet frame format
- Topology
- IEEE 802.3 model versus OSI model
- Frame transmission
- VLAN
- Ethernet vs. SDH
- Ethernet in the first mile
- Applications for Ethernet 10 Gigabits
- Wireless Ethernet

IV – MPLS

- Introduction
- MPLS
- Traffic management
- Virtual Private Networks

V - ATM

- Introduction
- Traffic management and QoS
- Addressing and signalling
- Architecture
- Applications

VI – ISP

- Types of ISPs
- Internet services
- Main ISP architectures
- Interconnection
- National backbone architecture

• International backbone architecture

• Security issues

VII – VoIP

• Introduction

• Voice over IP

• Advantages of VoIP

• Transport protocols

• QoS

VIII – IPTV

• Introduction

• IPTV network topology

• Technologies in IPTV distribution networks

• IPTV applications and services

• QoS

Duration

5 days

Table of Contents – GSM/GPRS/EDGE SYSTEM OVERVIEW

Target

Telecoms Engineers and Telecoms Technical Staff of digital transmission area

Objectives

To provide understanding concerning optical transmission:

• Digital transmission

• Physical supports

• Digital hierarchies: PDH, SDH

• Performance of digital transmission systems

• Optical Transport Network

• Carrier Ethernet

Prerequisites

Basic telecommunications knowledge

Contents

I.- Digital Transmission ,

• Introduction for Pulse Code Modulation (PCM): Sampling, Quantization, Coding

• Advantages of digital coding

• Synchronism Transmitter/Receiver

II - Transmission techniques – Optical Fibber

• Optical Fibber

• Basic principles of propagation in Optical Fibber

• Different types of optical fibber

• Cables and connectors

• Fibber tests

III - Digital hierarchy - PDH

• E1 Frame

• PDH E2; E3 e E4 Frames - multiplexing

• Clock/Synchronism

• Protection systems in PDH

• Technology restrictions

IV - Digital hierarchy – SDH

Main characteristics

• SDH layer model / Equipments and network topology

• Hierarchy / Frames SDH / Multiplexing structure

• Numbering schemes

• Overhead bytes

• Concatenated VCs

• Alignment / Justification in SDH transmission systems SDH (Traffic mapping PDH, Traffic mapping ATM, GFP)

• Protection system in SDH

• SDH optical interfaces

• Fault management

• DCN

• Clock / synchronism distribution

• Main standards

V - Performance of PDH/SDH Transmission Systems

• G.826, M2100, M2101

VI - OTN

• How to scale SDH / Wavelength multiplexing

• Optical Transport Network / Network elements and topology

• OTH hierarchy

• Traffic mapping

• Protection systems in OTN

• DCN

• Main standards

VII - Carrier Ethernet

• Main characteristics

• Metro Ethernet Forum

- Services ELine, ETree and ELAN
- User interface - UNI
- Provider Bridge – 802.3ad
- MPLS-TP
- OA&M
- What future for TDM? – CES

Duration

5 days

Table of Contents – UMTS/eHSPA SYSTEM OVERVIEW

Target Group

Mobile telecommunications engineers, mobile telecommunications technicians, technical sales personnel and mobile industry managers

Objectives

Understand the functioning of GSM, GPRS and EDGE systems in a mobile network context.

Prerequisites

Technical knowledge in telecommunications

Contents

I – Introduction

- Historical evolution
- Global System for Mobile communications – GSM
- GSM Services

II – Network Architecture

- Network Elements and its functions.
- OSI Model
- Interfaces
- GSM Protocols
- Geographical structure in the GSM network – Areas
- ID numbers

III – GSM / GPRS Functionalities and Procedures

- PLMN and cell selection
- Location Update
- Call setup
- DTX
- Power Control
- Handover
- SMS transfer
- Mobility Management states in GPRS

• Mobility Management procedures in GPRS: GPRS Attach, TLLI types, Localization, Security.

• Session Management procedures in GPRS: PDP Context Activation

• Radio Resources Management in GPRS: Paging, TBF Establishment, TBF release

IV – Introduction to EDGE

• Evolution from GSM/GPRS to EDGE

• Technology behind EDGE

• Improvements in Radio Interface

• Improvements in Communication Protocol

• Impact over architecture and planning of radio access network planning

GSM/GPRS/EDGE

V – Air Interface and Propagation Phenomena

• F/T/CDMA theoretical access

• Frequency bands

• Carriers

• Logical channels

• Bursts

• Time slots and TDMA frames

• Multi-frames

• Problems in the radio transmission

VI – Introduction to the Network Planning

• Link budget

• C/I relation

• C/A relation

VII – Knowledge Integration – Practical

• Drive test Tools

• Network statistics measures

Duration

5 days

Table of Contents – LTE SYSTEM OVERVIEW

Target

Mobile Communications Engineers and Telecoms Technical Staff

Objectives

To provide a LTE and LTE-An overview concerning network architecture, mode of operation and initial radio planning

Prerequisites

Basic radio communications knowledge

Contents

I - LTE System Overview

• Evolution history of the 2G and 3G networks in operation today

• EPS and nodes, overall

• Basic Concepts: EPS Bearers, PDN Connections, Quality of Service etc

II - OFDM Fundamentals

• OFDM (Orthogonal Frequency Division Multiplexing) principles

• The use of OFDM in E-UTRAN

• The MIMO technology

III - E-UTRAN – the evolved radio network

• E-UTRAN nodes and mode of operation

• E-UTRAN radio interface characteristics and frequency bands

• E-UTRAN Traffic cases

IV - Introduction to LTE Radio Planning

• Steps in the radio network planning process, input data and design goals / requirements

• Initial planning and parameter planning, verification and acceptance

• Comparing LTE planning to GSM and UMTS

V - LTE-Advanced (LTE-A)

• Potential new frequency bands for LTE-A

• Enhanced downlink MIMO techniques

• Enhanced uplink transmission techniques

• Carrier aggregation: concept, options and investigated scenarios

• Coordinated Multipoint transmission and reception (CoMP): concept, joint processing, dynamic cell selection, coordinated beam forming, uplink CoMP

• Relay architecture: relay nodes and donor cells, in band/out band relaying.

Duration

3 days

Table of Contents – GSM/GPRS RADIO PLANNING

Target

Mobile Communications Engineers and Telecommunications Technical Staff

Objectives

To provide an understanding of radio planning for GSM/GPRS networks and to supply methods and models for realistic coverage and capacity dimensioning.

Prerequisites

GSM/GPRS/EDGE System Overview from basic radio communications knowledge.

Contents

I - Cell Planning Fundamentals

- Steps in the Radio Planning Process
- Different cell types
- Frequency Reuse
- Channel Assignment Strategies
- Handover Strategies
- Interference and System Capacity

II - The GSM/GPRS System

- Competing and Complementing Technologies
- Services
- GSM/GPRS Architecture and Logical Channels
- Areas, Services and Identity Numbers
- GSM/GPRS Traffic cases

III - Radio Wave Propagation and Antenna Technology

- Radio Propagation Fundamentals
- Theoretical and Empirical Models for Urban Propagation
- Propagation within, near, and into Buildings
- Mobile Radio Channel Characterization
- Antenna Technology Fundamentals
- Base Station and Mobile Station Antennas
- Antenna Related Techniques used in GSM900 and GSM1800

• Antenna near Devices

IV - Cell Coverage and Link Budget

• GSM Radio Frequency Bands

• GSM Equipment Characteristics

• GSM Cell Coverage: Definitions, Margins and Design Levels

• The Link Budget, Power Balancing and Extracting the Cell size

V - Capacity Dimensioning

• Traffic Theory Fundamentals

• Trunking and Grade of Service

• Traffic Channel (TCH) Dimensioning

• SDCCH Dimensioning

• Traffic Forecasting

VI - Improving Capacity in GSM/GPRS Systems

• Cell Splitting

• Sectoring

• Dual Band

• Cell Types

• Hierarchical Cell Structures

• Tighter Reuse on TCH frequencies and Hot Spot Micro Cells and Frequency Planning

VII - Indoor Cell Planning Overview

• Indoor Capacity Dimensioning

• Antenna Technology in Indoor Systems

• BTS Systems, Single and Multiple BTS

• Indoor Link Budget and Design Levels

• Distributed Antenna Configurations and Coverage predictions

• Surveys and Coverage Measurements

• Indoor Frequency Planning

Duration

5 days

Table of Contents – UMTS/eHSPA RADIO PLANNING

Target

Mobile Communications Engineers and Telecommunications Technical Staff

Objectives

To provide understanding of radio planning for UMTS/HSPA networks and to supply methods and models for realistic coverage and capacity dimensioning.

Prerequisites

UMTS/eHSPA System Overview. Basic radio communications knowledge

Contents

I - Radio Planning Introduction and UMTS Fundamentals

- Radio Planning Introduction: Definitions, Network Planning Process
- UMTS Fundamentals: Standards, Network Architecture, Spreading and Modulation, Channel Architecture
- QoS Concept, Architecture and Classes

II - Radio Propagation Issues

- Free Space Propagation
- Large-Scale Propagation Models: The Okumura-Hata model, The COST 231 Walfisch–Ikegami model, Ray Tracing models
- Multipath Environment Related Concepts: Electromagnetic Wave Properties, Reflection, Refraction, Shadowing, Combining both types of fading, Inter-Symbolic Interference (ISI)
- Noise and Interference: Thermal noise, Noise Factor, Interference
- Antennas

III - UMTS Radio Network Planning

- UMTS Radio Planning Dimensioning: The Link Budget, Capacity Enhancement, Soft Capacity
- UMTS Planning and Optimization: Capacity and Coverage Prediction, Cell Planning Tool, Network Optimization
- GSM Co-planning
- HSPA Link Budget

IV - Network Planning and System Capabilities

- Radio Resource Management: Handover, Power Control, Admission Control, Load Control, Bit Rate Adaptation

• Scrambling Code Planning: Cell Search Procedure, Downlink Scrambling Code Planning

• Power Planning

V - Radio Network Monitoring

• Field Measurements: Field Measurement Tools, Radio Parameter Measurements, Drive Test Output Examples

• Network Measurements: Performance Statistics, Performance Recording, Operational Tools

• Costumer Complaint

VI - Co-planning issues

• Radio planning issues: Co-existence of different systems for the same operator, Co-existence of different mobile operators (Tower sharing, Rooftop sharing), Transmission sharing

• Interference Problems: Wideband noise, adjacent channel interference, spurious emissions, Inter modulation products, Receiver blocking

• Co-planning rules: Antenna decoupling with vertical and horizontal separation, Coexistence with fixed network operators

VII - Coverage and Capacity Enhancement Methods

• Repeater Systems, Mast Head Amplifiers, Remote RF Head Amplifiers

• Sectorization, Micro Cells, UMTS 900

• HSDPA (High Speed Downlink Packet Access)

• HSUPA (High Speed Uplink Packet Access)

• Additional Carriers and Scrambling Codes

• MIMO (Multiple Input Multiple Output)

VIII - Transmission Network Planning

• Transmission network planning process

• Transmission media: Copper wires, Optic fiber Microwave links, Satellite links

• Transmission Network Solutions: xDSL, Point to Point Systems, Point to Multipoint systems

• Transport Technologies: PDH, SDH and SONET, Ethernet

• Transport Protocols: ATM, IP

• Microwave Link Planning: Link Budget Calculation, Microwave propagation, Countermeasures against fading

• Network topologies

- Iub Capacity Dimensioning: Capacity Calculations for AMR Voice Calls, CS64 calls, HSPA services and Common Transport Channels
- Transmission Network Optimization: Mapping of Counters, Iub blocking and Congestion

IX - Electromagnetic Fields

- Field Strength Calculations: Near-field/Far-field, Power Density
- Basic Restrictions to Electromagnetic Radiation
- Interference with Electronic Equipment
- Measurement and Reporting: Decision levels, Applicability of Measurement Methods
- Wide Band and Narrow Band Measurements
- Safety Rules: Safe work practices, Stand-Off Distances, Personal Monitoring, Public Safety

Duration

5 days

Table of Contents – LTE RADIO PLANNING

Target

Mobile Communications Engineers and Telecoms Technical Staff

Objectives

To provide understanding of radio planning for LTE networks and to supply methods and models for realistic coverage and capacity dimensioning.

Prerequisites

LTE System Overview Basic radio communications knowledge

Contents

I- LTE System Overview

- EPS architecture and nodes, overall mode of operation
- The use of OFDM in E-UTRAN
- LTE Random access procedure and preamble assignment
- LTE Cell reselection and handover, power control, measurement reporting, call setup
- Self-Organized Network (SON) concept

II - Radio Propagation and Antennas for LTE

- LTE spectrum allocations and regulatory requirements
- Theoretical and empirical models for urban propagation
- Propagation within, near, and into Buildings
- Wideband mobile radio channel characterization
- LTE Antenna technology fundamentals: e NB and UE antennas, LTE spatial diversity techniques, SU-MIMO and MU-MIMO
- MIMO mode switching and feedback

III - LTE Coverage and Capacity Dimensioning

- Overview of Licenses: Channel bandwidth, output power, uplink and downlink capacity license
- Dimensioning Method: dimensioning options, high-level view of dimensioning process, input quantities
- Calculating LTE uplink and downlink coverage
- Calculating LTE uplink and downlink capacity

IV - LTE Control Channel Dimensioning

- Resource element and resource element groups
- Resource blocks and scheduling
- Downlink Common Control Channels and Signals: Reference Signal, Physical Broadcast Channel, Primary and Secondary Synchronization Signal, Physical Control Format Indicator Channel, Physical HARQ Indicator Channel, Physical Downlink Control Channel
- Uplink Common Control Channel Configuration: Demodulation Reference Signal, Physical Uplink Control Channel, Physical Random Access Channel
- Dimensioning Downlink and Uplink Control Channels

V - LTE Deployment Guidelines

- Deployment considerations: requirements, spectrum issues, operator
- Deployment strategies
- Site selection and cell configuration
- Coverage and capacity improvement strategies
- PCI planning, frequency and neighboring planning
- Key Performance Indicators (KPI)'s: Tuning for KPIs, accessibility, retainability and integrity measurements

VI - Co-location and Coexistence Guidelines

- Isolation against LTE spurious emissions and blocking towards LTE
- Spurious emission level and sensitivity degradation
- Co-location and coexistence for E-UTRA: E-UTRA band 7, 13 and 40 with other systems
- Co-location solutions: co-location with separate antenna systems, with dual diplexer and Shared Mast Feeder and with shared antenna

Duration

5 days