Consultation on Draft QoS Policy and Draft QoS Regulatory Framework

Annex 3:

Quality of Service Benchmark Report

6 March 2014

Communications Regulatory Authority

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1 Introduction

1.1 Context

Like other regulatory authorities in the world, the role of the Communications Regulatory Authority (CRA) in Qatar is to perform a multitude of tasks, which include the monitoring of the Service Providers' Quality of Service (QoS).

The State of Qatar has set very ambitious objectives for the telecommunications sector in Qatar 2030 Vision, as developed within the ICT Plan for 2015.

In this context, CRA's QoS regulatory framework in place needs to be improved. CRA is currently reviewing this framework and is planning to impose new QoS requirements on Service Providers. To conduct a full review of this QoS regulatory framework, CRA intends to have a better knowledge of best practices.

The goal of this report is therefore to provide CRA with a detailed overview of regional and international practices with respect to QoS regulation.

1.2 Structure of the document

This document elaborates conclusions which can be used for the QoS regulatory framework in Qatar on the basis of best practices identified. The three main axis of other countries' QoS regulatory framework are analysed in this report:

- QoS policies and objectives;
- KPI, targets and measurements;
- Regulatory authorities organisation and processes.

For each of these 3 axis, several types of best practices which could be followed by CRA are identified.

While the main body of this report summarizes the regional and international benchmark, annexes describe for each country of the benchmark the details of the QoS regulatory framework. The reader is therefore advised to refer to the annexes in case specific information not covered in the main body is required.

1.3 Scope of the benchmark

For this benchmark, 13 countries have been selected. They are located in different parts of the world: in the Gulf region (Bahrain, Oman, UAE and Saudi Arabia), in Arabic countries (Morocco, Jordan), in Europe (Austria, France, Germany, and Norway), in Asia (Singapore), in Africa (Ghana) and in America (Canada).

These countries have been chosen either because:

- they have similar market conditions as in Qatar (Gulf region);
- or they have a long history of QoS regulation (France, Canada, Jordan, Morocco);
- or they have high level of QoS (Singapore, Norway);
- or they are following innovative approaches (Austria, Germany, Ghana).

Data has been collected in each of these countries, either thanks to responses provided by National Regulatory Authorities (NRA) following a questionnaire being sent to them in September 2013 (Austria, Bahrain, France, Germany, Ghana, Morocco, Norway, Saudi Arabia, Singapore, UAE) or thanks to publicly available information only (Canada, Jordan, Oman). The level of details can vary and mainly depends on regulatory authorities' involvement with regards to QoS or publicly available information (for example, France publishes a significant amount of information while Norway publishes very limited information).

Each of these parts addresses topics for which countries are compared together and outcomes of the benchmark are identified. The situation in Qatar is taken into account in the identification of these outcomes.

NB: the following acronyms are used: AU for Austria, BH for Bahrain, CA for Canada, FR for France, GE for Germany, GH for Ghana, JO for Jordan, MO for Morocco, NO for Norway, OM for Oman SA for Saudi Arabia, SI for Singapore, UAE for United Arab Emirates.

2 QoS regulatory framework in benchmarked countries

2.1 QoS regulatory policies and objectives

2.1.1 General framework

a. Summary

While legal frameworks in place set the scope of actions of NRAs with respect to QoS, some countries have also issued QoS policy documents. QoS policy documents are documents which set out the basis upon which the QoS offered by providers of telecommunications services shall be measured and regulated and which define NRA's objectives with respect to QoS regulation. Such documents enable to set at a high level the respective responsibility and roles of the NRA and operators in the QoS framework, for all key issues such as QoS indicators definitions, measurements, audit, reporting, and long term follow up actions.

Not all countries are publishing such documents but it appears that all Gulf countries and Jordan have issued such documents, even if the format of these documents can vary significantly. Outside these countries, policies are either set out in the law or not defined precisely (see Table 1).

Table 1 – Publication of a QoS policy document

Item	Available Policy document defining QoS Policy and objectives
AU	(law specifies objectives)
BH	Yes
CA	Yes
FR	(law specifies objectives)
GE	(law specifies objectives)
GH	No[1]
JO	Yes
MO	No
NO	No
OM	Yes, latest not publically available
SA	Yes
SI	No

[1] QoS regulations document yet to be consented by Parliament

Item	Available Policy document defining QoS Policy and objectives
UAE	Yes, light document

Whether or not QoS policy documents are published, NRAs tend to specify their own objectives with respect to QoS regulation.

Whereas most of NRAs aim to provide transparent QoS information related to market performance in order to assist end users and improve competition, the NRAs in countries with low level of competition (among which Gulf countries), or concerned by important areas where competition is low (e.g. Canada) aim to ensure that the operators actually meet definite target QoS figures. Three or four QoS objectives are used by a high number of NRAs but additional objectives are sometimes considered (see Table 2).

Table 2 - Objectives of QoS regulation

Item	Assist end users for choosing their operator and assist operators to compete on equal terms	Provide to the market objective comparison information between operators	Provide transparent, objective and detailed QoS information to the NRA to take action	Ensure Service Providers effectiveness in low competition markets or areas with targets QoS figures / Verify licences obligations	Engage a long term QoS process with operators in order to take into account technology changes and follow it	Assist operators in the design of their interconnection
AU						
BH	X	X	X			X
CA	X[2]	X		X		
FR	X	X	X		X	
GE	X[3]	X			X	
GH	X	X	X			X
JO	X	X		X		
MO	X	X	X[4]			
NO	X	X	X		X	
OM	X	X	X	X		
SA	X	X	X	X		

[2] Focus on low competition areas

[3] Focus on end user control of delivered QoS for Broadband Services

[4] Better understand the market

Item	Assist end users for choosing their operator and assist operators to compete on equal terms	Provide to the market objective comparison information between operators	Provide transparent, objective and detailed QoS information to the NRA to take action	Ensure Service Providers effectiveness in low competition markets or areas with targets QoS figures / Verify licences obligations	Engage a long term QoS process with operators in order to take into account technology changes and follow it	Assist operators in the design of their interconnection
SI	X	X	X	X		
UAE	X	X	X			

NB: this table shows what NRA clearly states as objectives, not necessarily what they do.

Once policies and objectives are set, NRAs can adopt different types of regulatory approaches with respect to QoS (light or strong), notably in relation with the competition level between operators in the country. Some NRAs follow a light approach, some a strong approach (see Table 3) while countries like Saudi Arabia recognise that when competition will develop QoS regulation could be softer.

Table 3 - Type of regulation

Item	Strong regulation by defining KPIs and setting associated KPI targets	Co regulation by defining KPIs and associated KPIs targets jointly with operators and taking firm action in case of non-compliance of the market performance for specific KPIs or issues	Light regulation by only monitoring the market performance	The type of regulation set above is in accordance with the competitive situation of the market and the delivered QoS
AU			X	X
BH		X		
CA			X	X
FR		X		X
GE			X	X
GH	X			
JO		X		
MO		X		
NO			X	X
OM	X			

Item	Strong regulation by defining KPIs and setting associated KPI targets	Co regulation by defining KPIs and associated KPIs targets jointly with operators and taking firm action in case of non-compliance of the market performance for specific KPIs or issues	Light regulation by only monitoring the market performance	The type of regulation set above is in accordance with the competitive situation of the market and the delivered QoS
SA	X			X
SI		X		X
UAE		X		

Once defined, the regulatory QoS approach taken by the NRA will drive the definition of a set of KPIs (Key Performance Indicators) and possible associated targets. As QoS can be sometimes subjective, KPIs are the tool used by all NRAs to objectivise QoS levels. The definition of KPIs will generally lead to detailed discussions between the NRA and the concerned operators for each QoS regulation domain.

The discussed topics are generally related to the characteristics of the induced QoS measures (objectiveness, transparency, standardized, accessible through certified measurement systems, etc.), to the final benefits or added value for the end users, for the operators, for the NRA, and finally to their overall costs in terms of investment or man power effort.

In their QoS regulatory documents (such as QoS policy documents described above), NRAs generally specify the guidelines and constraints they should follow when setting KPI (see Table 4):

- KPI should be comparable, measurable, objective and clearly defined;
- The cost associated with measuring KPI should be proportionate;
- KPI targets should be representative of a reasonable and meaningful improvement objective to the end user;
- KPI should be easy to understand for end-users (it is interesting to note that, to our knowledge, only Canada has clearly stated this);
- KPI should be focused on services performances rather than technologies and networks performances;
- Etc.

These constraints are generally closely related to the QoS regulatory objectives discussed above.

Table 4 - Constraints on KPIs

Item	KPI should be comparable, measurable, objective and clearly defined	Total costs induced by KPIs measurements and processes should be proportionate to the associated QoS regulation objective or added value	When defined, KPI targets should be representative of a reasonable and meaningful improvement objective to the end user	KPI should be easy to understand for end-users	Focus on services rather than technologies and networks	Focus on activities that are under operators' control
AU						
BH						
CA	X	X[5]	X	X		X
FR	X	X				
GE						
GH	X	X	X	X	X	
JO	X	X			X	
MO	X					
NO						
OM	X	X	X			
SA	X	X			X	
SI						
UAE						

b. Conclusions

The benchmark enables to identify the following outcomes with respect to QoS policies and objectives:

- **A QoS policy document is sometimes used**, especially in the Gulf countries and Jordan. This type of document is useful to clearly set the respective high level responsibilities and roles of NRAs and operators in the QoS framework, for all key issues like QoS indicators definitions, measurements, audit, reporting, and long term follow up actions for

[5] "Eliminate outdated, difficult to administer, inefficient and onerous to track KPIs"

ensuring that the defined NRA objectives are fulfilled. **Such a document does currently not exist in Qatar.**

- QoS policy documents have very different formats, size and levels of details.
- A QoS policy document typically lists the following objectives with respect to QoS:
    - Assist end users for choosing their operator;
    - Provide objective comparable information between operators to the market by publishing transparent, objective and detailed QoS information;
    - Ensure Service Providers effectiveness in low competition markets and verify licences obligations;
    - Engage a long term QoS process with operators in order to take into account technology changes.
- A QoS policy document can also be the opportunity to outline stakeholder's roles:
    - Operator's role and responsibilities (e.g. use and maintain in operational conditions of certified measurement systems, use of specific templates for QoS reporting, active contributions to QoS audits, reports of critical network outages, etc).
    - NRA role and responsibilities (e.g. QoS processes definition and publication, setting of KPIs and associated targets in each QoS domain, actions taken in case of QoS issue, escalation processes, etc.).
- **The type of regulation which is adopted by the NRA of a given country is strongly related to the competition level between operators in the various market segments**, not only a nationwide basis but also on a regional or even local basis (e.g. in Canada).
- **Co-regulation**, in which the NRA action has a close monitoring attitude without setting targets from its own while being ready to take a firm action in case of a clear QoS violation or failure of the market performance, **is often observed as being considered as an efficient**

and cost effective scheme but is not necessarily adequate when competition is weak.

- **The constraints which are taken into account on KPIs are mainly related to the necessity to deal with clearly defined, measurable, comparable indicators, well accepted by operators who will be in charge of establishing, of administrating, and of maintaining the related measurement systems and processes.** The overall concern here is efficiency, not to waste too much energy on less priority or already solved issues, but put it on the very QoS indicators which are key for today's services and markets.

- **KPI should also be easy to understand for end-users and focused on service performances rather than network performances.** It is interesting to note that one country (Canada) indicates that KPI should only be focused on services on which operators have full control. However, while setting targets for services on which operators have no control can indeed be an issue, monitoring KPIs for these services remains relevant.

2.1.2 Scope of QoS regulation

a. Summary

The QoS regulatory action aims at various markets, depending on the QoS policy and objectives and the competitive situation in each country.

While the vast majority of countries are regulating retail fixed and mobile QoS (residential and businesses), this is much less rare for wholesale QoS (see Table 5 and Table 6). This can be explained by the fact that reference wholesale offers generally include Service Levels Agreements which does not require an additional level of regulation. However, monitoring KPIs related to wholesale services can be relevant, especially to make sure the non-discrimination obligation, when imposed, is well applied. The initiative of Bahrain with respect to International Internet connectivity is also interesting to better understand this segment of the broadband markets.

Table 5 - Scope of QoS regulation – retail for residential

Item	Retail for Residential

	Fixed tele-phony	Fixed Broad-band	Mobile services (tele-phony and data)	Mobile cove-rage	Interna-tional Internet con-nectivit y	QoS in the context of Univ-ersal service	Account s,billing and complai nts	Number porta-bility	Directo-ry services
AU	X		X	X					
BH	X	X	X	X	X		X	X	X
CA	X								
FR	X	X	X	X		X	X		X
GE	X	X	X	X		X[6]			
GH			X	X				X	
JO		X	X	X					
MO	X	X	X	X			X	X	
NO		X					X	X	
OM			X	X			X		
SA	X	X	X	X					
SI	X	X	X	X	X	X		X	
UAE	X	X	X	X			X	X	

Table 6 - Scope of QoS regulation – retail for business and wholesae

Item	Retail for business	Wholesale for operators			
	Leased Lines	Access Network Services (LLU, bitstream, line sharing, Passive FTTH)	Network Interconnection Services (PSTN TDM & SS7, IP SIP)	Wholesale Capacity Services (TDM, Ethernet)	IP Transit, i.e. access to Internet IXPs
AU					
BH		X			
CA		X	X		
FR	X	X	X	X	
GE					
GH			X		
JO					
MO	X				

[6] No KPIs

Item	Retail for business	Wholesale for operators			
	Leased Lines	Access Network Services (LLU, bitstream, line sharing, Passive FTTH)	Network Interconnection Services (PSTN TDM & SS7, IP SIP)	Wholesale Capacity Services (TDM, Ethernet)	IP Transit, i.e. access to Internet IXPs
NO					
OM	X				
SA		X	X	X	X
SI	X				
UAE	X				

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the scope of QoS regulation:

- **Fixed and mobile services for residential** are almost always regulated as they are located at the core of NRA objectives for QoS, with the exception of countries which have implemented light regulation schemes (Canada, Norway);

- **Leased Lines QoS for businesses is generally regulated**, e.g. as part of Universal Service (France), or due to its major role for the Business sector;

- **Wholesale services QoS is regulated by NRAs in a limited number of countries**, i.e. Canada, France, Ghana, Saudi Arabia. However, it is to be noted that this should become very widespread in the coming years in the European Union because the European Union issued in September 2013 a document which recommends NRA to impose the publication of KPIs for wholesale offers[7]. Such regulation is a key success factor to the development of good quality and cost effective offers from wholesale operators to both retail residential and business markets. It is possible to identify the following segments:

[7] See Commission recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment - C(2013) 5761

- Access network services which brings QoS to Broadband ISPs and Business operators at the access level;
- Capacity and IP Transit services, which brings end to end QoS for those same operators in the Broadband IP domain;
- Network Interconnection Services (PSTN TDM & SS7, IP SIP), which brings end to end QoS for those same operators in the voice and Value-Added Services (VAS) domains.

It is noted that CRA's draft QoS instructions published in July 2013 cover these different markets except wholesale markets.

2.2 KPIs and targets

2.2.1 Number of KPIs

a. Summary

As the analysis of the QoS regulation scope shows strong differences in terms of number of supported KPIs by the NRAs, the results for this quantitative aspect of the scope are provided below (see Table 7[8]).

Table 7 - Number of KPIs

Item	Fixed Access Retail including Fixed Access, Telephony, Universal Service	Fixed Broadband Retail	Leased Lines	Mobile Retail	Wholesale including LLU	Number Portability	Others e.g. Directory / Enquiry Services	Total KPIs
AU	13	0	0	0	0	0	1	14
BH	11	6	1	20	2	1	2	42
CA	3	0	0	0	5	1	0	9
FR	19	5	3	20	17	3	4	71
GE	5	3	0	0	0	0	0	8
GH	0	0	0	10	0	7	0	20
JO		2						2
MO	5	4	3	20	0	2	0	34
NO	1	4	0	3	0	1	0	9

[8] The order of magnitude should be considered since the exact numbers may vary

Item	Fixed Access Retail including Fixed Access, Telephony, Universal Service	Fixed Broadband Retail	Leased Lines	Mobile Retail	Wholesale including LLU	Number Portability	Others e.g. Directory / Enquiry Services	Total KPIs
OM	12	3	5	8	0	2	0	30
SA	8	6	0	5	22	0	0	41
SI	4	8	5	9	0	2	0	28
UAE	5	4	1	11	0	2	1	24

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the number of KPIs in each country:

- For the scope of retail services, countries with strong regulation policy or co regulation with “close monitoring” policy, show fairly high number of KPIs (observed for France, Bahrain, Morocco, Oman), whereas countries with light regulation policies work on a fairly limited number of KPIs (e.g. Canada, Norway).

- Within the retail segment, **mobile services are showing the highest number of KPIs to be managed**, in relation to voice, data, and coverage sub domains. This is probably because mobile QoS tend to vary more easily;

- When it is regulated, **the wholesale segment is also an area of complexity which generates numerous KPIs.**

- For the time being, **fixed broadband QoS which is a prime concern for both operators and end users does not generate a significant number of KPIs,** generally lower than fixed legacy services in most cases.

2.2.2 KPIs and targets for retail fixed access services

a. Summary

In retail fixed access markets, 6 categories of KPI are traditionally observed:

- KPIs related to supply;
- KPIs related to faults;
- KPIs related to network performance;
- KPIs related to national calls;
- KPIs related to international calls;
- KPIs related to complaints and billing.

The supply time of access lines and the provisioning time of services are monitored and targeted by NRAs, according to the following table (see Table 8):

Table 8 - Supply Time related KPIs for Fixed Access Services

Item	Supply Time for fixed network access
AU	X< 15 wk days for 95% of all accesses supplied
BH	X
CA	
FR	X, ETSI Rec, target 8 days for 95% of access requests[9]
GE	
GH	
JO	
MO	
NO	
OM	X, target 10 wk days for 90% of lines
SA	X, target 5 wk days for 90% of lines
SI	X, target 5 wk days for 95% of lines
UAE	X

It is interesting to note that in Canada, a different KPI is used for supply time: the percentage of installation appointments that are met (it should be above 90%). In France, several types of KPIs are used for supply time (95th percentile fastest, 50th percentile fastest, % of access delivered in less than 20 days, average time to supply after 20 days).

The fault rate and repair time for access lines are reported and targeted by NRAs, according to the following KPI table (see Table 9):

[9] In the context of universal service obligations only

Table 9 - Fault related KPIs for Fixed Access Services

Item	Fault Report rate per fixed access line (per annum)	Fault repair time for fixed access line
AU	X, target less than 2%	X, target 24 hours
BH	X	
CA	X, target 10% in urban areas, 20% in rural areas	
FR	X, ETSI Rec, target 7,5%[10]	X, ETSI Rec
GE		
GH		
JO		
MO	X, target 25%	X, target 48 hours for 85% of lines
NO		
OM	X, target 12%	X, target 24 hours for 90% of lines
SA	X, target 5%	X, target 24 hours for 90% of lines
SI	X, target 0,5%	X, target 24 hours for 90% of lines
UAE	X	X

The QoS of national fixed telephony calls is monitored in terms of "legacy KPIs" such as unsuccessful call rates, call set up time, audio voice quality, drop call ratio and disconnection resolution times, with associated targets according to the NRA QoS policy (see Table 10).

Table 10 - National Fixed Telephony Calls KPIs

Item	Unsuccessful National Call Rate during busy hour	Call Set up Time	Voice Quality according to ITU-T Rec	Drop call ratio	Disconnection resolution time	Percentage of public payphones in working order, as part of Universal Service
AU	X	X Target >1	X MOS above 3,5			X Target above 98% per year
BH	X	X		X	X	
CA						
FR	X, ETSI target 0,7%	X, ETSI target 2,9 seconds [11]	X, MOS of ITU-T Rec P862			X, target 97% with less than 12 hours failure

[10] In the context of universal service obligations only

[11] In the context of universal service obligations only

Item	Unsuccessful National Call Rate during busy hour	Call Set up Time	Voice Quality according to ITU-T Rec	Drop call ratio	Disconnection resolution time	Percentage of public payphones in working order, as part of Universal Service
GE	X, ETSI	X, ETSI	X, MOS of ITU-T Rec P862	X		
GH						
JO						
MO	X, target 5%					
NO						
OM	X, target 1%	X	X, target level 3 of E-Model of ITU-T Rec G107			X, target 96%
SA	X, target 2%		X, target MOS 3.5	X, target 2%		
SI						
UAE						

NRAs in Singapore, Austria and UAE, also regulate the network aspects of the legacy telephony service:

- UAE refers to the ITU-T Rec E425 related to Network Effectiveness (NER) through internal automatic observations, measuring the ability of a given network to deliver calls. This is used here for national calls, even if the ITU-T original concept was intended for international calls.
- Austria refers to availability.
- Singapore refers to access network availability with a target of:
    - 99.85% for access network;
    - 99.99% for telephone equipment.

Other NRAs do not mention network related KPIs for the legacy telephony service, according to the Table above.

International telephony QoS is a main concern in some Gulf Countries and Morocco (see Table 11), whose regulators set up targets for call success rates, availability rates of international voice traffic routes, up to the percentage of echo cancellers provisioned at the incumbent office to guarantee a satisfactory end to end voice quality. France and Germany keep on monitoring the international call QoS on the basis of ETSI EG 202 057-2 without setting any target.

Table 11 - KPIs related to International telephony calls QoS

Item	Unsuccessful International Call Rate during busy hour	International voice traffic routes answer rate (Answer Seizure Rate and Answer Bid ratio for international calls)	International operator services - meantime to answer[12]	International operator services - mean holding time after answer to reach international destination [13]
AU				
BH	X	X, based on E425 ASR/ABR	X	X
CA				
FR	X, ETSI			
GE	X, ETSI			
GH				
JO				
MO	X, target 7%			
NO				
OM	X, target 3%			
SA	X, target 2%			
SI				
UAE				

Finally, NRAs regulate customer complaint aspects of the delivered QoS, by monitoring the rate of complaints, its resolution time with a focus on billing related complaints (see Table 12).

[12] This KPI relates to international manual operator service

[13] This KPI relates to international manual operator service

Table 12 - KPIs related to customer complaints and billing related customer complaints

Item	Bill correctness complaints	Customer complaint resolution time	Disconnection complaints rate	Calling card complaint rate	Billing customer complaints resolution time – 80% fastest	Customer complaints resolution time – 80% fastest
AU	X, target 0,5%					
BH			X			
CA						
FR	X, ETSI Rec, target 0,08%[14]	X, ETSI Rec			X, ETSI Rec, target 5 days[15]	X, ETSI Rec, target 5 days[16]
GE						
GH						
JO						
MO	X, target 0,25%					
NO						
OM	X, target 1,5%	X, target 20 working days for 96% of complaints		X, target 1%		
SA						
SI						
UAE						

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the retail fixed access KPIs:

- A common issue to fixed access KPIs is the quality of their definition, and their relation to standards. **Using ETSI documents as a reference for such KPIs can make a difference, in that they show an in depth work on both KPI definitions and associated measurements**. Therefore, relying on ETSI EG 202 057 set of documents (part 1

[14] In the context of universal service

[15] In the context of universal service

[16] In the context of universal service

General, part 2 Voice telephony) brings clear benefits compared to a situation of non-defined KPIs. For Voice Audio Quality, the reference is ITU-T P862.

- **The performance of operators in terms of Supply Time of access lines / Fault rate / Fault repair time show that targets such as 10 days / 10 % / 1 day for 90% of lines are commonly used by NRAs who set such targets.**

- **Fairly high performance targets can be reasonably proposed for national phone calls, such as 1% unsuccessful call rate, 3 sec Call Set up Time, MOS 3.5 Voice Quality, all values that are commonly used as targets and confirmed by operator's statistical measurement reports.**

- For supply time and fault repair time, several KPI can be used to measure QoS for slowest supply and fault repair times. Using only a single average value can prevent observing very long supply times for some customers.

- Telephony network availability or NER KPIs mentioned in Singapore and Oman, which measures the ability of telephone equipments to deliver the amount of required calls, do not seem to be meaningful indicators, as the main faults would not be related to such equipments, but to underlying infrastructures (energy, fire, etc.); the preferred requirement on operators would be to provide the NRA with detailed reports on any critical outage, follow up of improvement measures, etc. For national voice QoS, these NER KPIs would however be relevant for countries with high long distance transmission costs, in order to ensure that the intercity terrestrial link dimensioning (TDM, SS7) does not bring any network congestion.

- **International Voice QoS is to be monitored and targeted in countries like Gulf countries**, with a unsuccessful international call rate below 2%, as this value is related to the perceived voice QoS of major parts of the Business sector.

- Targets for customer complaints are related to the complaints resolution time (e.g. 5 days for 80% of complaints in France, 20 days for 96% in UAE), and to the rate of bill correctness complaints (e.g. 0,08% in France, 1,5% in UAE).

2.2.3 KPIs and targets for fixed broadband retail services

The retail broadband segment covers KPIs related to broadband fixed access, through technologies such as DSL or FTTH at Access level, Ethernet / IP at Edge and Core levels, allowing an end to end broadband connection between the end user and the ISP Web Services platform.

a. Summary

The supply time of broadband access lines and provisioning time of broadband services are monitored and targeted by NRAs, according to the following KPI table (see Table 13).

Table 13 - KPIs related to the Supply Time of Broadband Service Access

Item	Supply Time for broadband service access
xAU	
BH	
CA	
FR	See 2.2
GE	
GH	
JO	
MO	
NO	
OM	X, target 7 wk days
SA	X, target 10 wk days for 90% of access requests
SI	X
UAE	X

The fault rates and repair time for broadband services are also sometimes reported and targeted by NRAs (see Table 14).

Table 14 - Fault related KPIs for Broadband Access Services

Item	Fault Report rate per fixed access line	Fault repair time for broadband service access
AU		
BH		
CA		
FR	See 2.22.2.2	See 2.22.2.2
GE		

Item	Fault Report rate per fixed access line	Fault repair time for broadband service access
GH		
JO		
MO		
NO		
OM		
SA	X, target 5%	X, target 24 hours for 90% of faults
SI		
UAE	X	X

Broadband services being marketed according to their speed, i.e. peak data rates in the download and upload directions, NRAs tend to set performance indicators to measure the actual speed delivered on an end-to-end basis by the broadband service providers (see Table 15).

Two main methods are used to measure such speed performances:

- Inserting measurement probes on the application layers (TCP and HTTP) at defined points of the end-to-end path, these probes providing statistical values of download and upload data rates on all connections up to a distant server located at an IXP level;
- Providing some test users with dedicated routers connected between their broadband box and their PC, these dedicated routers reporting to the operator in charge of the “speed test” the actual values of download and upload speeds which are measured at the end user level.

The other possibility, which is not a real measure of the network performance, is to have on line measurements activated by the end users through a Web server.

Table 15 - Speed related KPIs for Broadband Access Services

Item	Download speed	Upload speed	Time to load web pages
AU			
BH[17]	X	X	

[17] Average value, through probes, TCP and HTTP cached and not cached

Item	Download speed	Upload speed	Time to load web pages
CA			
FR[18]	X	X	X
GE[19]	X	X	X
GH			
JO	X	X	
MO[20]	X	X	X
NO[21]	X	X	
OM[22]	X	X	
SA[23]	X	X	
SI[24]	X	X	
UAE			

The end-to-end features of broadband access services imply that the real time behaviour of the network is key to the user perception of the quality of attempted connections. Such parameters like the time to reach the DNS server, the round trip delay of packets and the packet loss ratio can be used to assess the ability of the broadband connections to support Web services and interactive real time traffic (see Table 16). Except for network latency, these KPI are rarely used.

Table 16 - Network Performance KPIs for Broadband Access Services

Item	Network latency i.e. packet round trip delay	Packet loss ratio	DNS time	Ping time
AU[25]				

[18] With close distant server and far distant server close to main IXP

[19] With on line end customer meaurements

[20] Distinction between peak hour and outside of peak hour

[21] Throughput measurement by a web service

[22] Throughput measurement by a web service

[23] Target for peak hour throughput is 50% of best effort download speed

[24] TCP throughput

[25] With on line end customer meaurements

Item	Network latency i.e. packet round trip delay	Packet loss ratio	DNS time	Ping time
BH	X, dedicated study	X, based on ITU-T M2301 IPLR	X	X
CA				
FR	X	X		
GE				
GH				
JO				
MO				
NO	X			
OM	X			
SA				
SI	X, target 50ms for national Internet access and 300ms for international Internet access			
UAE				

For most of broadband services, including basic services like Web surfing, access to International bandwidth is required. NRAs may need therefore to measure the quality of access of local ISPs to national or distant IXP points, most of the time through the IP backbone of the incumbent national operator. Only Singapore (in this benchmark) is measuring this (see Table 17).

Table 17 - International Bandwidth KPIs for Broadband Access Services

Item	International Bandwidth utilization (Usage of incumbent backbone by ISPs), i.e. peak traffic load on all links of any ISP to first IXP
AU	
BH	
CA	
FR	
GE	
GH	
JO	
MO	
NO	
OM	

SA	
SI	X, target 90% for 3 consecutive months
UAE	

b. Conclusions

The regional and international benchmark enables to identify the following outcomes with respect to the retail fixed broadband access services KPIs:

- Supply time for broadband access lines is not regulated. However, Oman sets a target of 7 working days for this KPI.

- Fault reports / Repair time for broadband are generally not monitored by NRAs for a similar reason; with the exception of Saudi Arabia whose NRA sets targets at 5% / 24 hours for 90% of lines.

- **Speed related KPIs have the objective to provide comparable and objective measurements of the download and upload speeds of broadband connections and of the time to load reference Web pages from most popular Web sites**. As explained previously, two measurement methods are now widely used and implemented by NRAs. It is to be noted that the method using dedicated routers deployed at thousands of end user sites (www. Samknows.eu) is used by Ofcom, by the FCC and adopted by the European Commission for their studies related to Broadband QoS. Some countries (Norway, Germany, Oman) rely on end user measurements using dedicated Web sites. NRA generally do not assign any target to Speed related KPIs, with the exception of Saudi Arabia, whose NRA sets a target for peak hour throughput “equal to 50% of best effort speed” (no details on the measurement process). Therefore, the outcome for these KPIs is that the adoption of widely used measurement methods and processes (not yet “standardized” however) is to be considered as a priority.

- **Network Performances are mainly described in terms of latency or round trip delay and packet loss ratio**. Latency has been carefully studied in Bahrain by Renesys using 90 Internet measurement points worldwide. This study provides interesting recommendations for operators to increase QoS (decrease latency), for example through the use of caches. NRAs generally do not set targets on theses KPIs but have a close monitoring policy (e.g. France).

2.2.4 KPIs and targets for leased lines services

a. Summary

Leased lines supply time and fault repair time are key aspects for the business users and are therefore often monitored. For these KPIs, France, Morocco, Oman and Singapore set target, such as depicted in the following Table.

Table 18 - International Bandwidth KPIs for Broadband Access Services

Item	Supply time for < 2Mbps LL	Supply time for 2Mbps LL	Supply time for above 2Mbps LL	Fault repair time	Delivered Speed at peak hour for 2 / 4 / 16 Mbps LL
AU					
BH	X				
CA					
FR	X, target 45days for "analog LL"@64 kbps or below	X, target 20 hours		X, target 10 working hours per LL	
GE					
GH					
JO					
MO	X, target 1 week	X, target 2 weeks	X, target 4 weeks		
NO					
OM	X, target value as specified in SLA for 90% of LL	X, target value as specified in SLA for 90% of LL	X, target value as specified in SLA for 90% of LL	X, target 4 hours on International LL	
SA					
SI	X, target 95% of national lines delivered in the agreed time frame	X, target 95% of national lines delivered in the agreed time frame	X, target 95% of national lines are delivered in the agreed time frame	X, target 3 hours for mean time to repair	
UAE					X

It is to be noted that KPI tend to be different for leased lines with speeds below 2Mbps, with speeds equal to 2Mbps and with speeds above 2Mbps. The main reason for that is that leased lines are using different technologies in the 3

cases (typically leased lines below 2Mbps are based on copper in the access network for example).

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the leased lines services KPIs:

- **Fault repair time and supply time are the main KPIs;**
- **Fault repair time targets, in order to be meaningful to the end user and to the business market segment, should be specified per lease line (i.e. 100% of leased lines) or at least for 95% of leased lines and not in terms of mean time to repair.**
- **leased lines below 2Mbps, equal to 2Mbps or above 2Mbps can have different KPIs.**
- **Specifying supply time targets as a function of external parameters like "agreed time frame" (Singapore) or "time specified in SLA" (Oman) does not seem to be easy to manage.**

2.2.5 KPIs and targets for mobile retail services

a. Summary

KPIs related to service delivery time, fault repair time, voice quality parameters, network availability and customer care are used to assess mobile services QoS. The specifics of mobile radio technologies bring additional KPIs related to prepaid service delivery, to the network ability to maintain established calls for 2 – 5 minutes with various voice quality marks (2 to 5 on MOS range), and to the measure of Radio Access Network (RAN) congestion level (see Table 19 and Table 20). Most of these KPIs are measured through drive tests.

Table 19 - KPIs for Mobile Voice Services regarding Call Handling and Performances (1/2)

Item	% of successful call attempts (set up)	% of call dropped by the network within 2 minutes	% of call blocked due to network congestion	% of call set up and held for 2 minutes	% of call set up and held for 2 minutes and marked MOS 5	% of call set up and held for 2 minutes and marked MOS 4	% of call set up and held for 2 minutes and marked MOS 3
AU							

Item	% of successful call attempts (set up)	% of call dropped by the network within 2 minutes	% of call blocked due to network congestion	% of call set up and held for 2 minutes	% of call set up and held for 2 minutes and marked MOS 5	% of call set up and held for 2 minutes and marked MOS 4	% of call set up and held for 2 minutes and marked MOS 3
BH				X		X	X, MOS 3 or MOS 4
CA							
FR				X	X	X	
GE							
GH	X, target 95%	X, target 3%	X, target 2%	X, target 70%			
JO							
MO				X	X	X	X
NO							
OM		X, target 0.8%	X, target 1.1%	X, target 95%			
SA	X, target 98%	X, target 2%					
SI		X, target 2% during busy hour	X	X, target 99% for all cells, 95% in the busiest cell locality			
UAE	X	X		X			X, marked MOS 2.8

Table 20 - KPIs for Mobile Voice Services regarding Call Handling and Performances (2/2)

Item	% of call set up and held for 2 minutes and marked MOS 2	% of call set up and held for 5 minutes	% of call set up and held for 5 minutes and marked MOS 5	% of call set up and held for 5 minutes and marked MOS 4	% of call set up and not maintained after 5 sec	Voice Quality according to ITU-T Rec	% of call attempts failed
AU							
BH							
CA							
FR		X	X	X			
GE							

Item	% of call set up and held for 2 minutes and marked MOS 2	% of call set up and held for 5 minutes	% of call set up and held for 5 minutes and marked MOS 5	% of call set up and held for 5 minutes and marked MOS 4	% of call set up and not maintained after 5 sec	Voice Quality according to ITU-T Rec	% of call attempts failed
GH							X, target 1%
JO							
MO	X				X		X
NO							
OM						X	
SA						X, target MOS 3.5	
SI							
UAE							

Table 21 - KPIs for Mobile Voice Services regarding Service Delivery Time, Network Performances

Item	Service delivery time for prepaid customers	Service delivery time for postpaid customers	Meantime to repair critical faults, affecting 30% of customers	Meantime to repair non critical faults, all other cases
AU				
BH				
CA				
FR				
GE				
GH	X, target 1 hour	X, target 7 days for 90% of customers	X, target 6 hours for 95% of critical faults	X, target 24 hours for 90% of non critical faults
JO				
MO				
NO				
OM				
SA				

Item	Service delivery time for prepaid customers	Service delivery time for postpaid customers	Meantime to repair critical faults, affecting 30% of customers	Meantime to repair non critical faults, all other cases
SI				
UAE				

Table 22 - KPIs for Mobile Voice Services regarding Customers Services

Item	Customer Center response time	Percentage of billing complaints resolved within a given time frame	Percentage of billing complaints among all bills
AU			
BH			
CA			
FR			
GE			
GH			X, target 0,5%
JO			
MO			
NO			
OM		X, target 96% within 20 working days	
SA	X, target 1 minute for 80% of calls		
SI			
UAE			

It is to be noted that CRA has used similar KPI in its study “Quality of Service Measurements-Mobile Services Network Audit 2012”.

KPIs are generally used for SMS and MMS (only once) too (see Table 23).

Table 23 - KPIs for SMS and MMS Services

Item	Percentage of SMS received within 15 seconds	Percentage of SMS received within 30 seconds	Percentage of SMS received within 2 minutes	Percentage of SMS received within 5 minutes	Percentage of SMS received after 5 minutes	Percentage of MMS received within 3 minutes	Percentage of MMS received within 5 minutes

Item	Percentage of SMS received within 15 seconds	Percentage of SMS received within 30 seconds	Percentage of SMS received within 2 minutes	Percentage of SMS received within 5 minutes	Percentage of SMS received after 5 minutes	Percentage of MMS received within 3 minutes	Percentage of MMS received within 5 minutes
AU							
BH	X	X	X				
CA							
FR		X	X			X	X
GE							
GH							
JO							
MO		X	X	X	X		
NO							
OM				X, target 90%	X, target 99% within 30 minutes		
SA							
SI							
UAE							

Mobile Data Services have an increasing success with the development of mass market smartphones and dongles connected to laptops. Corresponding KPIs have been measured by NRAs in 5 countries (see Table 24 and Table 25).

Table 24 - KPIs for Mobile Data Services for dongles

Item	Percentage of successful radio connections within 10 seconds	Percentage of successful radio connections within 1 minute	Speed of FTP download (max and/or average)	Speed of FTP upload (max and/or average)	Speed of HTTP download (max and/or average)
AU					
BH	X	X	X	X	X
CA					
FR					
GE					
GH					
JO					
MO	X, for 2G/3G	X, for 2G/3G	X	X	X
NO					

OM					
SA					
SI					
UAE					

Table 25 - KPIs for Mobile Data Services for smartphones

Item	Percentage of successful radio connections for Web Access	Speed of FTP download	Speed of FTP upload	Speed of HTTP download	Download time for Web Access
AU				X	
BH	X, within 1 minute max	X			X
CA					
FR	X, within 30 sec max	X			
GE					
GH					
JO					
MO	X, for 3G	X for 3G			
NO				X, report of a target 2 Mbps speed on next 4G LTE[26]	
OM					
SA					
SI					
UAE	X, within 10 sec, 30 sec, 1 min	X, for dual 2G/3G and 4G			

It is to be noted that in Austria, the regulatory authority has created a test where much more KPIs are tested (see section 1.2.2).

[26] Under definition

Video streaming being a main application service on smartphones for Data, NRAs have regulated QoS parameters related to the ability to deliver video sequences of 2 minutes without drop and with a good video quality (see Table 26).

Table 26 - KPIs for Video Streaming Data Services

Item	Percentage of videos set up and held for 2 minutes without drop	Percentage of videos set up and held for 2 minutes without drop and marked 3 or 4	Percentage of videos set up and held for 2 minutes without drop and marked 4	Delay in sec between the launch click and the beginning of the sequence (average, max)
AU				
BH	X	X	X	X
CA				
FR	X	X	X	
GE				
GH				
JO				
MO				
NO				
OM				
SA				
SI				
UAE				

The radio network availability and the ability to deliver calls is also sometimes measured (see Table 27).

Table 27 - KPIs for Mobile Radio

Item	Access Network availability	Core Network availability	Network congestion as % of cells with reduced Grade of Service higher than 5% during busy hour
AU			
BH			
CA			
FR			
GE			
GH			
JO			

Item	Access Network availability	Core Network availability	Network congestion as % of cells with reduced Grade of Service higher than 5% during busy hour
MO			
NO			
OM	X, target 95%		
SA			
SI	X	X	X
UAE	X, no standard	X, no standard	

The coverage of 2G or 3G Mobile Networks is defined in terms of coverage obligations in mobile operators' licences for voice services. NRAs control these obligations and monitor such coverage with a set of indicators, such as defined in Table 28. New indicators are required for data coverage purposes, and some are under definition by Arcep in France, based on received Radio Frequency power and Channel Quality Indicators (CQI) reported by the Mobile Network Management System.

Table 28 - KPIs for Mobile Radio Coverage

Item	Voice	Accessibility rate, i.e. ring tone maintained during 20sec	Probability for a call to be maintained more than 1 minute in the covered area	Voice Service coverage defined by a minimum received power	Voice Service coverage on street level, on defined test routes	Voice Service coverage in buildings, average per building	Data	Internet Service coverage defined by a minimum received power	Internet Service coverage defined by a Channel Quality Indicator (CQI)
AU									
BH									
CA									
FR		X, in areas supposed to be covered	X, measured through RSSI/RSCP levels, target 95% for 3G					X, being defined	X, being defined
GE									
GH									
JO									
MO									

Item	Voice	Accessibility rate, i.e. ring tone maintained during 20sec	Probability for a call to be maintained more than 1 minute in the covered area	Voice Service coverage defined by a minimum received power	Voice Service coverage on street level, on defined test routes	Voice Service coverage in buildings, average per building	Data	Internet Service coverage defined by a minimum received power	Internet Service coverage defined by a Channel Quality Indicator (CQI)
NO									
OM									
SA				X, for outdoor and indoor					
SI				X, target 99% coverage in outdoor / indoor / tunnels for 3G@ -100dBm	X, target 95% for 2G	X, target 85% of public areas			
UAE				X, -100 dBm for both 2G and 3G					

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the retail mobile services KPIs:

- A specific KPI related to Service Delivery Time for pre-paid customers is used in Ghana, with a 1 hour target;
- **Targets for call handling performances are set in Ghana, Oman, Saudi Arabia and Singapore, with target values such as 95% successful call set up and held for 2 minutes, 2% call drop at busy hour, 2% call blocked due to network congestion;**
- **Close monitoring of audio quality MOS values is carried out in Bahrain, France, Morocco with dedicated KPIs;**
- **The QoS of mobile data services running on dongles and smartphones is monitored in terms of:**

- **Percentage of successful radio connections established in a given limited time frame, lower than 1 minute, without target;**
- **Speed of FTP and HTTP data transfer in the upstream and downstream directions,** with statistical measures reported such as average, max and standard deviation or 10%-50%-90% percentiles; the measures are taken with dedicated probes set in various points of the network which are representative of a set of various radio conditions, in order to have a full range of meaningful measures. It is quite notable that no targets are set for the KPIs related to download speeds, whereas operators are sometimes marketing their residential offers based on the peak values of these parameters. This situation will probably move on short term due to some pressure of customers who will require some form of control on the actual speed values. This is the reason why a 2 Mbps target average speed has been reported for next 4G LTE licences in Norway, whereas similar licences held recently did mention peak data rates only and no “mean user” data rate.

- The coverage parameters for voice services are defined in terms of minimum required radio frequency received signal in some countries (Saudi Arabia, Singapore, UAE) without any precision on the system type (2G, 3G) and with coverage targets for indoor locations, not controlled by the operator.
- The coverage parameters for data Services are still not defined among benchmarked NRAs.

2.2.6 KPIs and targets for wholesale services

a. Summary

The benchmark allows identifying the following segments for QoS regulation, within the various countries:

- Access network services (LLU, bitstream, line sharing, Passive FTTH), which brings QoS to broadband ISPs and business Operators at the access level (see Table 29);

- Capacity and IP transit services, which brings end to end QoS for those same operators in the broadband IP domain (see Table 30);
- Network interconnection services (PSTN TDM & SS7, IP SIP), which brings end-to-end QoS for those same operators in the voice and Value Added Services domains (see Table 30).

Table 29 - KPIs for Access Network Wholesale Services

Wholesale Access Network KPIs	Bahrain	Canada	France	Saudi Arabia
Bitstream Access Service (E2E up to the ISP POP)				
Supply time			X	X, target 5 working days
Fault report rate			X	X, target 5%
Fault repair time			X	X, target 24 hours for 80% of lines
Local Loop Sharing Service (LLU, Tie cables, DSLAM)				
LLU and Tie cables Supply time	X, target 25 working days	X, target 90% on due date	X	X, target 22 working days
LLU and Tie cables Fault report rate			X	X, target 5%
LLU and Tie cables Fault repair time			X	X, target 10 hours for 85% of lines
Service Node Unbundling Provisioning time	X			
Percentage of CLEC out of service trouble reports related to LLU cleared within a given time frame		X, target 90% within 24 hours		
Percentage of CLEC out of service trouble reports related to LLU that were not cleared on due date and that were cleared on an additional time period		X, target 90% within additional 24 hours		
Percentage of rejection of LLU orders by ILEC due to CLEC side issues		X, target 5%		
Backhaul service (ISP DSLAM to ISP POP)				
Supply time			X, as a Leased Line Service above 2 Mbps	X, target 12 weeks
Fault report rate			X, as a Leased Line Service above 2 Mbps	X, target 99%

Wholesale Access Network KPIs	Bahrain	Canada	France	Saudi Arabia
Fault repair time			X, as a Leased Line Service above 2 Mbps	X, target 10 hours for 85% of lines
Bitstream Access Link service (Incumbent CO to ISP POP)				
Supply time			X, as a Leased Line Service above 2 Mbps	X, target 12 weeks
Fault report rate			X, as a Leased Line Service above 2 Mbps	X, target 99%
Fault repair time			X, as a Leased Line Service above 2 Mbps	X, target 10 hours for 85% of lines

Table 30 - KPIs for Wholesale Network Interconnection and Capacity Services

Wholesale Access Network KPIs	Bahrain	Canada	France	Saudi Arabia
SS7 interconnection links				
Supply time			X, percentage of links delivered in the agreed time frame	X, target 20 weeks
Fault repair time				X, target 10 hours for 85% of lines
Service availability				X, target 99,7%
Unsuccessful call attempts				X, target 2%
Network Failure rate, as 1 - Network Effectiveness Rate (ITU-T E425)			X, target 0,7% of calls to/from all operators interconnected to Orange Network	
Blocking Probability, as per ITU-T Q784 tests for ISUP				
SIP interconnection links				
Supply time				X, target 6 weeks
Fault repair time				X, target 10 hours for 85% of lines
Service availability				X, target 99,8%
Unsuccessful call attempts				X, target 2%
End to end round trip delay for any VoIP SP				X, target 25ms for 95% of calls

Wholesale Access Network KPIs	Bahrain	Canada	France	Saudi Arabia
Network Failure rate, as 1 - Network Effectiveness Rate (ITU-T E425)			X, target 0,7% of calls to/from all operators interconnected to Orange Network	
Blocking Probability				
Leased Lines such as E1 / E3 / STM1 / STM4 / STM16 / Ethernet 100 Mbps / GigEth				
Supply time			X	
Fault repair time		X, target 4 hours for MTTR Mean Time to Repair Out of Order "CDN" digital services such as DS0/DS1/DS3 /OC3/OC12 provided at Access / CO / Inter CO ILEC level to CLECs	X	
Internet Bandwidth Access Service				
Peak traffic load on all links used by any ISP to the first IXP, in order to avoid the congestion of the incumbent backbone by ISP traffic				X, target 90% for 3 consecutive months

b. Conclusions

The benchmark enables to identify the following outcomes with respect to wholesale services KPIs:

- Canada which has adopted a light regulation policy sets targets on several LLU KPIs, related to supply time and resolution time of faults; this reflects the complexity of LLU regulation in a country with several incumbents, not to be generalized to other situations.
- **The QoS regulation of wholesale services in France is not based on targets, but on close monitoring of KPIs such as supply time, fault**

report rate, fault repair time of wholesale leased lines from the incumbent. The goal of these KPIs is to verify the non-discrimination obligation (the regulated operator should serve its retail arm under the same conditions as its competitors).

- Saudi Arabia sets targets to all wholesale services KPIs, reflecting its strong regulatory strategy.

It is important to note that in Singapore, KPIs and targets are imposed on Opennet, the equivalent of Q-NBN for service provisioning.

2.2.7 KPIs and targets for number portability

a. Summary

The QoS of Number Portability is regulated with a set of KPIs and associated targets, such as depicted in Table 31.

Table 31 - KPIs for Number Portability

Item	Time for the receiving operator to transfer the request to the donor operator	Time for the donor operator to answer the request	Unavailability of the service	Percentage of portability orders for local numbers that are met on due date
AU	X, target 5 wk day / 1 wk days for fixed / mobile number	X, target 5 wk day / 1 wk days for fixed / mobile number		
BH		X target 8 wk hours for 98% of requests		
CA				X, target 90% within 2 wk days for fixed numbers
FR	X, target 5 - 7 days for residential - business number	X, target 3 - 5 days for residential - business number	X, target 4 hours	
GE				
GH				
JO				
MO	X, target 1 day as a total	X, target 1 day as a total		
NO	X, target 16 wk hours			
OM	X, target 2 wk days as a	X, target 2 wk		

Item	Time for the receiving operator to transfer the request to the donor operator	Time for the donor operator to answer the request	Unavailability of the service	Percentage of portability orders for local numbers that are met on due date
	total	days as a total		
SA				
SI	X, target 1 day as a total	X, target 1 day as a total		
UAE	X, target 1 wk day / 5 wk days for fixed / mobile number	X, target 5 wk day / 1 wk days for fixed / mobile number		

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the Number Portability KPIs:

- **Many countries, including light regulation countries like Norway or co regulation countries like France, set targets for the KPIs related to the Number Portability, which is a key practical feature for end users;**
- **However, the targets adopted in Norway and France are not very strict compared to Morocco or Singapore (1 day target as total time).**

2.2.8 KPIs and targets for other services

a. Summary

Other KPIs are sometimes defined for example:

- Directory services (Austria, France, Bahrain, see sections 1.2.1, 2.2.3 and 4.3.8 of annexes);
- Telephone enquiry services (France, see section 4.3.8);
- Call centres (Norway, UAE, see sections 9.2.3 and 13.2.1).

Austria and France are the only countries which sets targets for these KPIs. This is conducted in the context of universal service.

b. Conclusions

While directory and telephone enquiry services are less and less used with the development of Internet, monitoring operators' call centres QoS can be relevant.

2.2.9 Geographical analysis

a. Summary

For some KPIs, some countries analyse KPIs at a regional level in addition to the national level. This enables to identify potential QoS issues in key areas, like urban or rural areas.

Table 32 – Geographical Analysis of QoS by NRAs

Item	Strict control of Mobile coverage in rural areas	Provide assistance to local authorities and government to deploy mobile networks in rural areas	Differentiated KPI targets for Fault Repair Time, Appointments Met Rates of Access Lines between Rural and Urban Areas
AU			
BH			
CA			X
FR	X	X	
GE			
GH	X		
JO			
MO			
NO			
OM			
SA			
SI			
UAE			

b. Conclusions

- Rural and low density areas are a key concern in France for fixed broadband and mobile telephony QoS, for fixed access QoS in Canada and for mobile services in Ghana.
- France and Canada are conducting specific QoS policies to meet their QoS objectives in those areas.

2.2.10 Customer satisfaction studies

a. Summary

The benchmark identifies the NRAs which use customer satisfaction studies as action means to complement their measure of QoS and better understand customer expectations.

Table 33 – Customer Satisfaction Studies

Item	Customer Satisfaction Study
AU	
BH	
CA	
FR	
GE	
GH	X
JO	X
MO	
NO	
OM	X
SA	
SI	
UAE	

b. Conclusions

3 NRAs are conducting customer satisfaction studies: Ghana, Jordan, and Oman.

2.3 KPI measurements

For retail fixed and mobile services, the benchmark enables to better understand how measurements are conducted:

- What type of measurement methodologies are used, i.e.
    - based on the statistical data provided by operators, which are available in their own systems (Service Management Layer, Performance Monitoring Applications);
    - based on empirical values derived from dedicated tests specifically implemented on the field during test campaigns;
    - based on the intervention of end users, able to perform quality tests of their connection (speed, latency) from their home/mobile phone by establishing a connection to a dedicated Web service;
- Who reports these measures, i.e. operators, NRA, or companies specialized in QoS measurements which are contracted by the NRA to do so;
- What the global effort related to such KPI is:
    - Large number of KPIs or not;
    - Significant number of standardized KPIs or not, the standardization level being a positive factor of effectiveness.

2.3.1 Fixed retail

a. Summary

The following table summarizes the KPI measurement information for fixed retail KPIs:

Table 34 - KPIs for Fixed Retail Services

Item	Measures provided by Operators	Measures provided by the Regulator	Measures provided by specialized companies contracted by the regulator	Measures based on statistical values from Operator Information System	Measures based on empirical values from field tests	Measures involving the end user	Large Number of KPIs	Significant use of standardized KPIs
AU								
BH	X		X, for dedicated test campaigns	X	X		X	
CA	X			X				
FR	X, certified measurement systems	X	X, for dedicated test campaign	X, for fixed access and Universal service	X	X, for broadband	X	X
GE			X, for Broadband			X		
GH	X			X				
JO	X					X, for broadband		
MO	X			X				X
NO	X			X		X, for broadband and call centre QoS		
OM	X			X		X, for broadband	X, with targets	
SA	X			X	X		X, with targets	
SI	X			X			X, with targets	
UAE	X			X				

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the fixed Retail KPI measurements:

- Most of the countries implement a fixed KPI measurement policy in which operators provide statistical measures and NRAs conduct specific tests campaigns for assessing the QoS performance of broadband connections;
- QoS measurements related to broadband services which involve users are cost effective and transparent, and as such a useful complement to dedicated test campaigns event if they cannot provide the required accuracy and confidence levels required by the NRA;
- Countries with high number of KPIs like France have developed a policy of standardization;
    - When defining KPIs through the use of ETSI, ITU-T standards;
    - When conducting measurements:
        - use of recognized and certified measurement systems,
        - long term partnership with companies specialized in QoS measurements,
        - strong involvement of national operators in KPI measurements, with consultations and dedicated workshops,

      Under those conditions, a high number of KPIs can be supported with limited cost and manpower efforts by the regulator and the concerned operators.

2.3.2 Mobile retail

a. Summary

The following table summarizes the KPI measurement information for mobile retail KPIs:

Table 35 - KPIs for mobile retail services

Item	Measures provided by operators	Measures provided by the NRA	Measures provided by specialized companies contracted by the regulator	Measures based on statistical values from operator's Information System	Measures based on empirical values from field tests	Measures involving the end user	Large Number of KPIs
AU		X for broadband			X	X	
BH			X		X		X
CA							
FR	X		X	X	X		X
GE			X		X	X, foreseeing control checks by user for broadband QoS	
GH	X	X		X	X		X
JO	X			X			
MO	X	X	X	X	X		X
NO	X			X		X, foreseeing control checks by user for broadband QoS	
OM	X	X		X	X		
SA	X			X			
SI	X			X	X		X
UAE	X		X	X	X		X

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the mobile retail KPI measurements:

- For KPIs related to legacy services, i.e. Voice / SMS / MMS and Licence related obligations for QoS and coverage, most of NRAs have implemented a KPI measurement policy in which:

- Operators provide measurement reports based on statistics;
- Companies specialized in mobile QoS and coverage measurements are contracted for dedicated test campaigns, allowing the NRA to publish periodic reports, generally on a yearly basis.

This policy is efficient, as it is based on established measurement systems and processes running at each level (operator, contractor, NRA);

- For KPIs related to video and data services, i.e. broadband mobile services available through broadband connections established with dongles and smartphones, NRAs are relying on dedicated test campaigns like the ones conducted by Directique in Bahrain and France, in a situation where KPI definition for mobile broadband coverage is not finalized yet.

  The new ITU-T standard for mobile multimedia QoS, i.e. ITU-T Rec E.MqoS defined with an end-user perspective and planned to be released in 2014 will be an important milestone to improve the standardization and therefore the objectiveness, transparency, and efficiency of related KPI measurements.

2.4 NRA organisation and processes in relation to QoS

2.4.1 Internal staff

a. Summary

The benchmark provides some indications on NRAs' internal organization and assigned staff related to QoS tasks, for 5 countries out of 13.

The following table provides the information related to the internal staff assigned to QoS related tasks.

Table 36 – Number of staff people assigned to QoS tasks

Item	Number of staff people
AU	No specific staff dedicated
BH	1 person

Item	Number of staff people
CA	Not Available
FR	4 people
GE	Not Available
GH	7 people
JO	Not Available
MO	4 people
NO	5 partly assigned people, working on a per project basis
OM	Not Available
SA	Not Available
SI	Not Available
UAE	Not Available

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the internal staff assigned to QoS tasks:

- The average value of internal staff is 4 people, in case of dedicated resources.
- This value has no relation with the number of managed KPIs.

2.4.2 Processes

a. Summary

The benchmark provides various pieces of information related to the processes which are followed by NRAs, such as QoS measurement reporting processes, QoS measurement audits, actions which are taken in case of late submission or absence of submission, actions which are taken in case of non-compliance to a KPI target or to a set of KPI targets, including the financial penalties which are foreseen.

Some countries however do not have precise processes, and therefore the collected data may be heterogeneous (see Table 37).

Table 37 – QoS related processes

Item	Precise processes are defined and used	Measurement reports are issued by operators	Measurement reports are issued by the NRA	Operator measures are audited by the regulator	Actions taken by the regulator in case of QoS issue	Main action	Other action (1)	Other action (2)
AU								
BH	X	X	X			Follow up corrections, sanctions are not systematic		
CA	X	X		X[27]		Monthly action plans for retail QOS issue	Rebates for ILEC for wholesale QoS issue	Many local decisions according to observed facts
FR	X[28]	X	X	X		Follow up corrections, no sanction		
GE								
GH		X	X	X		Fines if licence obligations are violated	Build a radio site for local coverage issue	Penalties
JO	X	X	X	X		Escalation of critical QoS Issue [29]		
MO		X	X			Follow up corrections	Warning is sent	Operator licence can be withdrawn as an extremity
NO	In project	X				Follow up corrections, no sanction		

[27] As external QoS audits which are conducted by ILECs

[28] Focus on mobile QoS & coverage, and broadband QoS

[29] Escalation to impose the appropriate sanction on the Licensee (as written in the License)

Item	Precise processes are defined and used	Measurement reports are issued by operators	Measurement reports are issued by the NRA	Operator measures are audited by the regulator	Actions taken by the regulator in	Main action	Other action (1)	Other action (2)
OM		X		X		Penalties are defined for a basket of KPIs	Compensations for end users based on the received claims	Light penalties [30]
SA	X	X		X		Penalties after 6 months failure to recover		
SI		X				Penalty between 5 and 50 kSGD per failed KPI target For Singapore's Next Generation Nationwide Broadband Network (fibre) the minimum financial penalty for Open Net is SGD10,000		
UAE	X	X	X			Oblige operators to publish QoS results	Penalties[31]	

[30] No highly punitive penalties to operators, as they are seen as inefficient

[31] Penalties ranging from 10 to 50 k USD per failure, with a 2 M USD cap

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the processes in effect within NRAs organization for QoS regulation:

- Precise processes are defined in some countries such as Jordan, Ghana, and Morocco; other countries prefer to manage the relationship with operators on a more flexible basis, defining their actions as a function of issues at stake.

- QoS measures audits are formally performed by the NRA in France, Jordan and Ghana via external independent bodies, while in Canada such external QoS audits are conducted by operators, in a situation where most of the measurements are performed within the operators' operation and maintenance department with a strong dependency to its information system.

- Some NRAs oblige operators to report any critical outage affecting a significant percentage of the traffic (Jordan, 30% affected traffic) or whose duration is higher than a given delay (Oman, 1 hour).

- A full range of actions are taken in case of non-compliance:

    - Follow up corrections without setting any sanction, which is done in Bahrain, France, Morocco, Norway; these NRAs have a full confidence that operators will quickly react and take successful correction actions, which confidence is based on their passed experience and on the overall market situation (such as level of competition);

    - Building of a short term action plan to correct immediately a retail QoS issue, or impose a rebate for wholesale buyers in case of a wholesale QoS issue, which is done in Canada in a pragmatic way. The timing of action is the driver in this case.

    - Engage legally defined procedures in order to oblige the failing operator to:

        - provide compensations including rebates or full refund of the monthly fee to the affected end users (Ghana, Oman);

        - pay fines or penalties.

However no information is available at this stage on the practical results that these legally defined procedural actions have produced in terms of QoS improvements and on which time frame.

2.4.3 Publication periods

a. Summary

The benchmark provides information on the imposed publication period of QoS measurement reports from operators and audit & reports from the NRA, when they are defined by the NRAs (see Table 38)..

Table 38 – Publication periods of QoS reports

Item	Publication period of the reports by operators (months)	Publication period of the audit & reports by the NRA (months)
AU		
BH	3	12
CA	3	
FR	3 for access, 6 for broadband, 12 for mobile	12
GE		
GH	6	
JO	6	
MO		
NO		
OM	6	6
SA	6	
SI	3	
UAE	3	12

b. Conclusions

The benchmark enables to identify the following outcomes with respect to the publication periods of QoS measurements and audits:

- 3/ 6 months period are generally observed for operators reports for fixed / mobile services;

- 12 months period is generally observed for the NRA reports, related to audit results and/or dedicated studies.

3 Summary of outcomes

3.1 Summary of outcomes with respect to QoS policy

- A QoS policy document is useful to clearly set the respective high level responsibilities and roles of NRAs and operators in the QoS framework.
- The type of regulation which is adopted by the NRA of a given country is strongly related to the competition level between operators in the various market segments.
- Co-regulation, in which the regulator action has a close monitoring attitude without setting targets from its own while being ready to take a firm action in case of a clear QoS violation or failure of the market performance, is often observed as being considered as an efficient and cost effective scheme but is not necessarily adequate when competition is weak.
- The constraints which are taken into account on KPIs are mainly related to the necessity to deal with clearly defined, measurable, comparable indicators, well accepted by operators who will be in charge to establish, administrate, and maintain the related measurement systems and processes.
- KPIs should also be easy to understand for end-users and focused on service performances rather than network performances.
- Fixed and mobile services for residential are almost always regulated.
- Leased lines QoS for businesses is generally regulated.
- Wholesale services QoS is regulated by the NRA in a limited number of countries.

3.2 Summary of outcomes with respect to KPIs and targets

- Countries with a strong regulatory policy or co regulation with “close monitoring” policy, show fairly high number of KPIs, whereas countries with light regulation policies work on a fairly limited number of.

- Fixed networks (access, voice, leased lines) have a longer QoS regulation history and therefore corresponding KPIs tend to be more comparable between countries.
- Using ETSI documents as a reference for such KPIs can make a difference, in that they show an in depth work on both KPI definitions and associated measurements.
- International Voice QoS is to be monitored and targeted in countries like Gulf countries, with an unsuccessful international call rate below 2%, as this value is related to the perceived voice QoS of major parts of the business sector.
- For the time being, fixed broadband QoS which is a prime concern for both operators and end users does not generate a significant number of KPIs, generally lower than fixed legacy services in most cases.
- Close monitoring of mobile audio quality MOS values is carried out in Bahrain, France, Morocco with dedicated KPIs.
- The mobile coverage parameters for data services are still not defined among benchmarked NRAs.
- Only 4 countries monitor wholesale QoS. The QoS regulation of wholesale services in France is not based on targets, but on close monitoring of KPIs such as supply time, fault report rate, fault repair time of wholesale leased lines from the incumbent. The goal of these KPIs is to verify the non-discrimination obligation (the regulated operator should serve its retail arm in the same way as its competitors). Saudi Arabia sets targets to all wholesale services KPIs, reflecting its strong regulatory policy strategy.
- In Singapore, KPIs and targets are imposed on Opennet, the equivalent of Qnbn for service provisioning.
- Many countries, including light regulation countries like Norway or co regulation countries like France, set targets for the KPIs related to the Number Portability, which is a key practical feature for end users.
- Some NRAs are conducting customer satisfaction studies.

3.3 Summary of outcomes with respect to KPIs measurements

- Most of countries implement a fixed KPI measurement policy in which operators provide statistical measures and NRAs conduct specific tests campaigns for assessing the QoS performance of broadband connections.
- QoS measurements related to broadband services which involve users are cost effective and transparent, and as such a useful complement to dedicated test campaigns even if they cannot provide the required accuracy and confidence levels required by the NRA.
- Countries with high number of KPIs like France have developed a policy of standardization:
    - When defining KPI through the use of ETSI, ITU-T standards;
    - When conducting measurements.
- For KPIs related to mobile legacy services, most of NRAs have implemented a KPI measurement policy in which:
    - Operators provide measurement reports based on statistics;
    - Specialized companies in mobile QoS and coverage measurements are contracted for dedicated test campaigns.
- For KPIs related to video and data services, i.e. broadband mobile services available through broadband connections established with dongles and smartphones, NRAs are relying on dedicated test campaigns.

3.4 Summary of outcomes with respect to NRA organisation and processes to monitor QoS

- The average value of internal staff is 4 people, in case of dedicated resources. This value has no relation with the number of managed KPIs.
- Precise processes are defined in some countries; other countries prefer to manage the relationship with operators on a more flexible basis, defining their actions as a function of issues at stake.

- Some NRAs oblige operators to report any critical outage affecting a significant percentage of the traffic or whose duration is higher than a given delay.
- A full range of actions are taken in case of non-compliance:
    - Follow up corrections without setting any sanction,
    - Engage legally defined procedures in order to oblige the failing operator to:
        - provide compensations including rebates or full refund of the monthly fee to the affected end users;
        - pay fines or penalties.
- 3 / 6 months periods are generally observed for operators' reports for fixed / mobile services.
- 12 months period is generally observed for the NRA reports, related to audit results and/or dedicated studies.

ANNEXES

0 List of countries

For the benchmark, 13 countries have been selected. They are in different parts of the world: in the Gulf region (Bahrain, Oman, UAE and Saudi Arabia), in Arabic countries (Morocco, Jordan), in Europe (Austria, France, Germany, Norway), in Asia (Singapore), in Africa (Ghana) and in America (Canada).

These countries have been chosen:

- Either because they have similar market conditions as in Qatar (Gulf region)
- Or because they have a long history of QoS regulation (France, Canada, Jordan, Morocco)
- Or because they have high level of QoS (Singapore, Norway)
- Or because they are following innovative approaches (Austria, Germany, Ghana).

These annexes present the data collected in each of these countries, either thanks to responses provided by regulatory authorities following a questionnaire being sent to them in September (Austria, Bahrain, France, Germany, Ghana, Morocco, Norway, Saudi Arabia, Singapore, UAE) or thanks to publicly available information only (Canada, Jordan, Oman). The level of details can vary and mainly depends on regulatory authorities' involvement with regards to QoS or publicly available information (for example, France publishes a significant amount of information while Norway publishes very limited information).

The table below lists for each of the 13 selected countries main economic and telecommunications market development indicators:

Table 39 – Main economic and telecommunications market development indicators for the 13 countries and Qatar

Country	# of inhabi-tants[32]	GDP per capita	NRA	Penetration rates[34]	# of main competitors

[32] United Nations, June 2013

	(millions)	PPP (US$)[33]		Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Qatar	2	83,460	CRA	16%	123%	8%	1	2
Austria	8	44,208	RTR	40%	155%	26%	3	3
Bahrain	1	23,886	TRA	21%	128%	14%	3	3
Canada	35	42,533	CRTC	48%	75%	32%	++	3
France	64	36,104	ARCEP	56%	105%	26%	4	4
Germany	83	40,901	BNA	63%	132%	32%	3	4
Ghana	26	2,048	NCA	1%	85%	0.3%	1	6
Jordan	7	6,148	TRC	7%	118%	3%	2	4
Morocco	33	5,193	ANRT	11%	113%	2%	3	3
Norway	5	65,640	NPT	43%	117%	36%	4	4
Oman	4	27,015	TRA	10%	169%	2%	2	2
Saudi Arabia	29	24,571	CITC	16%	191%	6%	1	3
Singapore	5	61,803	IDA	37.2 %	157%	105.0 %	2	3
United Arab Emirates	9	42,080	TRA	23%	149%	11%	2	2

For each country, the QoS regulatory framework is described in 3 parts:

1 QoS policy and objectives (in which the legal context is sometimes reminded, when relevant);

2 KPI, targets and measurements;

3 Organisation and processes.

[34] ITU, for 2011

[33] World Bank, 2012 or 2011

For each part also, the level of details can vary significantly from a country to another (for example, some countries do not have detailed processes).

The structure of each section related to one country has been kept as far as possible identical from one country to another.

NB: sometimes “operators” is replaced by “Licensees”, “Service providers”, “License holders” in some cases.

NB: some tables show values for “actual QoS”. These values are the observed QoS in latest available QoS reports published by regulatory authorities. For reporting purposes, when several operators’ QoS is published only average values are listed. As a consequence, one should refer to regulatory authorities QoS reports for more up to date and disaggregated values.

1 Austria

Table 40 - Main economic and telecommunications market development indicators for Austria

Country	# of inhabitants[35] (millions)	GDP per capita PPP[36] (US$)	NRA	Penetration rates[37]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Austria	8	44,208	RTR	40%	155%	26%	3	3

1.1 QoS Policy

1.1.1 Legal context

There are 5 European directives relevant for the telecommunications sector in Europe (framework, access, authorization, universal service and privacy/data protection) and 4 of them discuss about QoS.

- The "framework" directive states that one of the policy objectives of National Regulatory Authorities (NRA) is to promote competition by *"ensuring that users, including disabled users, derive maximum benefit in terms of choice, price, and quality".*
- The "authorization" directive states that NRA can require operators to provide information justified for *"publication of comparative overviews of quality and price of services for the benefit of consumers".*
- The "access" directive states *"Obligations of non-discrimination shall ensure, in particular, that the operator applies equivalent conditions in equivalent circumstances to other undertakings providing equivalent services, and provides services and information to others under the same conditions and of the same quality as it provides for its own services, or those of its subsidiaries or partners".*

[35] United Nations, June 2013

[36] World Bank, 2012

[37] ITU, for 2011

- The "universal service" directive includes 3 articles that are relevant for QoS:
    - Article 11 states that operators being designated as universal providers *"publish adequate and up-to-date information concerning their performance in the provision of universal service"* and that NRAs may:
        - May specify additional QoS standards for disabled end-users;
        - May *"specify the content, form and manner of information to be published, in order to ensure that end-users and consumers have access to comprehensive, comparable and user-friendly information";*
        - *"shall be able to set performance targets for those undertakings with universal service obligations"* (having taken into account the view of interested parties);
        - *"shall be able to order independent audits or similar reviews of the performance data, paid for by the undertaking concerned, in order to ensure the accuracy and comparability of the data made available by undertakings with universal service obligations".*
    - Article 20 states that the contract related to services providing connection and/or access to the public telephone network should include the service quality levels offered and any compensation which applies if contracted service quality levels are not met.
    - Article 22, which applies to all operators providing telecom services, indicates that NRA can require operators to publish information on QoS for publication and can specify the format and content (after having consulted on it).
- This latter directive has been amended in 2009[38]:

[38] *"DIRECTIVE 2009/136/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009 amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications*

- Article 20 has been modified to include the fact that the minimum service quality levels offered should be stated in the contract as well as *"information on any procedures put in place by the undertaking to measure and shape traffic so as to avoid filling or overfilling a network link, and information on how those procedures could impact on service quality";*

- Article 22 now states *that "In order to prevent the degradation of service and the hindering or slowing down of traffic over networks, Member States shall ensure that national regulatory authorities are able to set minimum quality of service requirements on an undertaking or undertakings providing public communications networks."* A specific process involving the European Commission and the group of European regulatory authorities (BEREC) has to be followed in this case.

These directives show the different facets of QoS regulation: publication, non-discrimination, minimum level of QoS, contractual impacts.

The new European regulatory framework for communications was transposed in Austria by means of the Telecommunications Act 2003 (TKG 2003) which took effect on August 20, 2003. The 'EU-Telecom Package' has been implemented in Austria by amending the 'Telekommunikationsgesetz 2003 - TKG 2003' / 'Telecommunication Act' (furthermore referred to as: TKG 2003). The amendment came into force on the 22nd of November 2011. It is to be noted that some articles within the amended TKG 2003, as stated in § 137 (4,5 + 6) TKG 2003, entered into force during the first half of the year 2012 (in February, April and May 2012).

1.1.2 QoS policy

No information.

1.2 KPI and measurement

1.2.1 Universal services KPIs

The following KPIs are measured by the USO. There is no formal validation process.

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sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws"

KPI	Definition	Target	Actual QoS	Measurement method
supply time for new access - if no specific date was agreed with the customer		≤ 15 working days for 95% of all accesses supplied	N/A	N/A
supply time for new access - if upon customer request a specific date was agreed		≥ 95% of cases the specified date was met		N/A
reported faults		≤ 2%		N/A
normal fault repair time		90% of faults must be repaired within 24 h during working days		N/A
fault repair time for contracts which offer shorter repair times for an additional fee		value specified in specific contracts		N/A
fault repair time for emergency number		"immediately"		N/A
Availability	at network termination point	≥ 99% per year		N/A
	emergency services	≥ 99.9% per year		N/A
Call success rate	statistical method must be stated in report	≥ 99%		Measured at a working day stipulated by the regulator, from 10am to 12am.
Call set-up time		≤ 1 s for 90% of calls within the network of the universal service provider		
Reaction time for directory services	charged for	≤ 10 s for 99% of calls		N/A
	free of charge	≤ 20 s for 99% of calls		N/A

average rate of operational public phones	number operational public phones / total number of public phones	≥ 98% per year		N/A
billing accuracy	number of billing complaints / total number of bills issued	≤ 0.5%		N/A
voice quality	customer surveys	"MOS" >3.5		4-point scale mean opinion score, which is not compliant with 5-point scale used widely for MOS

The universal service operator has to report these values on an annual basis.

1.2.2 Mobile services

RTR has launched an online tool for mobile and fixedbroadband measurements by consumers, called RTR-NetTest (www.nettest.at).

It is based on the open source and open data principle. The source code of the RTR-NetTest software is publicly accessible and RTR has put the components it has developed under an open source licence.

The RTR-NetTest data are published on the RTR-NetTest website as a file under https://www.rtr.at/de/tk/netztestopendata and are under the usage of the Creative Commons Namensnennung 3.0 Österreich (CC BY 3.0) License so made freely available to the general public for information, use, dissemination and other applications.

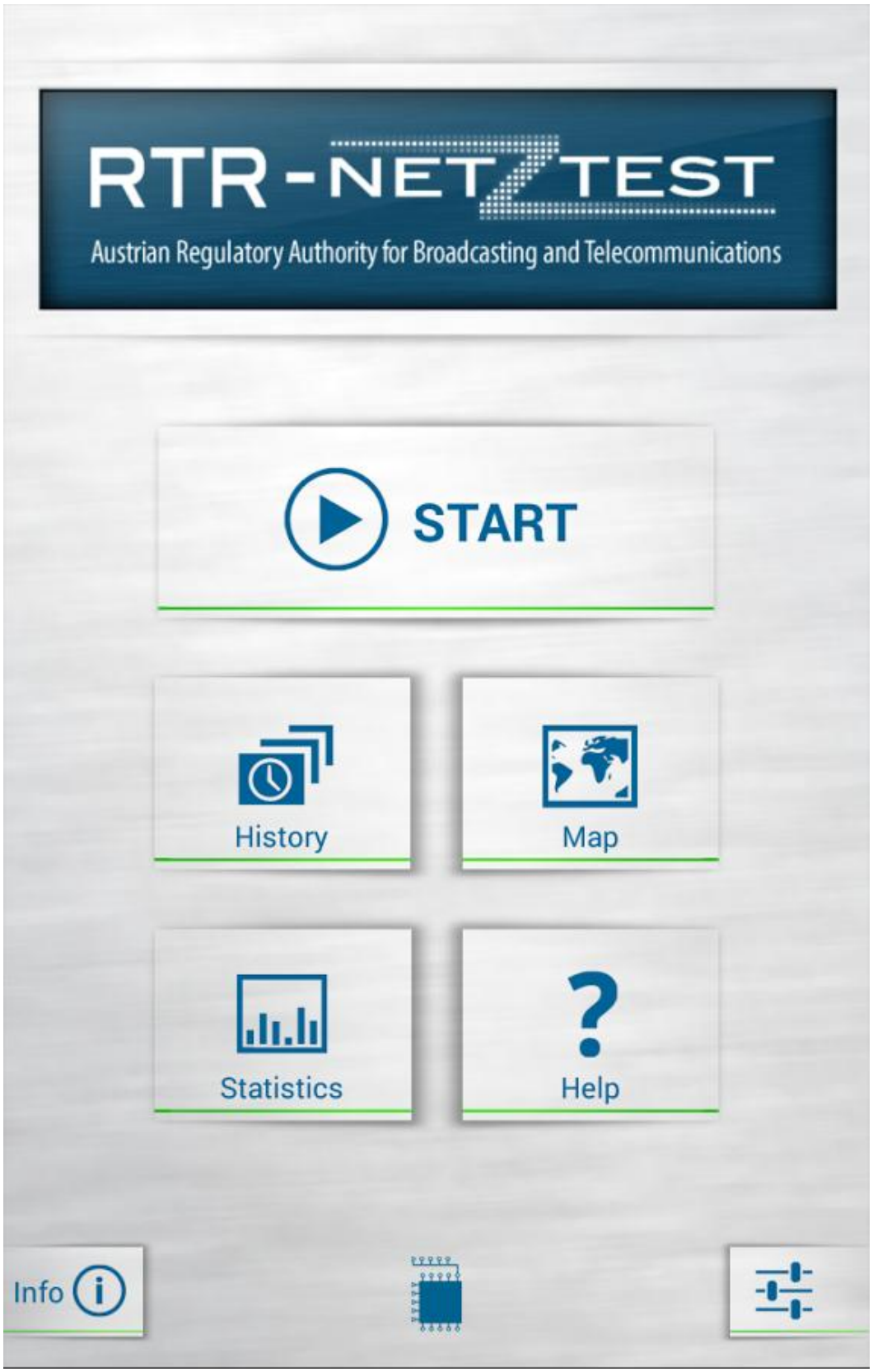
The RTR-NetTest allows users to obtain information on the current service quality (e.g. upload and download speed, ping, signal strength) of their Internet connection and provides them with comprehensive information, including statistical data. The RTR-NetTest provides:

- a map view of all test results with filter options for test parameters, statistics, operator, device and time of day;

- statistics on the results for all the major operators with filtering options for test parameters and test duration;
- a red/orange/green evaluation of the test result (“traffic-light”-system);
- the option to synchronise results of various devices and display them in the browser;
- the user’s own test history;
- statistics on tests
- results available as open data - see https://www.rtr.at/de/tk/netztestopendata for details;
- source code available at https://github.com/alladin-IT/open-rmbt

The following are example screen shots for Android:

Figure 1 – Snapshot of RTR-NetTest

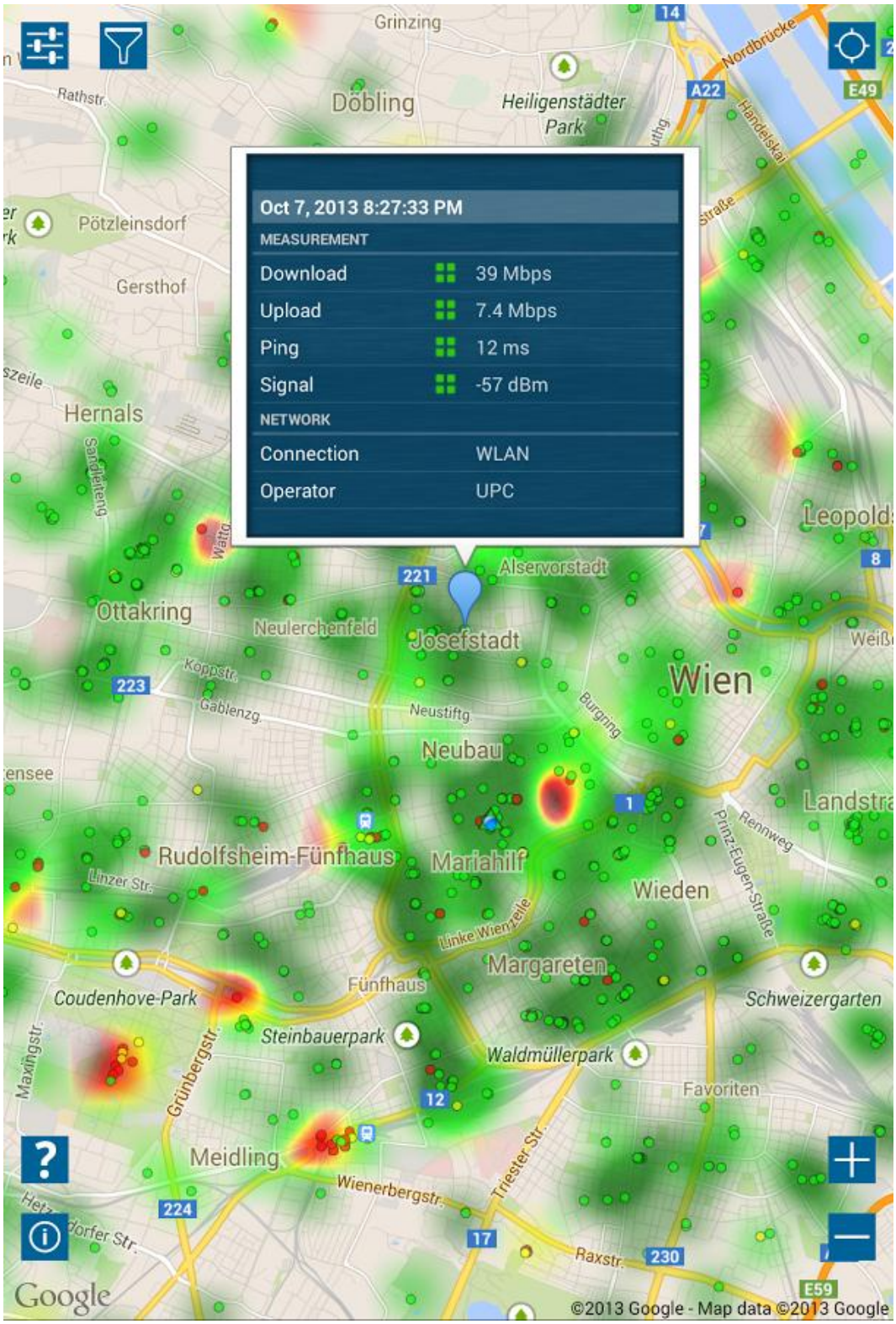


Source: RTR

Figure 2 - Snapshot of RTR-NetTest

Source: RTR

Figure 3 - Snapshot of RTR-NetTest



Source: RTR

User can select between different parameters to display:

- mobile download speed;

- mobile upload speed;
- mobile ping;
- mobile signal;
- WLAN (App) download speed;
- WLAN (App) upload speed;
- WLAN (App) ping;
- WLAN (App) signal;
- browser download speed;
- browser upload speed;
- browser ping.

In addition user can select either one specific operator or "all networks" and they can specify the time slot between one week and 2 years.

1.2.3 Number portability

The end-to-end porting process (the time taken between a valid port request being received and the completion of the provision of the service on the recipient operator network) must be lower than 5 working days for fixed number portability and 1 working day for mobile number portability.

1.3 Organisation and processes

No dedicated resources are assigned to QoS monitoring and related tasks.

Fines are applicable only in relation to coverage obligations.

2 Bahrain

Table 41 - Main economic and telecommunications market development indicators for Bahrain

Country	# of inhabitants[39] (millions)	GDP per capita PPP[40] (US$)	NRA	Penetration rates[41]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Bahrain	1	23,886	TRA	21%	128%	14%	3	3

2.1 QoS Policy

TRA's objectives and policies are set out in the document "Quality of Service regulation" of 11 September 2008. This regulation is the main QoS document in Bahrain. This is a relatively short document (main body is made of 6 pages). The scope of this document is defined as follows *"This regulation places obligations on Licensed operators for measuring and reporting Quality of Service and allows TRA to establish and amend, from time-to-time as required, performance targets that License Operators must comply with and introduces a reporting requirement for the regular collection of market data".*

In this document, TRA describes its own objectives with respect to QoS. These objectives are:

- Assist end users and operators to select their services;
- Assist operators with the design and operation of interconnection;
- Assist the development of the telecommunications industry;
- Assist in the maintenance and improvement of QoS provided by operators;
- Establish appropriate targets;

[39] United Nations, June 2013

[40] World Bank, 2012

[41] ITU, for 2011

- Support self-regulation unless competition is not sufficient to maintain a required level of QoS.

This document provides TRA with the ability to set targets in case observed QoS is not in line with international standards or benchmarks. Article 9.2 of the regulation states that in case targets are not met by an operator, TRA can:

- Require the operator to publish information about QoS;
- Require the operator to submit to TRA a plan to improve QoS.

However, TRA has never set any targets outside targets that are set mobile operators' licences.

TRA's main objective in relation to QoS is to observe, monitor QoS and discuss with operators on a case by case basis when QoS is not sufficient. This is why TRA requires the measurement and publication of KPI from operators and does not set targets. TRA also conducts its own measures. In TRA's opinion and experience, this is sufficient to improve QoS. As an example, in the first year following the publication of TRA's QoS regulation, one operator was showing very bad level of QoS. TRA did not publish these results in this first year and the operator increased significantly its QoS in the following year. It should be noted that the legal framework in place does not allow the imposition of fines in relation to QoS.

TRA specifies that QoS standards set out must be described in such a way that they provide flexibility in the provision of future services. Looking forward, TRA can amend the QoS regulation document but this has not been completed for now. TRA plans to update its QoS regulatory framework in early 2014 (starting in the coming weeks). TRA will consult the industry on its objectives, on a simpler and updated list of KPIs. **TRA will probably include targets on some services.**

2.2 KPI and measurement

Several types of KPIs are collected and reported in Bahrain:

- General network KPI as required by TRA's 2008 regulation;
- Account complaints KPI as required by TRA's 2008 regulation;
- Directory enquiry KPI as required by TRA's 2008 regulation;
- Internet latency KPI as measured by TRA on a case by case basis;
- Number portability KPI as required by TRA in the document "Number Portability Process Specification" (October 2010);
- WiMAX coverage and QoS KPI as measured by TRA;
- Mobile coverage and QoS KPI as measured by TRA;
- LLU KPI for verifying non-discrimination as imposed by TRA in the LLU Order of the 5th of May 2011.

2.2.1 General KPI measured by operators

General KPIs measured by operators have been divided into 8 categories: disconnection complaints KPI, disconnection resolution time KPI, other complaints KPI and associated resolution time, faults KPI, service supply time KPI, unsuccessful and dropped KPI on services, observations and measurements KPI and others KPI.

c. Disconnection complaints KPI

A disconnection is defined as any way of preventing a subscriber from using a service. It may not require physical unplugging of connections.

A disconnection complaint is a complaint that a disconnection is unjustified. A disconnection complaint should not be confused with a request for disconnection or transfer or with a fault report. A disconnection complaint may be submitted by phone, by personal contact at a customer service centre or in written form.

The measurements should include all disconnection complaints received during the reporting period, regardless of the validity of the complaint, the extent to which the complaint repeats an earlier one, and the dates of disconnections or any other occurrences that are the subject of the complaint.

The table below presents the KPI, targets if relevant and measurement methods:

Table 42 – KPI, targets and measurement methods related to disconnection complaints in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Disconnection complaint rate - Blocking SMS messages to or from certain numbers	See definition above	Not published		Statistics provided by operators
Disconnection complaint rate - Stopping services for alleged non-payment.				
Disconnection complaint rate - Stopping services after credit expiry				
Disconnection complaints received - Blocking calls to or from certain numbers or networks				
Disconnection complaints received - Blocking SMS messages to or from certain numbers				
Disconnection complaints received - Stopping services for alleged non-payment				
Disconnection complaints received - Stopping services after credit expiry				

d. Disconnection resolution time KPI

The time to resolve a disconnection complaint is defined as the elapsed time (not the working time) from when the complaint is received by an operator to when the cause for the complaint has been removed.

The measurements should include all disconnection complaints resolved during the reporting period, regardless of the validity of the complaint, the extent to which the complaint repeats an earlier one, and the dates of disconnections or any other occurrences that are the subject of the complaint.

The table below presents the KPI, targets if relevant and measurement methods:

Table 43 - KPI, targets and measurement methods related to disconnection resolution time in Bahrain

KPI	Definition	Target	Actual	Measurement

			QoS	method
Blocking calls to or from certain numbers or networks	See definition above	Not published		Statistics provided by operators
Blocking SMS messages to or from certain numbers				
Stopping services for alleged non-payment				
Stopping services after credit expiry				
Blocking calls to or from certain numbers or networks				
Blocking SMS messages to or from certain numbers				
Stopping services for alleged non-payment				

e. Other complaints KPI and associated resolution time

The table below presents the KPI, targets if relevant and measurement methods:

Table 44 - KPI, targets and measurement methods related to other complaints resolution time in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Miscellaneous complaint rate	N/A	Not published		Statistics provided by operators
Miscellaneous complaint received				
Miscellaneous complaint resolution time (mean)				
Miscellaneous complaint resolution time (Std dev)				
Miscellaneous complaint resolution time (95th percentile)				

f. Faults KPI

The table below presents the KPI, targets if relevant and measurement methods:

Table 45 - KPI, targets and measurement methods related to faults in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Fault report rate - Service affecting	N/A	Not published		Statistics provided by
Fault report rate - Non Service affecting				

Number of fault reported - Service affecting			operators
Number of fault reported - Non Service affecting			
Fault repair time (mean) - Service affecting			

g. Service supply time KPI

The table below presents the KPI, targets if relevant and measurement methods:

Table 46 - KPI, targets and measurement methods related to supply time in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Number - For all types of line (phone business, phone residential, CATS, bitstream, etc.)	N/A	Not published		Statistics provided by operators
Mean - For all types of line (phone business, phone residential, CATS, bitstream, etc.)				
St dev - For all types of line (phone business, phone residential, CATS, bitstream, etc.)				
95th percentile - For all types of line (phone business, phone residential, CATS, bitstream, etc.)				

h. Unsuccessful and dropped services KPI

The table below presents the KPI, targets if relevant and measurement methods:

Table 47 - KPI, targets and measurement methods related to unsuccessful and dropped services in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Unsuccessful call centre access - Public emergency	N/A	Not published		Statistics provided by operators
Unsuccessful call centre access - Operator assistance				
Unsuccessful call centre access - Directory information				
Unsuccessful call set-up / Fixed to fixed				
Unsuccessful call set-up / Fixed to Mobile (own network)				

Unsuccessful call set-up / Fixed to Mobile (other network)			
Unsuccessful call set-up / Mobile to fixed			
Unsuccessful call set-up / Mobile to Mobile (own network)			
Unsuccessful call set-up / Mobile to Mobile (other network)			
Dropped call ratio / Fixed to fixed			
Dropped call ratio / Fixed to Mobile (own network)			
Dropped call ratio / Fixed to Mobile (other network)			
Dropped call ratio / Mobile to fixed			
Dropped call ratio / Mobile to Mobile (own network)			
Dropped call ratio / Mobile to Mobile (other network)			
Unsuccessful SMS transmission ratio / Own network			
Unsuccessful SMS transmission ratio / Other network			
Unsuccessful MMS transmission ratio / Own network			
Unsuccessful MMS transmission ratio / Other network			
Unsuccessful Internet session login ratio			
Dropped internet session ratio			
Unsuccessful Internet data transmission ratio			

i. Internet and international KPI

The table below presents the KPI, targets if relevant and measurement methods:

Table 48 - KPI, targets and measurement methods related to Internet and international in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Internet data transmission (mean)	N/A	Not published		Statistics provided by operators
Internet data transmission (st dev)				
Internet data transmission (95th percentile)				

Observation on international outgoing telephone calls - Ref ITU - T E.422 - From fixed line			
Observation on international outgoing telephone calls - Ref ITU - T E.422 - From mobile line			
Observation on international outgoing telephone calls - Ref ITU - T E.422 - From soft dialers			
Internal automatic observations. Ref ITU - T E.425 - ASR for all international route			
Internal automatic observations. Ref ITU - T E.425 - ABR for all international route			
Internal automatic observations. Ref ITU - T E.425 - ASR for top 5 international destinations			
Internal automatic observations. Ref ITU - T E.425 - ABR for top 5 international destinations			
IP based network measurement - Ref ITU T M 2301 - Intrusive IPTD	IPTD: One way IP packet Transfer Delay IPDV: One way Packet Delay Variation IPER: IP packet error ratio IPLR: IP packet loss ratio IPDR: IP packet discard ratio		
IP based network measurement - Ref ITU T M 2301 - Intrusive IPDV			
IP based network measurement - Ref ITU T M 2301 - Intrusive IPER			
IP based network measurement - Ref ITU T M 2301 - Intrusive IPLR			
IP based network measurement - Ref ITU T M 2301 - Non intrusive IPER			
IP based network measurement - Ref ITU T M 2301 - Non intrusive IPLR			
IP based network measurement - Ref ITU T M 2301 - Non intrusive IPDR			
Performance and availability for MPLS networks. Ref ITU-T Y.1561			
Total number of calls to operator services – International operator services	N/A	Not published	Statistics provided by operators
Mean time to answer for the period – International operator services			

Mean holding time – International operator services			

2.2.2 Account complaints - KPI

KPIs measured by operators with respect to account complaints concerns have been divided into 2 categories: account complaints KPI and account complaint resolution time KPI associated.

a. Account complaints KPI

The table below presents the KPI, targets if relevant and measurement methods with respect to billing/account complaints:

Table 49 - KPI, targets and measurement methods related to account complaints in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Charging for services with fixed recurring charges more than once	An account is a statement of money owed or paid that is read or otherwise accessed by a Subscriber An account complaint is a complaint that an account is inaccurate. An account complaint should not be confused with a request for information about accounts or tariffs, or with a service fault report. An account complaint may be submitted by phone, by personal contact at a customer service centre or in written form.	Not published		Statistics provided by operators
Charging for calls more than once				
Charging for SMS messages more than once				
Charging for services with fixed recurring charges at incorrect rates				
Charging for SMS messages at incorrect rates				
Charging for calls at incorrect rates				
Charging for services with fixed recurring charges without successful supply				
Charging for calls without successful setup				
Charging for SMS messages without successful transmission				
Charging for calls beyond their durations				
Not crediting recharge payments to the account				
Not crediting bill payments to the account				

Not accepting attempts to make recharge payments			

b. Account complaint resolution time KPI

The table below presents the KPI, targets if relevant and measurement methods related to account/billing complaint resolution:

Table 50 - KPI, targets and measurement methods related to account complaints resolution time in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Charging for services with fixed recurring charges more than once	See above in the previous table	Not published		Statistics provided by operators
Charging for calls more than once				
Charging for SMS messages more than once				
Charging for services with fixed recurring charges at incorrect rates				
Charging for SMS messages at incorrect rates				
Charging for calls at incorrect rates				
Charging for services with fixed recurring charges without successful supply				
Charging for calls without successful setup				
Charging for SMS messages without successful transmission				
Charging for calls beyond their durations				
Not crediting recharge payments to the account				
Not crediting bill payments to the account				
Not accepting attempts to make recharge payments				

2.2.3 Directory enquiries

The table below presents the KPI, targets if relevant and measurement methods:

Table 51 - KPI, targets and measurement methods related to directory enquiries in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Total number of calls to DQ	N/A	Not published		Statistics provided by operators
Mean time to answer for the period				
Mean holding time				
Total number of phone number look-ups performed				
Number of unsuccessful look-ups				
Failure rate to DQ look-ups				
Average number of look-ups per DQ calls				

2.2.4 Network latency KPI

In December 2012, TRA asked Renesys Corporation to conduct a study on Network latency and Bahrain's content ecosystem. The following KPI were measured:

Table 52 - KPI, targets and measurement methods related to Internet latency

KPI	Definition	Target	Actual QoS[42]	Measurement method
Network latency (RTT) in ms	Not applicable	No Target	From 100 ms to maximum 500 ms in very few instances	Network latency is measured for each operator/ISP in Bahrain and for each destination used by this ISP Renesys operates a global network of 90 Internet measurement points, from which latency probes are sent to over a million responding hosts each day, worldwide.

[42] Average between all operators

				Using the latencies measured to each responding host and router, it is possible to build up a global picture of the fast and slow paths that Internet traffic can take between clients and servers. Renesys does not have measurement point within Bahrain. To examine the characteristic latencies between Bahrain's consumers and the world, Renesys performed more than 30 million traces from worldwide cities to IP addresses located in Bahrain, and used the paths and round trip times to build a map of each provider's inbound connectivity. Renesys used the primary hosting locations for a set of popular Web destinations (identified by Alexa.com). Renesys plotted the main trends in Internet delay for ten key Bahrain ISPs, and identified the primary geographic paths they take to reach popular content locations.

This study is relatively unique and provide interesting recommendations for operators to increase QoS (decrease latency), for example through the use of caches.

2.2.5 Number portability KPI

Following KPIs are monitored by TRA for number portability:

Table 53 - KPI, targets and measurement methods related to number portability in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Porting Request Acknowledge time	The time that the central system requires to respond to a porting request received from a recipient operator.	98% within 5 minutes	N/A	No detail
The central system check on blocking	Maximum time between porting request received in the central system from recipient operator and sending the request rejection message by the	98% of porting reject should be sent within		

issues	central system.	15 minutes		
Donor Operator check on blocking issues	Time between the porting request and the request acceptation/rejection by donor operator	98% responded within 8 working hours		
Standard Porting time	Maximum time between the submission of the number portability request by the recipient operator and request acceptation/rejection by the donor operator	98% completed at the planned date		
Porting Execution Time	Time required for the donor operator to disconnect a number and to update routing tables. The time is measured as the time elapsed between sending the "NpExecuteBroadcast" message and the receiving of the "NpExecuteComplete" message	95% completed within 10 minutes		
Porting Broadcast Time	Time required for other operators to update their routing tables. The time is measured as the time elapsed between sending the "NpExecuteBroadcast" message and the receiving of the "NpExecuteComplete" message	95% within 15 minute		
Deactivation Acknowledge time	The time that the central system requires to respond to a "NpDeactivate" message received from an operator	98% within 5 minutes		
Deactivation Time	Time required for the block operator to respond to the deactivation process. The time is measured as the time elapsed between sending the "NpDeactivateBroadcast" message and receiving of the "NpDeactivateComplete" message	98% within 30 minutes		
Deactivation Broadcast Time	Time required for other operators to respond to the deactivation process. The time is measured as the time elapsed between sending the "NpDeactivateBroadcast" message and the receiving of the "NpDeactivateComplete" message	95% within 30 minutes		

2.2.6 WiMAX coverage and QoS[43]

These KPIs are measured by TRA's contractors. Details of the KPIs are provided below:

Table 54 - KPI, targets and measurement methods related to Wimax in Bahrain

KPI	Definition	Target	Actual QoS	Measurement method
Coverage	Weighted average downlink RSSI samples higher than the target Downlink RSSI threshold	95% coverage	99.5% and 96.8%	Measurements are conducted over one month, every day except week-ends from 8 am to 7 pm Measurement are conducted on static points (no mobility is provided by WiMAX operators in Bahrain): - Either random locations - Or operators hotspots The measurements cannot guarantee that CPE are connected to the best serving cell WiMAX scanner DRT 4301A (NEMO technologies) is used A magnetic ultra-wideband cellular antenna GA110 is used Two CPE supporting operators' best commercial offers are used for each operator
Network latency in milliseconds	By sending an ICMP echo request to a specified server test. The RTT of 32 KB IP packets is measured (timeout 1s)	No target	75 mls at random locations, 68 mls at hotspots	
Rate of successful PING within 100 ms			95.1% at random locations, 100% at hotspots	
FTP transfer time - Downlink	Average transfer tome applied only to successful samples – 10 MB file – Timeout 60 s		20.7 s at random locations, 22.5 at hotspots	
Average speed (Mbps) for FTP – Downlink	Average throughput computed from successful samples – 10 MB file – Timeout 60 s		5.8 Mbps	
Max speed (Mbps) for FTP – Downlink	Best throughput from all successful samples – 10 MB file – Timeout 60 s		Not published	
FTP transfer time - Uplink	Average transfer tome applied only to successful samples – 1 MB file – Timeout 50 s		14.1 s at random locations, 12.9 at hotspots	
Average speed (Mbps) for FTP – Uplink	Average throughput computed from successful samples – 1 MB file – Timeout 50 s		0.7 Mbps	

[43] Source Wimax Audit Report 2013 from Sofrecom, published on the TRA web site

Max speed (Mbps) for FTP – Uplink	Best throughput from all successful samples – 1 MB file – Timeout 50 s		Not published	Coverage is assessed at -85dBm for one operator and -92 dBm for the other
Web browsing – Home page Download time (s)	Average delay recorded for each web page (5 web pages were tested) – Timeout 20s per page		5.3 at random locations, 4.3 at hotspots	
Voice - % of calls marked as perfect quality	Timeout 60 s – Tests with calls to fixed line		78.4% at random locations – 71.4% at hotspots	
Voice - % of calls marked as perfect or fair quality	Timeout 60s – Tests with calls to fixed line		95.5% at random locations – 97.3% at hotspots	

2.2.7 Fixed broadband QoS

These KPIs are measured by TRA's contractors. Details of the KPIs are provided below:

Table 55 - KPI, targets and measurement methods related to fixed broadband (as measured by TRA) in Bahrain

KPI	Definition	Target	Actual QoS[44]	Measurement method
Average TCP download speed (Mbps)	TCP throughput tests measuring download speeds are conducted at a raw socket level in order to test the full capacity of the connection. The probe is configured to initiate multiple TCP sessions and simultaneously use all of the open sessions for the transmission of data. This effectively "floods" the connection and reports the throughput capacity of the line. The test is conducted using a server endpoint running proprietary	No target	Between 0.8 Mbps and 1.8 Mbps	For each ISP, two Internet connections are purchased and are monitored using Epitiro tools. 2Mbps packages for ADSL, FTTH, WiMAX are considered Standardised tests are conducted from test probes hat have been deployed on each of the broadband connections.
Average TCP upload speed (Mbps)			Between 0.2 Mbps and 1.0 Mbps	

[44] Average between all operators

	software that is hosted in a well peered data centre. The test probe measures the time taken to transfer data and the volume of data transferred in a specific time.			Predefined set of tests (requests sent towards a specified list of public web sites and dedicated servers in Bahrain) each hour of the day, 7 days a week, 52 weeks of the year using standard fixed residential broadband connections supplied by each ISP. Results are stored in a centralised database server.
HTTP cached download speed (kB/s)	The HTTP test makes a request to a specified URL and records the time taken and the amount of data downloaded, from which the speed of the download is derived. Any additional content downloaded is reflected in the captured timings and size of data downloaded. Additionally, the HTTP test can be configured to run in one of two modes of operation: cached and non-cached. When the test downloads from the specified URL in "cached" mode, the speed of the download could be impacted by any caching mechanisms implemented by the network provider.		Between 35 and 65 kB/s	
HTTP non cached download speed (kB/s)			Between 15 and 35 kB/s	
DNS time (mls)	The DNS test records the time taken to resolve a fully qualified domain name to a corresponding IP address. The DNS servers used for the query are the DNS servers (primary and secondary) dynamically assigned by the service provider when the network connection is initiated. Alternatively a specific DNS server can be configured for use during DNS tests. The test probe disables the Windows DNS Client Service responsible for caching the results of DNS requests so that the DNS query is performed on the DNS servers, and not returned from any local cache.		Between 10 mls and 150 mls	
PING time (ms)	The Ping test measures network latency by sending an ICMP echo request to the specified server. The time recorded by test probe is		Between 200 and 290	

	the total round trip time from the request to the echo response being received from the server. The measurements reported are the average time for tests to servers located in Bahrain, Europe and the USA.			

2.2.8 Mobile coverage and QoS

Mobile coverage and QoS measurements have been divided by TRA (and its contractors) into 3 categories: voice and SMS main KPI, dongle KPI, smartphone KPI and others KPI.

The measurement method used for those KPI is the following.

- Handsets and subscriptions must be available to a large public. The HTC Desire was used for Voice and SMS and Samsung Galaxy S3 and iPhone 4S for smartphone tests. Handsets are rotated between teams.
- Measures are conducting by Directique. Measures are conducted incar, indoor, outdoor. For incar measurements, measures are done in towns of more than 50,000 inhabitants, tested zone were divided into equal areas and in smaller towns, measurements were performed on paths that include major roads and constructed zones. For outdoor measurements, 1/3 are dynamic, 2/3 are static in high attendance places. For indoor measurements, there are conducted close to a window or on deep indoor, at any floor: 46% in public places and 54% in offices and residential areas with more measurements in large places.
- Measures are conducted over one month between 9 am and 10 pm every day except Saturday.
- For calls, 70% were mobile to mobile calls, 30% were mobile to fixed calls, 50% of voice measurements are made in car, 25% indoor and 25% outdoor.

a. Voice and SMS KPI

These KPIs are measured by TRA's contractors:

Table 56 - KPI, targets and measurement methods related to Mobile Voice and SMS in Bahrain

KPI	Definition	Target	Actual QoS[45]	Measurement method
Voice - SHR	% of call set-up on first attempt and held for 2 minutes without drop	No target	Average 96.6%	See details above
Voice - PQR	% of call set-up on first attempt and held for 2 minutes without drop and marked 4 (ITU ref P.800 MOS)		Average 94.1%	
Voice – CQR	% of call set-up on first attempt and held for 2 minutes without drop and marked 3 or 4 (ITU ref P.800 MOS)		Average 96.2%	
RS 2	% of SMS not refused when sent out and received within 2 minutes without being altered – SMS with 26 characters		Average 99.6%	
RS 30	% of SMS not refused when sent out and received within 30 seconds without being altered – SMS with 26 characters		Average 99.3%	
RS 15	% of SMS not refused when sent out and received within 15 seconds without being altered – SMS with 26 characters		Average 96.5%	
Average reception SMS delay (sec)			Average 8 s	

b. Dongle KPI

These KPIs are measured by TRA's contractors:

Table 57 - KPI, targets and measurement methods related to mobile data received through a dongle in Bahrain

KPI	Definition	Target	Actual QoS[46]	Measurement method
% of successful radio connections within 1 minute	Connection within 1 minute timeframe without radio drop at hotspot locations	No target	Average 99.2%	See detail above

[45] Average between all operators

[46] Average between all operators

% of successful radio connections within 10 seconds	Connection within 10 seconds timeframe without radio drop at hotpot locations		Average 94.4%	
Average speed in kbps for FTP download	Average throughput once connected applied only to successful data transfer - 20 MB file		4 Mbps	
Max speed in kbps for FTP download	Best throughput recorded for a data transfer measurement - 20 MB file		14.5 Mbps	
Average speed in kbps for FTP upload	Average throughput once connected applied only to successful data transfer - 1 MB file		Not published	
Max speed in kbps for FTP upload	Best throughput recorded for a data transfer measurement - 1 MB file		Not published	
Average speed in kbps for HTTP download	Average throughput once connected applied only to successful data transfer - 20 MB file		13 Mbps	
Max speed in kbps for HTTP download	Best throughput recorded for a data transfer measurement - 20 MB file		4 Mbps	
Max speed in kbps for HTTP upload	Average throughput once connected applied only to successful data transfer - 1 MB file		Not published	
Max speed in kbps for HTTP upload	Best throughput recorded for a data transfer measurement - 1 MB file		Not published	

c. Smartphone KPI

These KPIs are measured by TRA's contractors:

Table 58 - KPI, targets and measurement methods related to mobile data received through smartphones in Bahrain

KPI	Definition	Target	Actual QoS[47]	Measurement method
% of successful radio connections within 1 minute for download FTP	Connection within 1 minute timeframe without radio drop at hotspot locations	No target	98.9%	See detail above

[47] Average between all operators

Average speed in kbps for FTP download	Average throughput once connected applied only to successful data transfer - 20 MB file		3.2 Mbps	
Max speed in kbps for FTP download	Best throughput recorded for a data transfer measurement - 20 MB file		Not published	
St deviation speed in kbps for FTP download	Standard deviation for throughput recorded for a data transfer measurement - 20 MB file		Not published	
% of successful radio connections within 1 minute for FTP upload	Connection within 1 minute timeframe without radio drop at hotspot locations		99.2%	
Average speed in kbps for FTP upload	Average throughput once connected applied only to successful data transfer - 1 MB file		0.7 Mbps	
Max speed in kbps for FTP upload	Best throughput recorded for a data transfer measurement - 1 MB file		Not published	
St deviation speed in kbps for FTP upload	Standard deviation for throughput recorded for a data transfer measurement - 1 MB file		Not published	
% of successful radio connections within 1 minute for download HTTP	Connection within 1 minute timeframe without radio drop at hotspot locations		99.0%	
Average speed in kbps for HTTP download	Average throughput once connected applied only to successful data transfer - 20 MB file		Not published	
Max speed in kbps for HTTP download	Best throughput recorded for a data transfer measurement - 20 MB file		Not published	
St deviation speed in kbps for HTTP download	Standard deviation for throughput recorded for a data transfer measurement - 20 MB file		Not published	
% of successful radio connections within 1 minute for HTTP upload	Connection within 1 minute timeframe without radio drop at hotspot locations		97.8%	
Average speed in kbps for HTTP upload	Average throughput once connected applied only to successful data transfer - 1 MB file		Not published	

Max speed in kbps for HTTP upload	Best throughput recorded for a data transfer measurement - 1 MB file		Not published	
St deviation speed in kbps for HTTP upload	Standard deviation for throughput recorded for a data transfer measurement - 1 MB file		Not published	
% of successful radio connections within 1 minute for Web access	% of successful page loading within 60 s out of the total number of connection attempts		99.1%	
Average download time (sec) – Web	Average delay once connected, applied only to successful data transfer		Not published	
Minimum download time (sec) – Web	Best delay to load a webpage		Not published	
Standard deviation download time (sec) – Web	Standard download time deviation applied only to successful data transfers		Not published	

d. Others KPI

These KPIs are measured by TRA's contractors. The KPIs are defined below:

Table 59 - KPI, targets and measurement methods related to other mobile KPI in Bahrain

KPI	Definition	Target	Actual QoS[48]	Measurement method
Streaming LHV	% of videos set up and held for 2 min without drop – Using YouTube videos	No target	95%	See detail above
Streaming VPQR	% of videos set up and held for 2 min without drop and marked 4 – Using YouTube videos – marks on the basis of global appraisal		20%	
Streaming VCQR	% of videos set up and held for 2 min without drop and marked 3 or 4 – marks on the basis of global appraisal		93%	
Average delay	Average delay between the launch click and the beginning of the sequence		9	
Minimum delay	Minimum delay between the launch click and the beginning of the sequence		3	

[48] Average between all operators

Data coverage – EDGE	Not applicable		Not published	
Data coverage - HSDPA				
Data coverage - UMTS				
Data coverage – HSDPA 2011				

2.2.9 KPI for LLU

TRA's 2011 LLU Reference Offer Order requires Batelco to provide the following KPI. Even if these KPI have never been measured because LLU has not been used by any operator, these KPI have been defined by TRA based on benchmark:

Table 60 - KPI, targets and measurement methods related to LLU in Bahrain

KPI	Definition	Target	Actual QoS[49]	Measurement method
Average LLU validation time	When the incumbent receives an order, it has to validate it	5 working days	LLU is not used by alternative operators for now	Not specified
Average LLU validation time of the 20% longest UMPL validation time		No target		
Average LLU provisioning time for active lines	A distinction between new lines and existing lines is needed	No target		
Average LLU provisioning time of the 20% longest UMPL provisioning time for active lines				
Average LLU provisioning time for non-active lines				
Average LLU provisioning time of the 20% longest UMPL provisioning time for non-active lines				
Average LLU provisioning time for all lines		10 working lines		

[49] Average between all operators

Average LLU provisioning time of the 20% longest LLU provisioning time for all lines		No target		
Total number of new LLU				
Average Tie Cable validation time for all lines	Tie cables are used to connect LLU lines to DSLAM	5 working days		
Average Tie Cable validation time for the 20% longest Tie Cable validation times		No target		
Average Tie Cable provisioning time for all lines		20 working lines		
Average Tie Cable provisioning time of the 20% longest Tie Cable provisioning time for all lines		No target		
Total number of new Tie Cables				
Average restoration time	Not applicable			
Average restoration time of the 20% longest restoration times				
Total number of faults				
Service Node Unbundling Request submission Date/Time	Used for collocation	No target		
Service Node Unbundling Request Validation Completion Date/Time				
Service Node Unbundling Cost requirements completion and submission to OLO Date/Time				
Service Node Unbundling confirmation received from OLO Date/Time				
Service Node Unbundling commencement of make ready work Date/Time				
Service Node Unbundling completion of make ready work Date/Time				

2.3 Organisation and processes

2.3.1 TRA internal organisation

One unique equivalent person is dealing half time with QoS at TRA Bahrain.

Other departments such as the legal department can be involved and can request assistance from this person.

Sometimes, presentations on QoS to consumer associations are conducted.

2.3.2 Process for measurement and reporting of QoS by operators

TRA's 2008 regulation describes the process that must be followed by operators for the measurement and reporting QoS.

Even for operators launching a new service, operators have to produce KPIs every 3 months. They must provide their number of customers.

The following process has to be followed to perform measurement and reporting.

1. Operators must make the measurement.
2. No later than 30 days after the measurement period, operators must submit in electronic format the measurements to TRA and details of observations and calculations.
3. Operators must keep information for at least 1 year.
4. TRA publishes on its websites the results of the measurements no later than 60 days after the measurement period of 3 months. TRA can add explanatory remarks and the name of the service known to subscribers.

From time to time, TRA verifies published KPI through samples.

To report these KPI, TRA provides a sample in its 2008 regulation.

Comparison between operators can remain complex for some KPI because some operators have measurements that are automated and some have not.

2.3.3 Process for measurement and reporting of QoS by TRA

When TRA conducts measurement campaigns (such as for mobile QoS), the measurement campaign is preceded by a workshop with relevant operators to:

- Describe the methodology;
- Conduct demonstration;
- Respond to questions.

This process is followed every year.

2.3.4 Process for LLU KPI

For setting LLU KPI targets, TRA conducted a benchmark and discussed with the incumbent. A consultation document was published and TRA took a decision on these targets.

Batelco is required to publish KPI on a calendar quarter basis, on Batelco's website no later than 5 working days from the end of the relevant calendar quarter. Batelco shall submit, at the same time, the underlying raw data used in the calculations of KPIs to TRA.

3 Canada

Table 61 - Main economic and telecommunications market development indicators for Canada

Country	# of inhabitants[50] (millions)	GDP per capita PPP (US$)[51]	NRA	Penetration rates[52]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Canada	35	42,533	CRTC	48%	75%	32%	++	3

3.1 Policy

3.1.1 Legal context

The basis of CRTC's QoS regulation are given by:

- The Telecommunications Act from 1993 (last amended 2012);

  "Section 7:

  7. It is hereby affirmed that telecommunications performs an essential role in the maintenance of Canada's identity and sovereignty and that the Canadian telecommunications policy has as its objectives

  [...]

  (b) to render reliable and affordable telecommunications services of high quality accessible to Canadians in both urban and rural areas in all regions of Canada"

- Order Issuing a Direction to the CRTC on Implementing the Canadian Telecommunications Policy Objectives from 2006.

[50] United Nations, June 2013

[51] World Bank, 2012 or 2011

[52] ITU, for 2011

3.1.2 QoS Policy

CRTC has a very long experience in monitoring QoS. Today, two main axis of QoS regulation are identified:

- QoS regulation for wholesale offers which is described and discussed in the document “Finalization of quality of service rate rebate plan for competitors” of March 2005;
- QoS regulation for retail offers in areas where competition is limited. This is described and discussed in the Telecom Decisions CRTC 2009-304 "Retail quality of service regime in non-forborne markets for ILECs with over 25,000 NAS" and related CRTC 2009-156 "Revised regulatory requirements to provide information to customers".

With regards to wholesale QoS regulation, CRTC has defined the principles that it follows when defining relevant KPIs:

- QoS indicators to be included should measure performance of the provision of services to competitors;
- QoS indicators to be included should be measured on a competitor-by-competitor basis;
- QoS indicators to be included should be calculated only in respect of an activity that is within the ILEC's control;
- QoS indicators to be included should be such that they do not duplicate activities that are already measured by other indicators;
- Rate rebates should provide sufficient incentive to ensure an ILEC meets its QoS obligations;
- The scheme should maintain just and reasonable rates and must not operate as a penalty mechanism;
- It should be easy to understand, to administer and to audit;
- It should be effective for all competitors that acquire services from the ILEC for which a QoS KPI exists.

With regards to QoS regulation at the retail level, the retail QoS regime was established in the late 1970s to measure the level of service that ILECs provide to subscribers. The purpose of this QoS regulation is to ensure that Canadians receive consistent, high-quality service in areas where the Commission has not forborne from the regulation of local exchange service (non-forborne areas). As CRTC has a long experience in regulating retail QoS, it is interesting to note that:

- CRTC is of the view that the use of customer surveys to monitor retail QoS in non-forborne areas would not provide sufficient detailed and objective information;
- CRTC is of the view that a QoS regime based on complaints received rather than on specific KPI is not appropriate;
- CRTC has eliminated over time some KPIs because they were outdated, difficult to administer, inefficient and onerous to track.

In general, CRTC is following a very soft regulation approach, involving a lot of public discussions and giving stakeholders options to comment on proposals from CRTC. The KPIs mentioned here are indications of the objective of the regulation. However, there are many single decisions for specific operators or for specific regions, taking into account many exceptions.

3.2 KPI and measurement

3.2.1 CRTC's KPIs at retail level

CRTC has reduced - by the decision mentioned above - their KPIs to the ones given in the following table. Measurements have to be done by operators and to be reported to CRTC.

Table 62 - KPI, targets and measurement methods related to retail services in Canada

KPI	Definition	Target	Actual QoS	Measurement method
Installation Appointments Met – Urban	N/A	> 90%	N/A	N/A
Installation Appointments Met – Rural		> 90%		

Installation Appointments Met – Community*		> 90%		
Out-of-Service Trouble Reports Cleared within 24 Hours – Urban		> 80%		
Out-of-Service Trouble Reports Cleared within 48 Hours – Rural		> 80%		
Out-of-Service Trouble Reports Cleared "Remote" within 5 Working Days – Community*		> 90%		
Repair Appointments Met – Urban		> 90%		
Repair Appointments Met – Rural		> 90%		
Repair Appointments Met – Community		> 90%		

3.2.2 CRTC's KPI at wholesale level

Table 63 - KPI, targets and measurement methods related to wholesale services in Canada

KPI	Definition	Target	Actual QoS	Measurement method
Competitor Installation Appointments Met	The total number of installation appointments booked and the number met, with percentage of those met relative to the total booked for customers who are also competitors.	90% or more	N/A	Completed orders are sorted to determine the actual number and percentage completed on the appointed date
New Unbundled Type A and B Loop Order Service Intervals Met	The percentage of time that the due dates for the provisioning of new unbundled type A and B local loop orders are met within the applicable standard service interval. Loop(s) delivered in working condition and according to the loop specifications agreed to by the Industry. Include orders that cannot be completed on an agreed to expedited due date. These orders are counted as missed in the calculation of the indicator. Include in measurement those orders where confirmed due dates are missed due to a lack of facilities. These orders are counted as missed in the calculation of the indicator.	90% or more	N/A	Completed new loop orders/loop migrations/standalone LNP orders are compiled, and the percentage of those that were completed within the applicable standard service interval is reported. Orders for which the requested due date is beyond the applicable standard service interval are excluded from this measure.

	Exclude from the measurement, those local service requests (LSRs) where confirmed due dates are missed due to causes attributable to CLECs or their customers			
Migrated Unbundled Type A and B Loop Order Service Intervals Met	The percentage of time that the due dates for the provisioning of migrated unbundled type A and B local loop orders are met within the applicable standard service interval Loop(s) delivered in working condition and according to the loop specifications agreed to by the Industry. Include orders that cannot be completed on an agreed to expedited due date. These orders are counted as missed in the calculation of the indicator. Include in measurement those orders where confirmed due dates are missed due to a lack of facilities. These orders are counted as missed in the calculation of the indicator. Exclude from the measurement, those local service requests (LSRs) where confirmed due dates are missed due to causes attributable to CLECs or their customers	90% or more	N/A	
Local Number Portability (LNP) Order (Standalone) Service Interval Met	The percentage of time that due dates relating to orders for the standalone porting of numbers are met within the applicable standard service interval. Include orders that cannot be completed on an agreed to expedited due date. These orders are counted as missed in the calculation of the indicator. Exclude from the measurement, those LSRs where confirmed due dates are missed due to causes attributable to CLECs or their customers	90% or more	N/A	
Local Number Portability Order (Standalone) Late Completions	The percentage of orders for standalone porting of numbers that missed the confirmed due date, which are completed within one working day of the confirmed due date	90% or more	N/A	Completed (standalone) local number portability orders that missed their confirmed due dates are compiled, and the

	Standalone porting of numbers only. Include orders not meeting the standard in indicator above Exclude from the measurement, those orders (ports) where confirmed due dates are missed due to causes attributable to CLECs or their customers Orders are considered completed when the ILEC has created a Subscription Version in the Number Portability Administration Centre / Service Management System (NPAC/SMS)			percentage of those that were completed within one working day of their respective confirmed due dates is reported
Competitor Interconnection Trunk Order Service Interval Met	The percentage of time that the agreed upon due date for the turn-up of Local Network Interconnection (LNI) trunks are met. Trunk(s) delivered in working condition and according to industry specifications. Include in measurement those orders where confirmed due dates are missed due to a lack of facilities. These orders are counted as missed in the calculation of the indicator. Include orders that cannot be completed on an agreed to expedited due date. These orders are counted as missed in the calculation of the indicator. Exclude from the measurement, those LSRs where confirmed due dates are missed due to causes attributable to CLECs.	90% or more	N/A	Tracking of due dates met. The due date interval is 20 business days or shorter for line side type trunks, when augments to existing trunk groups are required where facilities exist and 35 business days when new trunk groups are required where no facilities exist.
Interconnection Trunk Order Late Completions	The percentage of orders for the turn-up of Local Network Interconnection (LNI) trunks for which the due date is missed, but which are completed within five working days of the due date. Include all orders captured by indicator above that are not completed by the standard service due date set out in indicator above. The due date means the standard service due date, unless the parties have agreed to an earlier due date.	90% or more	N/A	Completed orders for LNI Trunks which were not completed on their due dates are compiled, and the percentage of those orders which were then completed within the next five working days of their respective due date is reported.

	Exclude from the measurement those LSRs where confirmed due dates are missed due to causes attributable to CLECs or their customers			
Local Service Requests (LSRs) Confirmed Due Dates Met	The percentage of instances that the agreed upon and confirmed due date is met for the provisioning of LSRs other than LSRs for new/migrated loops and for standalone LNP orders measured by indicators above. The due date means the agreed upon and confirmed due date that is different than the standard due date measured under indicators above Include in measurement those LSRs where due dates are missed due to a lack of facilities Exclude from the measurement, those LSRs where agreed upon and confirmed due dates are missed due to causes attributable to CLECs or their customers All constituent elements of an order are to be delivered in working condition	90% or more	N/A	Completed LSRs other than LSRs for new/migrated loops and for standalone LNP orders measured by indicators above are compiled, and the percentage of those which were completed by the agreed upon and confirmed due date is reported. LSRs are to be counted as complete only if all constituent elements of the LSR order are complete.
Unbundled Type A and B Loop Order Late Completions	The percentage of orders for unbundled type A and B loops and their sub-categories, for which the due date as measured in KPI , was missed, but which were completed within one working day of the confirmed due date. The due date means the standard service due date, unless the parties have agreed to another (earlier or later) due date. Include in measurement those orders where due dates are missed due to a lack of facilities. Exclude from the measurement those orders for type A and B loops and their sub-categories where due dates are missed due to causes attributable to CLECs or their customers	90% or more	N/A	Completed loop orders that are not completed by their due dates are compiled, and the percentage of these which were completed within one working day of their respective confirmed due dates is reported.
Unbundled Type A and B Loops Held Orders	The number of orders for type A and B loops and their sub-categories that were not completed on the confirmed due date because of a lack of facilities, expressed as a percentage of loop inward movement. The confirmed due date means the date	0.25% or less	N/A	Orders for unbundled loops are compiled and the percentage of these orders that were not completed on the due date as a result of the lack of facilities is reported.

	assigned by the provisioning ILEC and does not necessarily reflect the standard service interval, nor the customer requested due date. Inward movement means instances in which there is the provisioning of new and the migration of unbundled loops or modifications to existing unbundled loops that require loop facility changes.			
Local Service Request (LSR) Rejection Rate	The percentage of LSRs submitted by CLECs that are returned due to errors identified by the ILECs and based on an error that can be objectively demonstrated and that requires some corrective action that warrants the re-issue of an order.	5% or less		LSRs received and rejected are tracked and reported.
Local Service Request (LSR) Turnaround Time Met	The percentage of instances that the applicable LSR confirmation interval is met, as defined in the Canadian Local Ordering Guidelines (C-LOG), and in accordance with applicable Commission decisions. Measures by following the specific confirmation intervals related to the standard service as defined in the C-LOG. Once an LSC has been issued and a subsequent version of the LSR is issued, the service interval related to the new LSC commences.	90% or more		Local Service Confirmations (LSCs) are compiled, and the percentage of these which were returned within the applicable standard interval, is reported.
Confirmed Due Dates Met - CDN Services and Type C Loops	The percentage of time that the confirmed due dates are met for the provisioning of CDN services and type C loops. Exclude from measurement those requests where confirmed due dates are missed due to causes attributable to competitors or their customers. Requests for expedites included.	90% or more		Completed service requests for CDN services and type C loops are compiled and the percentage of those which were completed by the confirmed due date is reported.
CDN Services and Type C Loops - Late Completion	The percentage of time that CDN services and Type C loop orders for which the due date as measured in Indicator 1.19 was missed, but which were completed within one working day of the confirmed due date. The due date means the standard service due date, unless the parties have agreed to an earlier or later due date. Exclude from measurement those requests where confirmed due dates are missed due to	90% or more		Completed service requests for CDN services and type C loops that are not completed by their due dates are compiled, and the percentage of those which were completed within one working day of their respective confirmed due

	causes attributable to competitors or their customers. Requests for expedites included.			dates is reported.
Competitor Repair Appointments Met	The total number of repair appointments booked and the number met, with percentages of those met relative to the total booked for customers who are also competitors.	90% or more		Completed orders are sorted to determine the actual number and percentage completed on the appointed date.
Competitor Out-of-Service Trouble Reports Cleared within 24 hours	The total of initial out-of-service trouble reports and those cleared within 24 hours. Percentages of those cleared relative to this total. Initial out-of-service trouble reports are reports relative to unbundled loops and their sub-categories as well as LNI trunks.	80% or more		Compilation of trouble report data gathered at each repair bureau.
Competitor Out-of-Service Trouble Report Late Clearances	The percentage of trouble reports for type A and B unbundled loops and their sub-categories as well as LNI trunks that are not cleared within 24 hours (i.e., outside the performance standard of indicator 2.7), but which are cleared within the subsequent 24 hours. Includes out-of-service trouble reports for type A and B unbundled loops and their sub-categories. Excludes a subsequent report related to an open trouble.			Trouble reports are compiled for type A and B unbundled loops and their sub-categories as well as for LNI trunks outside the performance standard of
Migrated Local Loop Completion Notices to Competitors	The total number of completions of migrations of local loops and the number of notifications given on time by the incumbent telephone company to the competitors, notifying that the local loop migration is complete at the facilities of the incumbent telephone company, with the percentage of notifications given on time relative to this total.	90% or more		Completions of migrated local loops and the notifications given on time are sorted to determine the actual numbers and the percentage of notifications given on time.
New Loop Status Provided to Competitors	Percentage of order completion notices and order status reports provided to competitors for new type A and B unbundled loops and their sub-categories. Completion notices are to be provided to competitors as soon as possible following installation of an unbundled loop. Order status reports are to be provided to the	90% or more		New loop orders are compiled and the percentage of those is reported for which the required completion notices and/or order status reports were

	competitor by 5:00 p.m. (in the ILEC serving territory) for uncompleted orders on the day for which the orders are scheduled. Status to be provided by 5:00 p.m. in the ILEC serving territory. Measurement includes the count of completion notifications provided on completed new loops and status provided on non-completed new type A and B unbundled loops and their sub-categories.			provided to the competitor.
Competitor Degraded Trouble Reports Cleared Within 48 hours	The total number of CLECs degraded trouble reports cleared by ILECs within 48 hours of notification. Degraded trouble reports are reports relative to unbundled loops and their sub-categories as well as LNI trunks.	90% or more		Total degraded trouble reports are sorted to determine the actual numbers and the percentage of reports cleared.
Mean Time to Repair (MTTR) - CDN Services and Type C Loops	The mean time to repair (MTTR) on a monthly basis CDN services out-of-service trouble reports received from competitors and completed during the month. Exclude trouble reports not completed on account of causes attributable to competitors or their customers. Calculation of the MTTR does not include customer or competitor unavailable time.	4 h our MTTR or less.		Compilation of monthly trouble report data gathered at each repair bureau.
Service Failures within First 30 days	The percentage of services that have failed and/or degraded within 30 calendar days of delivery of the service. Track results separately for (1) Type A and B unbundled loops and their sub-categories, (2) CDN services and Type C loops, (3) LNI trunks. Report on an aggregate basis for all Type A and B unbundled loops and their sub-categories, CDN services and Type C loops, LNI trunks.			Total of failed and/or degraded trouble reports are sorted to determine the percentage of services that have failed and/or degraded within 30 calendar days of the completion of a new or change service request for the service. The results are expressed as a percentage of the total number of new and change service requests completed the previous month.

3.3 Organisation and processes

3.3.1 CRTC organisation

No information available

3.3.2 Process

At the retail level, retail QoS reports are required to be filed quarterly, and monthly exception reports/action plans are required to be filed whenever a service indicator result is below standard for 3 consecutive months, or 7 out of 12 consecutive months. The ILEC is required to file an exception report identifying the problem and a course of action to rectify the problem. This requirement remains in effect until the quality of service standard is met for three consecutive months.

It is to be noted that ILECs are required to include in their residential telephone directories a summary of the retail QoS regime, including the website addresses where customers can access retail QoS information; in addition the availability of Bill Management Tools (BMT) has to be included.

At the wholesale level, ILECs have to issue QoS results on a quarterly basis and provide it to CRTC within 30 days of the last day of the applicable quarter and make any rate rebate payments (5% of the bill) to competitors within the same 30-day time period. ILECs are required to file with the CRTC, and provide to the relevant competitor, all supporting details associated with the determination of the QoS results and the calculation of the rate rebate amounts.

ILECs have to conduct annual internal audits to verify that procedures and processes are in place for the ILEC to deliver and maintain facilities and services on time to competitors. They also have to retain an external auditor to conduct annual audits of the competition-related QoS, rebates calculations and any rate rebate payments. They have to file a report detailing any issues raised and findings made by the internal or external audits, within 30 days of the completion of the external auditor's report.

4 France

Table 64 - Main economic and telecommunications market development indicators for France

Country	# of inhabitants[53] (millions)	GDP per capita PPP (US$)[54]	NRA	Penetration rates[55]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
France	64	36,104	ARCEP	56%	105%	26%	4	4

4.1 QoS Policy

4.1.1 Legal framework

In France, two documents state ARCEP's role with regard to QoS:

- The European directives which are imposed to each European country (therefore, this applies also to Austria and Germany);
- The French post and electronic communications codes.

There are 5 European directives relevant for the telecommunications sector in Europe (framework, access, authorization, universal service and privacy/data protection) and 4 of them deal with QoS (see section 1.1.1 for more details as the European framework is the same as in Austria).

The French post and electronic communications codes is based on these directives. A specificity of this code is however that it states that operators measure QoS parameters defined by ARCEP (article D. 98-4). This statement poses the question as to whether ARCEP can measure QoS parameters itself. ARCEP has indicated that it held discussions on this article with operators when this article was enforced and identified two options: 1) either to ask the French

[53] United Nations, June 2013

[54] World Bank, 2012 or 2011

[55] ITU, for 2011

parliament a change of this article to let ARCEP conduct measures 2) or to leave this article as it is and govern QoS measures. The 2nd option was preferred by the different parties.

4.1.2 ARCEP QoS policy

ARCEP has never published any QoS policy document. ARCEP's objectives with regards to QoS are set in the law (see above).

However, in the context of the net neutrality debate, ARCEP has published a report in 2012 which details its objective, in particular with regard to QoS monitoring[56]. In this report and with regards to QoS:

- ARCEP reminds that Internet access QoS monitoring is its key objectives[57];
- ARCEP considers that measuring and publishing QoS parameters is sufficient in a transparent and competitive retail market[58];
- This concerns both fixed Internet access and mobile Internet access;
- ARCEP indicates it is important to differentiate what is the responsibility of operators and exogenous factors;
- ARCEP does not intend to use its ability to set minimum QoS parameters. It states that it will do so only if important (long or regular) malfunctions appear.

In parallel, ARCEP has taken several decisions in relation to QoS in the past few years.

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[56] Rapport au Parlement et au Gouvernement sur la neutralité de l'internet, september 2012

[57] *« L'objectif est d'assurer un suivi de la qualité du service d'accès à l'internet dont bénéficient les utilisateurs finals, dans un contexte de croissance des volumes de trafic échangés, de développement de nouveaux services (services spécialisés notamment) ou encore de mise en place de pratiques de gestion de trafic ».*

[58] *« Sur un marché de détail concurrentiel et suffisamment transparent, une telle information conduit alors à augmenter l'incitation pour les opérateurs à maintenir un niveau de qualité suffisant. »*

In 2008, ARCEP took a decision on fixed networks QoS (access and calls excluding Internet access)[59]. In this decision, ARCEP indicated the key principles used to set the related QoS framework:

- Measures should be comparable;
- Measures should be sincere and objectives. This should be achieved by using KPI and measurements methods which are issued by standardisation bodies and by certifying measurement systems;
- The cost associated to measures should be proportionate. This should provide also a better readability for consumers.

In 2009, ARCEP took a decision on number portability[60]. This decision::

- States that QoS must be identical for calls to ported and non ported numbers;
- Sets QoS targets in addition to legal targets already existing;
- Specifies that this can evolve over time.

In 2013, ARCEP took a decision which respct to fixed network QoS (calls and Internet but excluding access which is still regulated through the 2008 decision). In this decision, ARCEP describes:

- Its objectives with respect to Internet access. ARCEP's objectives are to better inform customers in order to improve competition and better inform ARCEP itself to make sure the market works well. If this is not the case ARCEP can decide to set minimum quality of service levels;
- ARCEP's Internet access KPI must be:
    - Comparable. To be comparable, measures must be conducted on clearly identified residential offers (homogeneous offers must be compared together), in a performing technical environment;

[59] Décision n° 2008-1362

[60] Décision n°2009-0637

  - Representatives: from a geographic point of view but also from the point of view of the diversity of access technologies. To make sure measures are representatives, ARCEP intends to conduct its own independent measures;
  - Sincere, i.e. conducting in normal circumstances;
  - Objectives. To be objectives, indicators must be clearly defined like for example IETF's indicators.

- Internet access published indicators must be intelligible. This should be done by producing a comparison between operators and by allowing customers to identify the type of access they use.
- Measures must be transparent. Operators' measures must be certified. Independent experts and customer associations are associated in the technical committee.
- ARCEP intends to set a common reference framework for measures which is defined in a technical committee which includes operators, customer associations, independent experts
- ARCEP's proposed updates to the fixed network calls QoS regulatory framework.

It is to be noted that there is no similar decision related to mobile QoS despite the fact that ARCEP conducts regular measures since 1997. However, in November 2012, ARCEP published a report which reviewed in details all issues related to mobile QoS and mobile coverage (this is conducted every 3 years by ARCEP). In addition to an analysis of mobile QoS and mobile coverage in France, ARCEP describes the objectives of measuring this in this document. These objectives are mainly to control coverage requirements as set out in mobile licences but also to assist local authorities and the government to deploy mobile networks in very rural areas, to better inform consumers. ARCEP concludes this report by proposing recommendations to make operators' coverage maps more robust, to build a reference framework to measure mobile Internet coverage

Regularly, ARCEP conducts market analyses in relation to wholesale markets (broadband, leased lines, voice, etc.). In this context, ARCEP requires SMP

operators to publish KPI that enable to compare the QoS provided to the SMP operators' retail arm and the QoS provided to alternative operators. **SMP broadcast operators do not have to publish any KPI.**

QoS is also monitored in France for universal service providers. Designated universal service providers have to meet minimum level of QoS. However, these are set by the Ministry of Economy, after public consultation and not by ARCEP.

ARCEP's approach to regulate QoS does not rely on targets. ARCEP is only monitoring QoS and is of the view that competition will bring the best level of QoS to customers. Setting minimum QoS levels is seen as the ultimate regulatory tool.

Until now, if KPIs show a low level of QoS or show a discriminatory behaviour, ARCEP holds meeting with stakeholders to improve the situation. If discussions show that a new KPI should be defined then a new KPI can be defined.

To define KPI and measurement frameworks, ARCEP holds regular meetings (every months or less) with operators, independent experts and customer associations.

An example of ARCEP's pragmatic approach is the recent press release published on its website which states that one operator's advertisements on maximum speed it offers are inaccurate[61].

4.2 KPI, measurements and targets

In France, QoS regulation can be split into 7 main categories:

- Fixed access QoS;

[61] Example of ARCEP's pragmatic approach

- Fixed calls QoS;
- Internet QoS;
- Mobile QoS and coverage;
- Universal service QoS (not managed by ARCEP);
- Number portability QoS;
- QoS related to non-discrimination obligations (wholesale QoS).

These categories are considered separately below.

4.2.1 Fixed access QoS – residential customers only

The table below presents the KPI, targets if relevant and measurement methods:

Table 65 - KPI, targets and measurement methods related to QoS of fixed access services in France

KPI	Definition	Target	Actual QoS[62]	Measurement method
Supply time for fixed network access – 95th percentile fastest	Time in calendar days for which 95% of access request are delivered – ETSI EG 202 057-1 Part 5.1 – Direct services only[63] An access request is considered as valid once the customer has given its consent	No target	When it is not needed to go to the customer, 16 calendar days for PSTN, between 11 and 28 for ADSL, 6 days for coax When it is needed to go to the customer: 65 for PSTN, between 38 and 52 for ADSL, between 25 and 38 for coax, 70 for FTTH	Statistics from operators – real values – The measurement is able to distinguish the different definitions used for the customer request date (some operators used the contract date,
Supply time for fixed	Time in calendar days for	No	When it is not needed to	

[62] Minimum and maximum values reported are provided here

[63] Direct service is a service where the operator directly provides the access (LLU, own network)

network access – 50th percentile fastest	which 50% of access request are delivered – ETSI EG 202 057-1 Part 5.1 – Direct services only[64] An access request is considered as valid once the customer has given its consent	target	go to the customer, 4 calendar days for PSTN, between 4 and 11 for ADSL, 1 days for coax When it is needed to go to the customer: 5 for PSTN, between 8 and 16 for ADSL, between 5 and 11 for coax, 24 for FTTH	some the date where the customer express its request). In some cases, due to the law, the time includes period of retraction
Supply time for fixed network access – % of access delivered in less than 20 days	% of access delivered in less than 20 days, calendar days – ETSI EG 202 057-1 Part 5.1 – Direct services only[65] An access request is considered as valid once the customer has given its consent	No target	Very wide	
Supply time for fixed network access – If above percentage is below 80%, average time to supply after 20 days	% of access delivered in less than 20 days, calendar days – ETSI EG 202 057-1 Part 5.1 – Direct services only[66] An access request is considered as valid once the customer has given its consent	No target	Very wide	
Fault report rate per fixed access line - % per line	ETSI EG 202 057 -1 Part 5.4 – Direct services only	No target	4% for PSTN, between 10 and 16% for ADSL, between 2 and 6% for coax and 4% for FTTH	Statistics from operators – real values – Operators are not always able to distinguish
Fault report rate per		No	0% for PSTN, between	

[64] Direct service is a service where the operator directly provides the access (LLU, own network)

[65] Direct service is a service where the operator directly provides the access (LLU, own network)

[66] Direct service is a service where the operator directly provides the access (LLU, own network)

fixed access line for faults occurring 30 days after activation - % per line active activated		target	1 and 2% for ADSL, between 0 and 2% for coax and 1% for FTTH	total faults and partial faults – Also young operators show higher fault levels
Fault repair time for fixed access line for 95th of faults	ETSI EG 202 057 -1 Part 5.5 – Direct services only	No target	Between 6 and 16 days	Statistics from operators – real values – Operators can have different measurement methods
Fault repair time for fixed access line - % of fault repaired within 48 hours		No target	Between 70 and 88%	
Response time for admin/billing enquiries – average picked up time for a human operator	ETSI EG 202 057 -1 Part 5.8 – Direct services only - Customer service is technical service but if operators cannot split administrative and commercial, then it will have to be indicated	No target	Between 50 s and 7 minutes (depends on operators)	Statistics from operators – real values –
Response time for admin/billing enquiries – Percentage of calls picked up after the vocal server (if any)	ETSI EG 202 057 -1 Part 5.8 – Direct services only – Customer service is technical service but if operators cannot split administrative and commercial, then it will have to be indicated	No target	Between 75% and 90%	Statistics from operators – real values –
Bill correctness complaints	ETSI EG 202 057 -1 Part 5.11 % of complaints related to billing out of total number of customers	No target	Max 0.08%	Statistics from operators – real values – Operators can have different measurement methods
Customer complaints resolution time	ETSI EG 202 057 -1 Part 5.10 % of complaints solved by a customer service and which does not generate a second call -	No target	Between 85% and 96%	

4.2.2 Fixed calls QoS

The table below presents the KPI, targets if relevant and measurement methods with respect to fixed calls QoS:

Table 66 - KPI, targets and measurement methods related to QoS of fixed calls in France

KPI	Definition	Target	Actual QoS[67]	Measurement method
Successful call ratio for national calls	5-1-3 of ETSI EG 202 057-2 An unsuccessful call is: a call with unattended message, a pick up time above 35 sec, a call interrupted before 3 min (1min for international calls), a busy ringing returned to the caller, an unavailability of tone observed.	No target	Between 99.7% and 99.9%	Tests calls are made with a dedicated infrastructure (technical sites, dedicated capacity and probes) Several network architecture are possible to provide a service for one type of access and therefore, the main architecture of the operator must be considered Test lines must be representatives in terms of technology and type (LLU lines should be used in LLU is the main wholesale offer used by the operator) ARCEP specifies the number of test lines (between 3 and 6) and specifies where they should be located (even if operators have to agree on the same areas). For international calls, they have to be tested to 3 out of the 5 biggest destinations Tests are done continuously (at least over 150 “full” days per half year) with 2 calls per hours between 7 am and 11:59 pm. A “full day” is a day with measures every hour and normal conditions (outside 31st of December and 1st of January, modem failure, planned maintenance period, line

[67] Minimum and maximum values reported are provided here

				test failure is the responsibility is from a wholesale operator, failure of the test system.
Successful call ratio for international calls			Between 99.0% and 99.8%	
Call setup time for national calls	Average time between the moment necessary numbering information is received by the network and the moment the end-user receives the ring tone (para 5-2-3 of ETSI EG 202 057-2). Unsuccessful calls are excluded.		Between 1 and 2 sec	
Call setup time for international calls			Between 3 and 10 sec	
Speech quality for a national call	ITU-T P.862.1 (PESQ)		Between 4.2 and 4.4	

4.2.3 Internet access QoS

These KPI are not yet fully precised since a technical committee is currently working on their definition (actual QoS levels are not yet published):

Table 67 - KPI, targets and measurement methods related to QoS of Internet access services in France

KPI	Definition	Target	Actual QoS[68]	Measurement method
Download speed – Median value, 5th percentile value and 95th percentile value	Data transfer rate measured with a "close" distant test server (i.e. with	No target	Not published	The test line should not be used outside the test (even if test may be done in the future with IPTV traffic in parallel). Measure is

[68] Minimum and maximum values reported are provided here

Upload speed - Median value, 5th percentile value and 95th percentile value	limited control from third parties) and a "far" distant server (i.e. outside France and close to important Internet peer points).			conducting once every hour at a random time (if not during an hour, measures should be conducted in the next hour) The minimum number of full days (with measures at every hour excluding the regular maintenance hour which is in the night and common to all operators) measured over 6 months Complementary measures are conducted by ARCEP with test servers. These measures are conducted by end-users with a software and enable to verify the representativeness of operators' measures and to measure KPI for operators that are too small (e.g. satellite)
Web usage - Median value, 5th percentile value and 95th percentile value	Average time to load web pages on a list of web pages previously selected and regularly updated (with large audience and including public services websites)			
On line video usage - Median value, 5th percentile value and 95th percentile value	Availability measures or video quality measures for videos watched on a list of platforms previously selected and regularly updated			
Peer to peer usage - Median value, 5th percentile value and 95th percentile value	Time or speed to load a file on peer-to-peer platforms			
Delay - Median value, 5th percentile value and 95th percentile value	Time to go back when packets are regularly sent			
Packet Loss - Median value, 5th percentile value and 95th percentile value	Packets that are not transmitted after a certain period of time			

Operators have to provide indicators per line tested (there can be several categories of lines and several lines per category), per test server or web server, over the day and during peak hours.

4.2.4 Mobile QoS and coverage

Even if operators have to conduct measures to make sure their coverage maps are accurate, most of mobile QoS and coverage measures are conducted by ARCEP (via suppliers).

About mobile voice QoS, the following KPI are tested:

Table 68 - KPI, targets and measurement methods related to mobile voice QoS in France

KPI	Definition	Target	Actual QoS[69]	Measurement method
% of calls maintained more than 2 minutes	See name of KPI. 4 levels of QoS can be attributed to audio quality: very poor, poor, acceptable, perfect	No target	96.35% outdoor – 95.16% indoor – 95.46% in car	Tests are conducted with a Samsung SII phone in the following configurations: pedestrian outdoor, pedestrian indoor (room with window), in car and train. Different cities are tested. Tests are conducted from 9 to 21 from Monday to Friday and busy hours have been preferred at 40% (12h-13h and 18h-21h). 2/3 of tests are conducted in cities and 1/3 outside the cities. Operators are not aware of the locations and time of tests. Test calls are 40% fixed to mobile and 60% to mobile to fixed (for audio quality, the lowest level of QoS attributed by the two callers is retained). Callers are trained, supervised. Tests are conducted before real tests. Callers are changed and
% of calls maintained more than 2 minutes and perfect audio quality			95.49% outdoor - 93.77% indoor – 94.54% in car	
% of calls maintained more than 2 minutes and acceptable audio quality			95.78% outdoor - 94.73% indoor – 94.90% in car	
% of calls maintained more than 5 minutes			94,34% outdoor – 93.59% indoor – 91.88% in car	
% of calls maintained more than 5 minutes and perfect audio quality			93,38% outdoor – 91.84% indoor –	

[69] Average value between operators' reported values

			90.56% in car	consistency of results if often verified. Operators are compared to each other.
% of calls maintained more than 5 minutes and acceptable audio quality			93,87% outdoor – 92.85% indoor – 91.04%	

About mobile data QoS, the following KPI are tested for data:

Table 69 - KPI, targets and measurement methods related to mobile data QoS in France

KPI	Definition	Target	Actual QoS[70]	Measurement method
% of SMS received	On-net SMS with 26 characters, in a static mode. SMS is supposed to be received if it is received before two minutes and content is exact.	No target	98.8% outdoor and indoor	Tests are conducted with a Samsung SII, iPhone 4 phones and iPad3 (iPad3 is used for Download and upload only). One commercial offer per operator is used. Different cities are tested. Tests are conducted from 9 to 21 from Monday to Friday and busy hours have been preferred at 40% (12h-13h and 18h-21h). 2/3 of tests are conducted in city centres and 1/3 outside the city centres. 50% of measures are conducted in-door (30% in private areas) and 50% outdoors. Operators are not aware of the locations and time of tests.
% of SMS received within 30 seconds	On-net SMS with 26 characters, in a static mode. SMS is supposed to be received if content is exact.		97.2% outdoor – 97.1% indoor	
% of MMS received	On-net MMS with 26 characters and 50kB picture, in a static mode. SMS is supposed to be received if it is received before 5 minutes and content is exact.		96.3% outdoor – 95.5% indoor	
% of MMS received within 3 minutes	On-net MMS with 26 characters and		95.8% outdoor -	

[70] Average between all operators

	50kB picture, in a static mode. SMS is supposed to be received if content is exact.		95.0% indoor	Test calls are 40% fixed to mobile and 60% to mobile to fixed (for audio quality, the lowest level of QoS attributed by the two callers is retained). Callers are trained, supervised. Tests are conducted before real tests. Callers are changed and consistency of results if often verified. The platform “EQUAL” is used for web browsing and download/upload indicators. Operators are compared to each other. Data study conducted by AFDTech and voice study conducted by LCC.
Quality of video streaming	A 2 minute video is watched and the quality of the video is ranked (4 levels).		89.1% outdoor – 87.4% indoor	
Quality of video streaming – Perfect quality			86.7% outdoor – 84.7% indoor	
Quality of video streaming – Correct quality			87.6% outdoor – 85.5% indoor	
% of web pages downloaded within 30 seconds	10 websites pages are selected.		94.9% outdoor – 94% indoor	
% of Web browsing with success	10 websites pages are selected. A web browsing failure is defined as: more than 30 seconds for a given site, web browsing blocked in a 5 minute web browsing session, more than 10% of website pages not downloaded.		77.8% outdoor – 74.9% indoor	
% of correct file uploaded within 2 minutes	Time to upload a 1MB file		Between 83.5% and 95.8%	
Upload speed– 90% percentile	Speed to upload a 1 MB file		Between 231 kbps and 322 kbps	
Upload speed – 50% percentile	Speed to upload a 1 MB file		Between 846 kbps and 1125 kbps	
Upload speed – 10% percentile	Speed to upload a 1 MB file		Between 1562 kbps and 2291	

			kbps	
% of correct file download within 2 minutes	Time to download a 5MB file		Between 93.8% and 97.5%	
Download speed – 90% percentile	Speed to download a 5 MB file		Between 668 kbps and 1299 kbps	
Download speed – 50% percentile	Speed to download a 5 MB file		Between 2391 kbps and 3855 kbps	
Download speed – 10% percentile	Speed to download a 5 MB file		Between 4819 kbps and 6682 kbps	

ARCEP has also conducted tests with fixed probes (with the supplier Directique). The goal of this study is to assess the impact of some parameters on data QoS (like where the probe is installed in a given building). Following KPI are measured:

Table 70 - KPI, targets and measurement methods related to mobile data QoS in France / Tests with probes

KPI	Definition	Target	Actual QoS	Measurement method
Speed at the application level	No further definition	No target	Not published	Tests are conducted by launching a download file and by measuring the amount of data transmitted within 10 seconds (rather than transferring a file of a certain file and assessing the duration). Tests are conducted in several buildings in France and at each building, test probes are installed in different locations within the building to measure various RSCP (indicator which measures propagation attenuation) and Ec/I0 parameter. The Ec/I0 parameter is a very important parameter in 3G which refers to the portion of signal which is usable: it is the ratio between signal strength (Ec) and noise floor/interference (I0). ARCEP wants indeed to
Technical speed				
Peak sped				
Rate of transaction failures (% of measures where the speed at the application level is below 200kbps)				

				see how the KPI listed here move when Ec/I0 changes. 6 measures per probe, per operator and per hour between 24 august and 12 November. 4 probes per location, each probe connected to 4 mobile with Android. Need to change SIM card often to avoid “fair use” impact. 5 experiments are conducted: • Experiment 0 enables to calibrate the study by measuring how speed at the application level evolves over the week, over the year, over a day per operator; • Experiment 1 shows the influence of the probe location within a building (deeper and deeper) on technical speeds; • Experiment 2 measures the influence of the level of RSCP and Ic/E0 on technical speed; • Experiment 3 compares application speeds at different densities and locations in France; Experiment 4 assesses the influence of the Ec/I0 parameter on the speed at the application level.

For coverage, the following KPIs are considered for 2G and 3G[71]:

Table 71 - KPI, targets and measurement methods related to mobile coverage in France

KPI	Definition	Target	Actual QoS	Measurement method
Accessibility rate in the	Ring tone must be	No target	Not	ARCEP has defined a reference

[71] See « referentiel de mesure de la couverture des services de radiotelephonie mobile »

whole administrative area	obtained in less than 20 seconds.		available	framework that operators must follow to verify the accuracy of their network coverage maps. This reference framework is available to anybody. Measures are conducted outdoor from a mobile towards a fixed from 9am to 9pm. A representative mobile phone must be used. For each measure, GPS location must be registered. In one administrative area (called “canton”), measures must be conducted in front of each city council of the “canton”. At least 1000 measures are needed and over 150 km. Statistical precision must be 1% (used to be 3%). For coverage, the RSSI level is measured in 2G on the BCCH channel and the RSCP level is measured in 3G on the CPICH channel. It is necessary to make sure that the mobile connects to the considered operator network. A curve showing the relationship between the RSSI/RSCP level and the probability to maintain a call more than one minute is built.
Accessibility rate in areas supposed to be covered				
Accessibility rate in areas supposed to be not covered				
% of reliability of the area supposed to be covered	Covered means Accessibility + call maintained more than 1 minute. The percentage of reliability is the probability of a call to be maintained more than 1 minute which is obtained from the RSSI/RSCP level and from a curve showing the relationship between the RSSI/RSCP level and the probability.	95% for 3G	96.7%	
% of reliability of the area supposed to be not covered			Not available	
% of reliability of the whole area				

For mobile Internet coverage, ARCEP is planning to build a reference framework[72]. ARCEP has not yet set this reference framework but is of the view

[72] This is required by the “arête” of the 15 January 2010

that the following KPI could be considered: maximum speed, access to websites, connection quality. ARCEP reminds that this relates to coverage and not QoS and therefore, effect of traffic congestion should be neutralised. More precisely, ARCEP states the two following indicators could be used:

- Level of power;
- Channel Quality Indicators which are both independent of the traffic.

4.2.5 Universal service provider QoS[73]

For the telephone service:

Table 72 - KPI, targets and measurement methods related to universal service (fixed telephony) in France

KPI	Definition	Target	Actual QoS	Measurement method
Supply time for fixed network access – 99% fastest	Time in calendar days for which 99% of access request are delivered – ETSI EG 202 057-1 Part 5.1 – Direct services only[74]	No target	Not applicable	Statistics from operators – Are excluded cases where the end-user asks for a longer period or where the end-user does not provide access.
Supply time for fixed network access – 95% fastest	Time in calendar days for which 95% of access request are delivered – ETSI EG 202 057-1 Part 5.1 – Direct services only[75]	8 calendar days	14	
Supply time for fixed network access – 50% fastest	Time in calendar days for which 50% of access request are delivered – ETSI	No target	Not applicable	

[73] Arrêté du 1er décembre 2009 portant désignation de l'opérateur chargé de fournir la composante du service universel prévue au 1o de l'article L. 35-1 du code des postes et des communications électroniques (service téléphonique)

[74] Direct service is a service where the operator directly provides the access (LLU, own network)

[75] Direct service is a service where the operator directly provides the access (LLU, own network)

	EG 202 057-1 Part 5.1 – Direct services only[76]			
Supply time for fixed network access – % of access delivered in less than the contracted duration (in days)	% of access delivered in less than 20 days, calendar days – ETSI EG 202 057-1 Part 5.1 – Direct services only[77]	No target	Not applicable	
Supply time for fixed network access – If above percentage is below 80%, average time to supply after the contracted duration	% of access delivered in less than 20 days, calendar days – ETSI EG 202 057-1 Part 5.1 – Direct services only[78]	No target	Not applicable	
Fault report rate per fixed access line - % per line	ETSI EG 202 057 -1 Part 5.4 – Direct services only	7.5%	5.9%	Statistics from operators
Fault repair time for fixed access line for 80% of faults	ETSI EG 202 057 -1 Part 5.5 – Direct services only	85% should be repaired within the timeline set by ETSI	Average 53 hours	Statistics from operators – Are excluded cases where the end-user does not provide access
Fault repair time for fixed access line for 85% of faults				
Fault repair time for fixed access line for 95% of faults				
Fault repair time for fixed access line – For faults repair within the contracted time				
Fault repair time for fixed access line – For faults repair after the contracted time				
Unsuccessful call ratio for national calls	5-1-3 of the guide ETSI EG 202 057-2	0.7%	0.33%	Statistics from operators

[76] Direct service is a service where the operator directly provides the access (LLU, own network)

[77] Direct service is a service where the operator directly provides the access (LLU, own network)

[78] Direct service is a service where the operator directly provides the access (LLU, own network)

Unsuccessful call ratio for international calls		No target	Not applicable	
Call setup time	Average time between the moment necessary numbering information is received by the network and the moment the end-user receives the ring tone (para 5-2-3 of ETSI EG 202 057-2).	2.9 seconds	2.2 seconds	Statistics from operators
Complaints rate	% of complaints received by the operator according to the operator evaluation methodology	Below 7%	5.1%	Statistics from operators
Bill correctness complaints	ETSI EG 202 057 -1 Part 5.11 % of complaints related to billing out of total number of customers	0.08%	0.05%	Statistics from operators
Billing customer complaints resolution time – 80% fastest	ETSI EG 202 057 -1 Part 5.10 % of complaints solved by a customer service	5 days	5.7	
Billing customer complaints resolution time – 95% fastest		15 days	18.5	
Customer complaints resolution time – 80% fastest	ETSI EG 202 057 -1 Part 5.10	5 days	5.7	
Customer complaints resolution time – 95% fastest	% of complaints solved by a customer service	15 days	18.5	

For leased lines:

Table 73 - KPI, targets and measurement methods related to universal service (leased lines) in France

KPI	Definition	Target	Actual QoS	Measurement method
Supply time for analogue leased lines	No definition	45 days	Not available	Not specified
Availability of Access Network for digital leased lines	No definition	Max 20 hours and max 13 hours with option		
Fault repair time	No definition	10 working hours and 4 hours as an option		

For telephone enquiry services[79]:

Table 74 - KPI, targets and measurement methods related to universal service (enquiry services) QoS in France

KPI	Definition	Target	Actual QoS	Measurement method
Call centre response time	ETSI EG 202057-1	10 seconds for 90% of treated calls	Not specified	Not specified
% of calls served		97% of calls received		
% of exact answers		97% of treated calls		

For directory services[80]:

[79] Arrêté du 18 novembre 2009 portant désignation de l'opérateur chargé de fournir le service de renseignements de la composante du service universel prévue au 2° de l'article L. 35-1 du code des postes et des communications électroniques

[80] Arrêté du 6 décembre 2012 portant désignation de l'opérateur chargé de fournir l'annuaire d'abonnés sous forme imprimée au titre de la composante du service universel prévue au 2° de l'article L. 35-1 du code des postes et des communications électroniques

Table 75 - KPI, targets and measurement methods related to universal service (directory services) QoS in France

KPI	Definition	Target	Actual QoS	Measurement method
Rate of exact information	Exact information is measured through the number of complaints from users	Below 0.01% of the number of fixed and mobile customers communicated	No detail	No detail

4.2.6 Number portability QoS

Table 76 - KPI, targets and measurement methods related to number portability KPI in France

KPI	Definition	Target	Actual QoS	Measurement method
Time for the receiving operator to transfer the request to the donor operator	N/A	5 days before the portability date for residential and 7 days for businesses	N/A	Not specified
Time for the donor operator to confirm the date and the fact that the request is eligible		3 days after having received the request for residential and 5 days for businesses		
Unavailability of the service		Max 4 hours		

4.2.7 QoS related to non-discrimination obligations (wholesale KPI)

For QoS regulation related to the application of the non-discrimination obligation, there is no target. Measures are very specific to Orange and therefore not described. The following KPI are measured for WLR/retail line rental, Line sharing/Bitstream/retail DSL lines, Full LLU/Naked DSL bitstream/Retail Naked DSL:

Table 77 – KPI for wholesale residential services provided by the incumbent in France

KPI
Average lead time when the lines need to be constructed;

% of lines delivered within the contractual lead time (in calendar days) when lines need to be constructed;
Number and % of lines delivered after 30 days for lines that need to be constructed;
Average lead time when the lines are existing;
% of lines delivered within the contractual lead time (in calendar days) when lines are existing;
Number and % of lines delivered after 30 days for existing lines;
Percentage of faults on lines delivered in the last calendar month;
% of faults repaired with the contractual time;
% of faults caused by Orange over a year and per line;
% of faults caused by other than Orange over a year and per line;
Number of faults caused by Orange and not repaired with 3 working days.

For lines with enhanced QoS (professional offers with shorter fault repair time):

Table 78 – KPI for wholesale enhanced quality services provided by the incumbent in France

KPI
Average lead time;
% of lines delivered within the contractual lead time (in calendar days);
Number and % of lines delivered after 30 days;
% of faults repaired with the contractual time;
% of faults caused by Orange over a year and per line;
% of faults caused by other than Orange over a year and per line;
Number of faults caused by Orange and not repaired within 4 hours.

Figure 4 – Actual QoS measures

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	Offres résidentielles, service téléphonique commuté		A Revente de l'abonnement	B Abonnement FT
	Délai pertinent de livraison		*8 jours calendaires, ou RV client*	
	Délai pertinent de relève des dérangements		*48h jours ouvrables*	
	Ligne existante			
1	Délais moyen de livraison	jours	2,6	6,2
2	Taux de respect du délai de 8 jours calendaires	%	94,1%	80,7%
3	Nombre de commandes livrées en plus de 30 jours calendaires	nb	60	3 391
4				
	Ligne avec construction			
5	Délais moyen de livraison	jours	21,1	16,7
6	Taux de respect du délai de 8 jours calendaires	%	4,5%	37,2%
7	Nombre de commandes livrées en plus de 30 jours calendaires	nb	182	8 091
8				
	Ligne existante ou avec construction			
9	Taux de signalisations sur les parcs livrés depuis moins d'un mois - cause FT	%	1,7%	0,7%
10	Taux de respect des délais contractuels de relève	%	44,4%	48,3%
11	Taux de signalisations sur le parc par ligne et par an cause France Télécom	%	7,4%	6,7%
12	Taux de signalisations sur le parc par ligne et par an autres causes	%	3,1%	2,8%
13	Nombre de dérangements de resp FT non relevés en 3 jours ouvrables	nb	2 035	28 688

	Offre résidentielle, accès DSL pour ligne avec RTC		A Dégroupage partiel	B Offre régionale résidentielle DSL access	C Détail DSL résidentiel Orange
	Délai pertinent de livraison		*7 jours ouvrés*		*8 jours calendaires*
	Délai pertinent de relève des dérangements		*J+1 (jours ouvrables)*		
14	Délais moyen de livraison	jours	3,3	2,9	7,4
15	Taux de respect du délai de 7 j ouvrés ou 8 j calendaires	%	94,9%	92,6%	78,1%
16	Nombre de commandes livrées en plus de 30 jours calendaires	nb	8	7	528
17					
18	Taux de signalisations sur les parcs livrés depuis moins d'un mois - cause FT	%	2,4%	3,3%	0,8%
19	Taux de respect des délais contractuels de relève	%	54,4%	40,8%	29,5%
20	Taux de signalisations sur le parc par ligne et par an cause France Télécom	%	1,6%	4,7%	8,0%
21	Taux de signalisations sur le parc par ligne et par an autres causes	%	4,3%	10,3%	6,4%
22	Nombre de dérangements de resp FT non relevés en 3 jours ouvrables	nb	213	304	11 684

	Offres résidentielles, accès DSL pour ligne sans RTC sans GTR 4h		A Dégroupage total	B Offre régionale résidentielle DSL access Only	C Détail Orange DSL nu
	Délai pertinent de livraison		*7, 8 jours ouvrés (ou RV client en construction)*		*8 jours calendaires*
	Délai pertinent de relève des dérangements		*J+2 (j ouvrables)*		
	Ligne existante				
23	Délais moyen de livraison	jours	3,3	3,8	5,8
24	Taux de respect du délai de 7 jours ouvrés, ou 8 j calendaires	%	95,3%	89,3%	83,8%
25	Nombre de commandes livrées en plus de 30 jours calendaires	nb	278	100	502
26					
	Ligne avec construction				
27	Délais moyen de livraison	jours	7,6	10,4	16,7
28	Taux de respect du délai de 8 jours ouvrés ou 8 j calendaires	%	72,8%	59,5%	36,7%
29	Nombre de commandes livrées en plus de 30 jours calendaires	nb	1 409	275	1 429
30					
	Ligne existante ou avec construction				
31	% de respect de réalisation de livraison avec portabilité dans la même journée	%	92,9%		
32	Taux de signalisations sur les parcs livrés depuis moins d'un mois - cause FT	%	4,8%	6,3%	8,2%
33	Taux de respect des délais contractuels de relève	%	55,0%	48,9%	33,2%
34	Taux de signalisations sur le parc par ligne et par an cause France Télécom	%	5,2%	12,1%	14,4%
35	Taux de signalisations sur le parc par ligne et par an autres causes	%	6,0%	10,1%	7,4%
36	Nombre de dérangements de resp FT non relevés en 3 jours ouvrables	nb	14 667	6 016	34 312

	Offres professionnelles, accès à toute la paire de cuivre avec GTR 4h		A Revente de l'abonnement - marché PRO avec GTR 4h	B Dégroupage Total avec GTR 4H	C Offre Numéris avec GTR 4H	D Offre régionaleDSL pro avec GTR 4H	E Détail DSL pro avec GTR 4H
	Délai pertinent de livraison		*8 j calend ou RV client*	*7, 8 j ouvrés ou RV client*	*8 j calend ou RV client*	*14 jours calendaires ou RV client*	
	Délai pertinent de relève des dérangements		*4 heures*				
37	Délais moyen de livraison	jours	7,8	13,3	28,0	32,4	64,6
38	Tx de respect du délai de 7, 8 j ouvrés, 8 j calend (col A,B,C), ou RdV client (col D,E)	%	78,4%	45,3%	20,0%	80,2%	97,0%
39	Nombre de commandes livrées en plus de 30 jours calendaires	nb	21	470	499		
40							
41	Taux de signalisations sur production de moins de 30 jours pour cause FT	%	0,7%	3,1%	ND	4,7%	ND
42	Taux de respect des délais contractuels de relève	%	71,1%	81,8%	17,6%	85,2%	67,8%
43	Taux de signalisations sur le parc par ligne et par an cause France Télécom	%	3,1%	4,6%	ND	16,8%	0,5%
44	Taux de signalisations sur le parc par ligne et par an autres causes	%	3,4%	6,7%	ND	10,7%	0,3%
45	Nombre de dérangements de la responsabilité FT non relevés en 4 heures	Nb	181	89	1 130	220	12

Source: Orange

For leased lines:

Table 79 – KPI for wholesale leased lines services provided by the incumbent in France

KPI
Average lead time;
% of lines delivered within the contractual lead time (in calendar days);
Average fault repair time for leased lines;
Percentage of faults repaired within the contractual fault repair time.

Figure 5 – Actual QoS Measures for leased lines

		A	B	E	C	D
		WHOLESALE			RETAIL	
		LA LPT tous débits	CE2O feuilles et troncs	Déport Optique	LL Transfix tous débits	Ethernet Link (pour livr : liens optiques seuls)
1	délai moyen de production	71,2	79,3	18,0	66,6	-
2	Taux de Respect de la Date Contractuelle de Livraison	67,2%	87,0%	100,0%	91,9%	-
3	délai moyen de rétablissement.	7h 17	2h 22	-	4h 15	1h 50
4	Taux de Respect du Délai Contractuel de Rétablissement	76,9%	88,6%	-	81,8%	93,2%

Source: Orange

It is important to note that definitions can vary between retail KPI and wholesale KPI. For example, lead time is measured:

- Between the moment the wholesale operators' request is accepted and Orange sends a message to say the line is activated at the wholesale level;
- Between the customer requests being entered in the IT system and the activation of the line at the retail level.

ARCEP also uses other KPI (for FTTH wholesale offers for example) but these are only used internally and during multilateral meetings with operators. They are not publicly available.

4.3 Organisation and processes

4.3.1 ARCEP internal organisation

ARCEP internal organisation with respect to QoS is relatively straightforward. 4 full time employees are dealing with QoS:

- 1 is responsible for mobile coverage (within the “mobile access and relationships with network suppliers” department and the “mobile frequency” unit);
- 1 is responsible for mobile QoS (within the “mobile access and relationships with network suppliers” department and the “mobile frequency” unit);
- 1 is responsible for fixed access and calls QoS (within the “electronic communications sector and relationships with consumers” department and the “capacity services and fixed telephony market” unit);
- 1 is responsible for fixed broadband QoS (within the “electronic communications sector and relationships with consumers” department and the “capacity services and fixed telephony market” unit).
- They have managers who partly deal with QoS.

All these employees are engineers. Their role is to work with external consultants and suppliers, to animate working groups with operators and to prepare report and publications on QoS. For fixed broadband QoS, a specific competence in statistics is required given the amount of data which will be collected.

Looking forward, ARCEP has explained that a potential target organisation would be to have all people working on QoS in a single unit.

There is no specific internal process.

Budget for external consultants/suppliers work on QoS is several hundreds of thousands of Euros.

4.3.2 Process for fixed access QoS

Measuring fixed access QoS is imposed to all operators with more than 100,000 customers. Other operators can do it voluntarily. ARCEP notes that publishing

operators' KPI can be a way to advertise operators and therefore, small operators may not benefit from not publishing their KPI.

ARCEP has used the following process to set the list of KPI:

- Preliminary working group sessions in 2006 to determine the list of KPI, how they should be measured and reported;
- First public consultation in end 2007;
- Second consultation in early 2008;
- Decision at end 2008;
- All operators have all agreed to use one single company to certify measures/statistics;
- Between end 2008 and half 2010, operators have worked together with ARCEP to establish a reference framework which specifies in detail the conditions under which measures must be conducted. This period of time was an "observation period" during which measures were not published;
- First published measured/statistics occurred when the framework was set in June 2010.

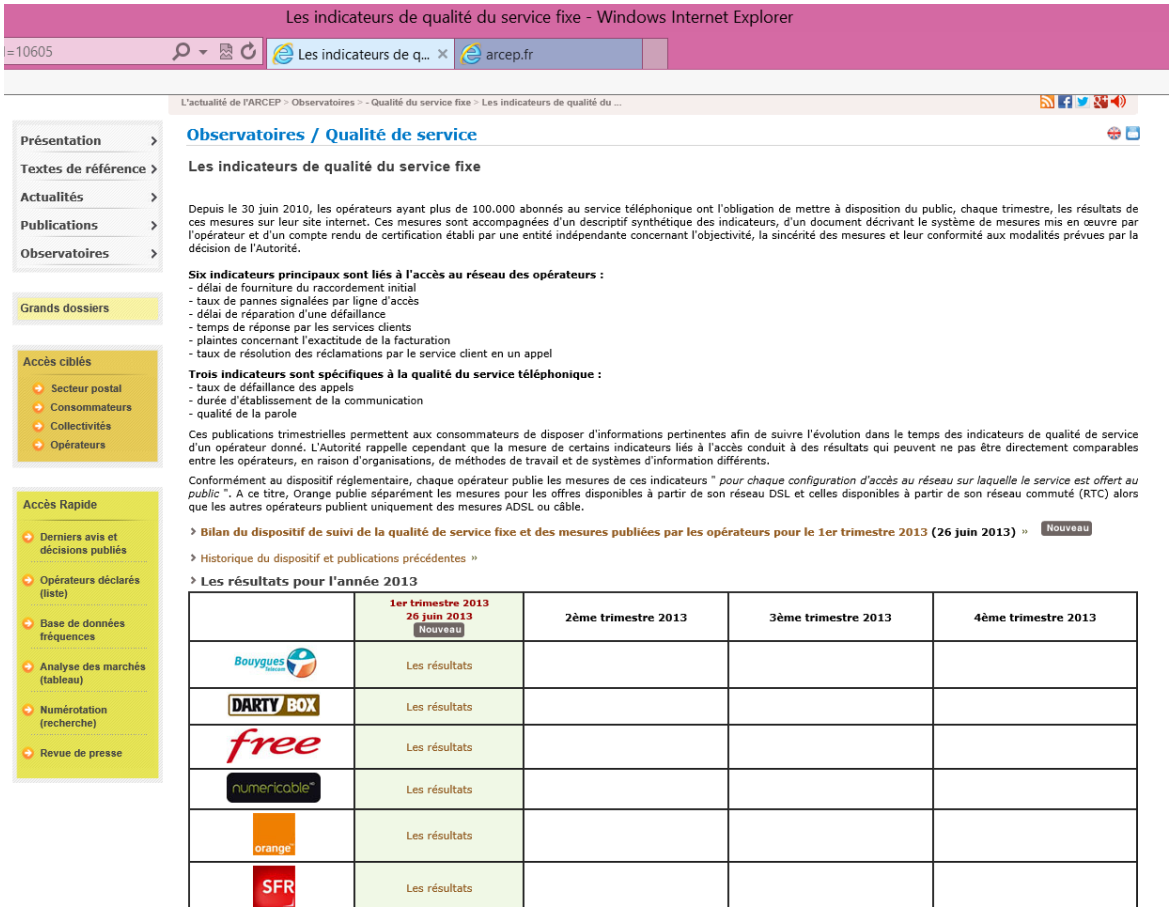
Since the framework has been set, the following process is followed:

- Operators produce statistics every 3 months;
- Operators have to publish results on their website 1 month after the period of measures. KPI are published for each type of access (DSL, FTTH, etc.). Operators generally add comments to the KPI to facilitate the understanding of results or to explain why differences can be observed from an operator to another;
- Operators have to provide in parallel ARCEP with a detailed documentation of their measurement system;
- Operators have to make their measures certified (by the company called "SGS");

- In parallel a working group (ARCEP and operators) meets every 3 months to discuss potential changes to the framework (which prevents ARCEP from issuing new decisions).

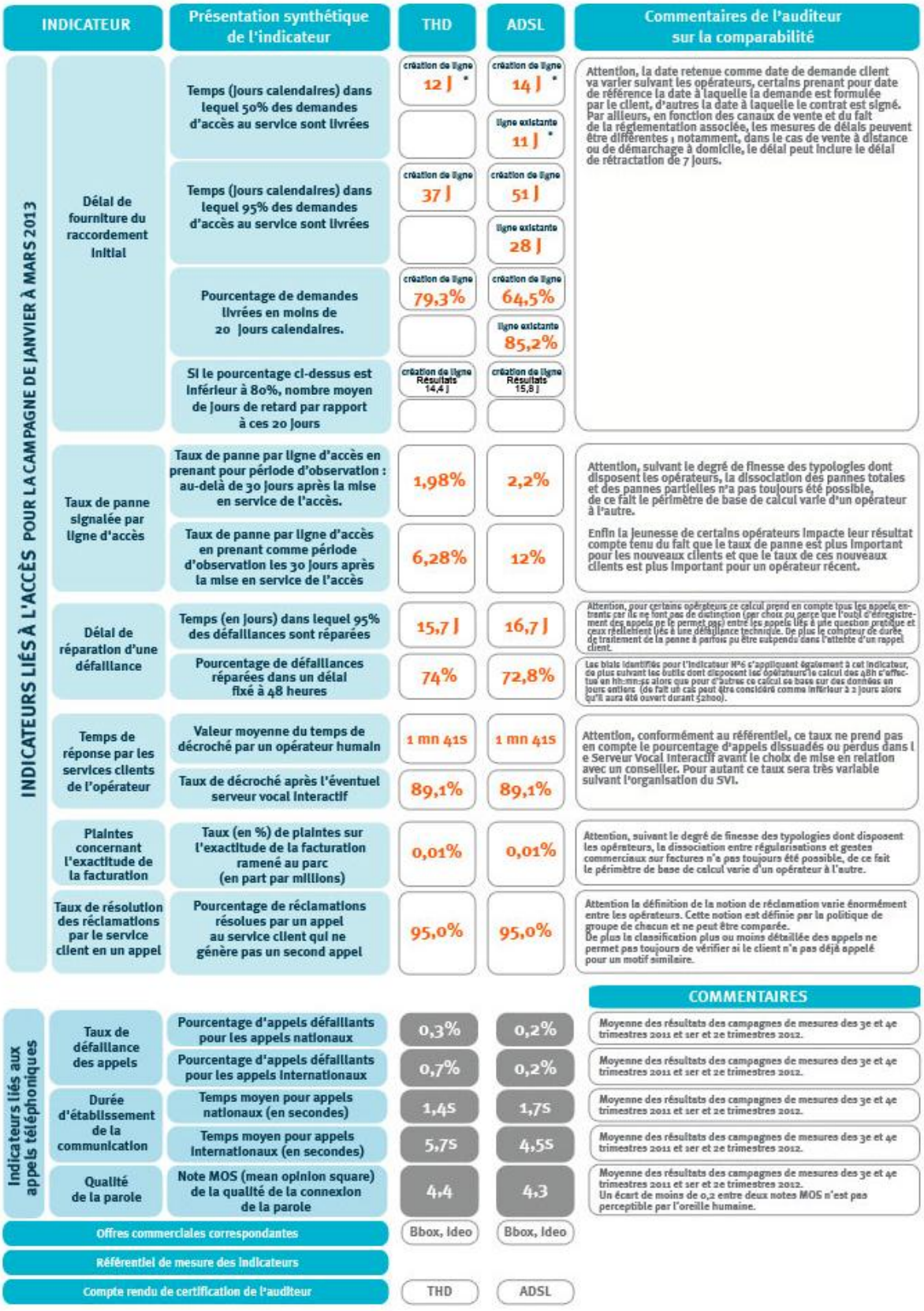
ARCEP publishes the links (URL) where operators publish their own KPI (see Figure 6 and Figure 7).

Figure 6 – Web page where ARCEP lists operators' web pages where QoS results are visible



Source : ARCEP

Figure 7 – QoS results published by one operator



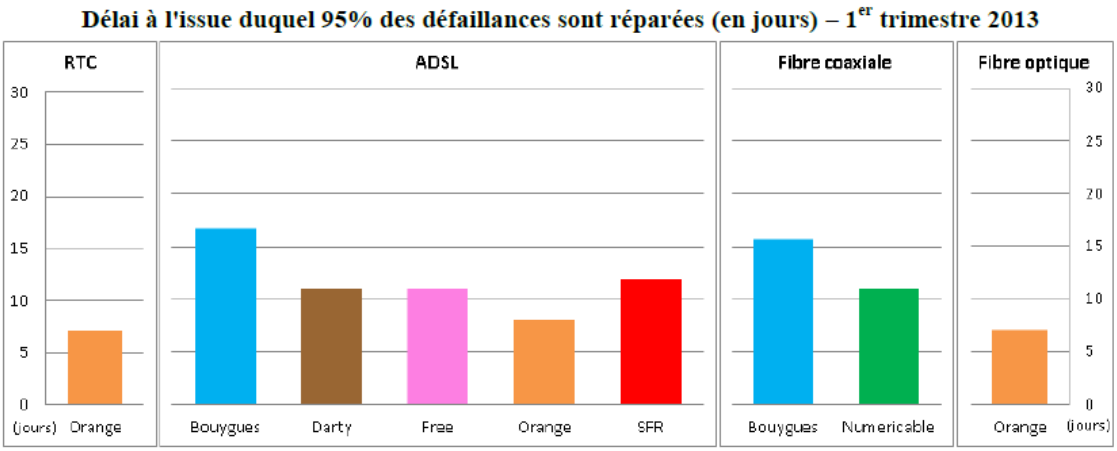
INDICATEUR		Présentation synthétique de l'indicateur	THD	ADSL	Commentaires de l'auditeur sur la comparabilité
INDICATEURS LIÉS À L'ACCÈS POUR LA CAMPAGNE DE JANVIER À MARS 2013	Délai de fourniture du raccordement initial	Temps (jours calendaires) dans lequel 50% des demandes d'accès au service sont livrées	création de ligne 12 j *	création de ligne 14 j *	Attention, la date retenue comme date de demande client va varier suivant les opérateurs, certains prenant pour date de référence la date à laquelle la demande est formulée par le client, d'autres la date à laquelle le contrat est signé. Par ailleurs, en fonction des canaux de vente et du fait de la réglementation associée, les mesures de délais peuvent être différentes ; notamment, dans le cas de vente à distance ou de démarchage à domicile, le délai peut inclure le délai de rétractation de 7 jours.
				ligne existante 11 j *	
		Temps (jours calendaires) dans lequel 95% des demandes d'accès au service sont livrées	création de ligne 37 j	création de ligne 51 j	
				ligne existante 28 j	
		Pourcentage de demandes livrées en moins de 20 jours calendaires.	création de ligne 79,3%	création de ligne 64,5%	
				ligne existante 85,2%	
		SI le pourcentage ci-dessus est inférieur à 80%, nombre moyen de jours de retard par rapport à ces 20 jours	création de ligne Résultats 14,4 j	création de ligne Résultats 15,8 j	
	Taux de panne signalée par ligne d'accès	Taux de panne par ligne d'accès en prenant pour période d'observation : au-delà de 30 jours après la mise en service de l'accès.	1,98%	2,2%	Attention, suivant le degré de finesse des typologies dont disposent les opérateurs, la dissociation des pannes totales et des pannes partielles n'a pas toujours été possible, de ce fait le périmètre de base de calcul varie d'un opérateur à l'autre. Enfin la jeunesse de certains opérateurs impacte leur résultat compte tenu du fait que le taux de panne est plus important pour les nouveaux clients et que le taux de ces nouveaux clients est plus important pour un opérateur récent.
		Taux de panne par ligne d'accès en prenant comme période d'observation les 30 jours après la mise en service de l'accès	6,28%	12%	
	Délai de réparation d'une défaillance	Temps (en jours) dans lequel 95% des défaillances sont réparées	15,7 j	16,7 j	Attention, pour certains opérateurs ce calcul prend en compte tous les appels entrants car ils ne font pas de distinction (par choix ou parce que l'outil d'enregistrement des appels ne le permet pas) entre les appels liés à une question pratique et ceux réellement liés à une défaillance technique. De plus le compteur de durée de traitement de la panne a parfois pu être suspendu dans l'attente d'un rappel client.
		Pourcentage de défaillances réparées dans un délai fixé à 48 heures	74%	72,8%	Les biais identifiés pour l'indicateur N°6 s'appliquent également à cet indicateur, de plus suivant les outils dont disposent les opérateurs le calcul des 48h s'effectue en hh:mm:ss alors que pour d'autres ce calcul se base sur des données en jours entiers (de fait un cas peut être considéré comme inférieur à 2 jours alors qu'il aura été ouvert durant 52h00).
	Temps de réponse par les services clients de l'opérateur	Valeur moyenne du temps de décroché par un opérateur humain	1 mn 41s	1 mn 41s	Attention, conformément au référentiel, ce taux ne prend pas en compte le pourcentage d'appels dissuadés ou perdus dans le Serveur Vocal Interactif avant le choix de mise en relation avec un conseiller. Pour autant ce taux sera très variable suivant l'organisation du SVI.
		Taux de décroché après l'éventuel serveur vocal interactif	89,1%	89,1%	
	Plaintes concernant l'exactitude de la facturation	Taux (en %) de plaintes sur l'exactitude de la facturation ramené au parc (en part par millions)	0,01%	0,01%	Attention, suivant le degré de finesse des typologies dont disposent les opérateurs, la dissociation entre régularisations et gestes commerciaux sur factures n'a pas toujours été possible, de ce fait le périmètre de base de calcul varie d'un opérateur à l'autre.
	Taux de résolution des réclamations par le service client en un appel	Pourcentage de réclamations résolues par un appel au service client qui ne génère pas un second appel	95,0%	95,0%	Attention la définition de la notion de réclamation varie énormément entre les opérateurs. Cette notion est définie par la politique de groupe de chacun et ne peut être comparée. De plus la classification plus ou moins détaillée des appels ne permet pas toujours de vérifier si le client n'a pas déjà appelé pour un motif similaire.
					COMMENTAIRES
Indicateurs liés aux appels téléphoniques	Taux de défaillance des appels	Pourcentage d'appels défaillants pour les appels nationaux	0,3%	0,2%	Moyenne des résultats des campagnes de mesures des 3e et 4e trimestres 2011 et 1er et 2e trimestres 2012.
		Pourcentage d'appels défaillants pour les appels internationaux	0,7%	0,2%	Moyenne des résultats des campagnes de mesures des 3e et 4e trimestres 2011 et 1er et 2e trimestres 2012.
	Durée d'établissement de la communication	Temps moyen pour appels nationaux (en secondes)	1,4s	1,7s	Moyenne des résultats des campagnes de mesures des 3e et 4e trimestres 2011 et 1er et 2e trimestres 2012.
		Temps moyen pour appels internationaux (en secondes)	5,7s	4,5s	Moyenne des résultats des campagnes de mesures des 3e et 4e trimestres 2011 et 1er et 2e trimestres 2012.
	Qualité de la parole	Note MOS (mean opinion square) de la qualité de la connexion de la parole	4,4	4,3	Moyenne des résultats des campagnes de mesures des 3e et 4e trimestres 2011 et 1er et 2e trimestres 2012. Un écart de moins de 0,2 entre deux notes MOS n'est pas perceptible par l'oreille humaine.
Offres commerciales correspondantes			Bbox, Ideo	Bbox, Ideo	
Référentiel de mesure des indicateurs					
Compte rendu de certification de l'auditeur			THD	ADSL	

Source : Bouygues Telecom

NB: ARCEP defines the exact format of publication and operators have to mention certain predefined sentences on their report.

Also, ARCEP publishes every year a full report comparing operators. It is to be noted that no comparison between operators is conducted for KPI related to call centres as measurement methods can be very different from an operator to another (ARCEP only shows min and max values). In this report, ARCEP provides explanation for differences (for example, it explains that FTTH lead time is longer because processes are new). The aim is really to educate the end-user to QoS.

Figure 8 – Extract of ARCEP's annual report



Source : ARCEP

4.3.3 Process for fixed calls QoS

The only difference with the fixed access QoS relates to the regular measurement/publication process:

- Operators conduct measurement campaigns every 6 months. These measures must be conducted over more than 150 days;
- Operators have to send results to ARCEP 20 days after the 6 month period. This includes: the gross data measured, synthetic results and the certification of their measures (the company "IP Label" certifies measures);
- Operators have to publish results on their website 3 months and a half after the 6 month period. Operators generally add comments to the KPI

to facilitate the understanding of results or to explain why differences can be observed from an operator to another;

- In parallel a working group (ARCEP and operators) meets every 3 months to discuss potential changes to the framework (which prevent ARCEP from issuing new decisions).

NB: Until now, main issue was international calls KPI because international calls KPI were showing significant differences between operators.

4.3.4 Process for fixed broadband QoS

Measuring fixed broadband QoS is imposed on all operators with more than 100,000 customers. Other operators can do it voluntarily.

ARCEP has used the following process to set the list of KPI:

- Preliminary working group sessions in 2011 to determine the list of KPI, how they should be measured and reported. This working group was made of operators, independent experts, consumer associations, network suppliers and content providers;
- First public consultation in end 2011;
- Second consultation in mid 2012;
- Decision in early 2013;
- A technical committee made of operators, consumer associations and independent experts is set up in 2013 to define a reference framework to conduct measures;
- An external independent supplier will be selected by operators to conduct measures and install required equipments;
- In the 3 first quarters of 2013, operators will conduct measures but results will not be published.
- When the framework will be set (end of 2013), the following process will be followed:
- Measurements campaigns will be conducted every 6 months;

- Results will be provided to ARCEP 20 days after the end of the half year. Operators will provide gross data and synthetic results which include the % of lines represented by test lines, the types of modems used as samples and the types of offers representatives of the offer provided over test lines. They will also demonstrate that measures are certified;
- Before any publication, ARCEP will meet the different operators in the technical committee;
- Operators will have to publish results on their website 3 months and a half after the 6 month period. Operators will be able to add comments to the KPI to facilitate the understanding of results or to explain why differences can be observed from an operator to another. If measures are not sufficiently comparable, ARCEP may decide not to publish them. KPIs will be published for the following categories:
    - Short DSL line (attenuation at 300 kHz is 21dB);
    - Medium DSL line (attenuation at 300 kHz is between 21dB and 43 dB);
    - Long DSL line (attenuation at 300 kHz is above 43 dB);
    - Cable TV at 100 Mbps;
    - Cable TV at 30 Mbps;
    - FTTH;
    - Radio electric local loop;
    - Satellite.
- In parallel a working group (ARCEP and operators) will meet every 3 months to discuss potential changes to the framework (which prevents ARCEP from issuing new decisions). Larger meetings are organised every 6 months;
- The reference framework will be regularly updated;
- ARCEP will publish every year a synthesis of the measures;
- ARCEP will be able to conduct complementary measurement campaigns.

4.3.5 Process for non discrimination QoS (wholesale)

ARCEP has not defined a specific process to deal with QoS at the wholesale level.

The incumbent has to publish on its website KPI every month. Not all KPI are published on the website. Many KPI are only provided to operators during multilateral meetings.

Because published KPI do not necessarily enable to conduct a precise comparison between retail and wholesale offers, ARCEP intends to improve the comparability (to make sure published KPI are measured within the same scope).

These KPI enable to observe potential issues and request changes during meetings with Orange.

4.3.6 Process for mobile QoS

As measures are conducted by ARCEP, there is no defined process. Mobile QoS is measured every year but the publication of the report does not happen at the same time every year. Measures are conducted over 3 months and the final report can be published 5 or 6 months later.

Operators pay these measurements campaigns.

The following companies are generally selected by ARCEP to conduct measurement campaigns:

- AFD for data;
- LCC for voice.

4.3.7 Process for mobile coverage

Contrary to mobile QoS, a strict process has been defined by ARCEP to measure mobile coverage:

- Each year, at mid-May, ARCEP specifies the list of “canton” where measures must be done (“cantons” are a small administrative division);
- ARCEP selects an external and independent contractor to conduct verification measures at end June of each year. Operators are involved in the choice;
- Operators provide coverage map on the 1st of July;
- The verification measures are conducted by the contractor on the second half of the year;
- Results of the verification measures are provided before half February of the following year;
- ARCEP transmits results to operators;
- Within maximum 3 months, operators provide a report describing consistency or inconsistencies between coverage maps and verification measures. Operators also describe measures they intend to take to remedy inconsistencies;
- Before the 1st of July, operators publish an analysis of the validity of their coverage maps.

Approximately every 3 years, ARCEP conducts a thorough analysis of mobile QoS and mobile coverage in which it establishes recommendations looking forward. For example, in this last analysis, ARCEP proposed to conduct further in-building analyses and to test MVNO QoS.

4.3.8 Process for universal service QoS

The universal service provider has to follow the following process:

- Every quarter, it provides ARCEP and the relevant minister with its quarterly KPI at least one month after the end of the quarter;
- Every year, it provides ARCEP and the relevant minister with its annual KPI at least 3 months after the end of the quarter. These must be published on its website too;

- Every quarter, it states what has been done to measure QoS KPI;
- Every quarter, it must detail at a regional level the most extreme situations with regards to lead time and repair time;
- If requested by the minister or ARCEP:
    - It provides data used to produce KPI;
    - Reasons for not respecting minimal QoS level.

In case the universal service provider is not able to meet the 8 calendar day lead time or the 48 hour repair time, it has to pay the end-user an amount equal to 2 monthly subscriptions.

Every 3 years a public consultation is issued to identify the criteria that should be used to select the universal service provider (including with regard to QoS).

4.3.9 Process for number portability QoS

There is no process for number portability QoS. Results are not published.

5 Germany

Table 80 - Main economic and telecommunications market development indicators for Germany

Country	# of inhabitants[81] (millions)	GDP per capita PPP[82] (US$)	NRA	Penetration rates[83]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Germany	83	40,901	BNA	63%	132%	32%	3	4

5.1 Policy

5.1.1 Legal context

There are 5 European directives relevant for the telecommunications sector in Europe (framework, access, authorization, universal service and privacy/data protection) and 4 of them discuss about QoS (see section 1.1.1 for more details as the European framework is the same as in Austria).

With the amendment to the Telecommunications Act in May 2012, the legislator created a broad range of instruments to enhance transparency in the telecommunications market. These include, for instance, broader provisions governing the content of contracts concluded with consumers (Section 43a of the Telecommunications Act) as well as the provisions governing general publication requirements (Section 45n of the Telecommunications Act). The aim of these measures is to facilitate objective decision-making for consumers in a competitive market.

5.1.1 QoS policy

Since the amended Telecommunications Act entered into force, the BNetzA has examined in particular the level of information supplied by providers in relation to **fixed and mobile broadband access**. As such, the focus has been placed on the difference between contractually agreed data transmission rates and the data transmission rates actually provided.

[81] United Nations, June 2013

[82] World Bank, 2012

[83] ITU, for 2011

In parallel to the measurements study, the BNetzA also analysed the contractual provisions on the speeds actually achieved both in the fixed network and mobile networks.

The BNetzA is currently developing a QoS regulatory framework. For this purpose, the BNetzA conducted a study on the service quality of broadband access lines from June to December 2012. This study is currently repeated until end of 2013 (June to December 2013).

Based on the findings of the measurements study and on the analysis of the content of standard contracts the BNetzA has published key elements to promote transparency for consumers and, on measuring procedures to provide a basis for the debate.

It is important to note that BNetzA is one of the rare regulatory authorities not conducting mobile QoS and coverage measurements. Indeed, in Germany, 2 specialised private companies and one independent foundation are conducting measures:

- Net Check for the website Chip Online (voice and data using the ETSI test Kepler)[84];
- P3 Communications for the newspaper Connect (voice and data in vehicles – voice quality measured with POLQA);
- Stiftung Warentest which goal is to promote consumers' rights. It conducted one single measurement campaign for 2 weeks in 2011 (voice and data in vehicles – voice quality measured with ITU-T P.862.1 PESQ).

Also, there is no universal service KPI in Germany.

[84] Following KPIs are tested:

- For voice: unsuccessful connection rate, rate of calls interrupted, time to establish a call, MOS, percentage of calls below a certain level of QoS.
- For data: success rate, average speed and share of measurements above 1Mbps, rate of web pages fully downloaded, time to load a page.

5.2 KPI and measurement

5.2.1 BNetzA's KPIs and measurements

Since BNetzA is currently evaluating a QoS framework with undergoing discussions with all stakeholders there are no defined KPIs or measurements for the time being. First results and decisions are expected for mid of 2014.

5.2.2 BNetzA's Study on Broadband Access

The BNetzA conducted a study on the service quality of broadband access lines from June to December 2012.

The quality of Internet access service was evaluated by use of an integrated measuring concept that used a combination of two components.

- A measurement platform (consisting of monitoring units at 26 sites throughout Germany and several server systems which served as, among other things, counter test points for the data measurements) conducted measurements in a fully-controlled measuring environment.
- The (upload and download) data transfer rate of fixed Internet access services was measured as part of the measurements conducted by end customers. For this, the BNetzA invited end customers between June and December to measure the data transfer rate of their Internet connection using special software available at the website of the Initiative Netzqualität (German website). The fundamental accuracy of the values obtained using the software application was monitored on an on-going basis by randomly comparing the values generated by the two methods. The results are based on a total of 226,543 valid measurements gathered between July and December 2012.

As a first step, the study examined the parameters which decisively influence the quality of Internet access service for the end customer, namely:

- The actual data transfer rate of the connection;
- The traffic management in the concentration network and core network.

The actual data transfer rate depends on the individual end customer’s Internet access connection and was therefore measured by individual end customer software measurement via the website. By contrast, the traffic management is

influenced by the network design and service profile settings of the provider and requires detailed measurements. Thus, these parameters where measured by use of the measurement platform. Traffic management aspects investigated are the temporal distribution of the actual data transfer rates, transfer times and the usability of standard applications.

As a second step, the study examined the question whether the data transfer rate changes when, in the case of bundled products consisting of Internet, VoIP and IPTV, other products are used at the same time as the Internet connection. To determine this, specific test measurements were conducted on the measurement platform: the data transfer rate of the Internet connection was first ascertained and then compared with the data transfer rate that can be achieved when VoIP and/or IPTV are used at the same time that data is being transmitted.

Following this, the question was addressed how end users can be put in a position where they themselves can reliably check the performance of their own broadband access. Selected technical methods for end-user measurements were compared with one another.

The study also examined the question whether there is evidence that data packets are handled differently on a systematic basis depending on the application, source, destination or content (question of net neutrality). The tests being conducted in this connection are still on-going. The findings from these activities will be taken account of in the work of BNetzA on net neutrality.

5.2.3 Number portability

Any service interruption when porting the number from the previous operator to the new operator must be less than 1 calendar day for fixed and mobile number portability. In cases where this cannot be achieved, the previous operator is obliged to continue the service and the customer affected by this will pay only 50% of the fixed monthly charges (pro rata for the period until porting is completed).

Operators can exclude number portability in their contracts with customers.

5.3 Organisation and processes

BNetzA currently does not wish to disclose details on their internal organization and processes regarding QoS regulation - they are not finally decided for the time being.

However, the following measuring procedures are planned to promote transparency for customers about data transmission rate (speeds):

- Information should be provided when customers conclude contracts;
- Checks should be carried out by the provider immediately after the access has been activated;
- Technical checks should be carried out by the consumer during use (measuring procedure) and the possibility of obtaining technical data on the basic product performance before a contract is signed;
- For non-flat rates offers:
    - Provision of information on an on-going basis about the data volume used;
    - Information on usage details to ensure consumers can switch providers.

6 Ghana

Table 81 - Main economic and telecommunications market development indicators for Ghana

Country	# of inhabitants[85] (millions)	GDP per capita PPP[86] (US$)	NRA	Penetration rates[87]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Ghana	26	2,048	NCA	1%	85%	0.3%	1	6

6.1 Policy

6.1.1 Legal context

The NCA Electronic Communications ACT 775, 2008 provides the guidelines for NCA's action with regard to QoS:

"The Authority shall specify (a) quality of service indicators for classes of public telecommunications service, and (b) the means to enforce a licensee's compliance with its stated quality of service standards, including measures by which a licensee shall compensate users adversely affected by a failure to provide electronic communications service in accordance with the standards."

Annex D1 of the licenses specifies the QoS obligations whereas Annex D2 provides the KPIs and their targets.

By a Legislative Instrument QoS parameters as well as their targets can be amended and gazetted by NCA. The NCA can make results available to the public via its website or the national newspapers.

6.1.2 QoS policy

NCA's QoS policy applies to mobile operators only. The requirements set out in Annex D1 of the mobile operators licenses provide NCA with the power to control, audit and give directions of nearly unlimited nature to the operators. In summary the QoS policy is focussed on:

[85] United Nations, June 2013

[86] World Bank, 2012

[87] ITU, for 2011

- Quality of Service:
    - operators must install measurement devices complying to ITU standards;
    - network capacity must be sufficient to guarantee certain level of QoS;
    - operators may be forced to pay for third party audits.
- network integrity in emergency situations;
- pre-sales statement of charges;
- itemized billing requirements;
- customer compensation in case of failure to provide service. NCA has developed a very sophisticated compensation plan. However, the mobile operator may present a different scheme and ask for approval.

NCA's QoS policy is based on services rather than technology or networks but the framework can be updated to take into account changes in technology.

According to Annex D2 of the licenses NCA imposes KPI and target values. Subscription in Ghana is usually prepaid; therefore issues of customer terminating their contracts are out of scope.

The NCA takes active part in the activities of ITU-T SG 12 and actually provides the chairman of this Study Group on QoS, QoE and Network Performance.

6.2 KPI, measurements and targets

6.2.1 KPI measurements

Operators report on Service performance and NCA performs independent field test. Audits of the operators' results are done by conducting monthly data verification exercises. Verification that KPI are measured consistently between operators is done by trend analysis of on-site verification data and by independent monitoring. Interaction with workshops is also facilitated through common workshops.

NCA avails log files for operators own analysis and reports. NCA is open to discount failures which are out of control of the operator and may be due to measurement tool.

Measurements are conducted on monthly basis. NCA can make results available to the public via its website or the national newspapers. Operators should keep the details of their QoS data for 3 months.

In summary, measurements are to be performed by the network operators. NCA has the right to request third party audits at the expense of the network operators. Measurement equipment of the operators shall comply with ITU standards.

6.2.2 NCA's KPIS

Table 82 - KPI, targets and measurement methods in Ghana

KPI	Definition	Target	Actual QoS	Measurement method
Service Delivery for prepaid customers	Waiting time after payment and insertion of SIM Card for service activation - this depends on availability of service coverage within the customer's area of interest	< 1 hour	Not published	Statistics
Service Delivery for post-paid customers	% of cases with waiting time for services exceeding 7 days - this depends on availability of service coverage within the customer's area of interest	< 10%		
Traffic Channel Congestion	Probability of failure of accessing traffic channel(s) during call connections	≤ 1%		See below
Signalling (SDCCH) Congestion Rate	Probability of failure of accessing a stand-alone dedicated control channel during call set up	≤ 1%		See below
Probability of Blocking		≤ 2%		N/A
Point of Interconnection Congestion	At wholesale level only			less than 80% utilization
Billing Accuracy	Complaints per 1000 bills	≤ 0.5%		Statistics

Billing Standard	Billing begins when the receiving network indicates that the call is connected, and ends when either the originating or receiving network indicates that the call is completed	Billing records must reflect prompt recognition of connect and disconnect signals.		Statistics
Call set up time	Period of time elapsing from the sending of a complete destination address (target telephone number) to the setting up of a call	< 10 seconds in 95% of cases		See below
Call completion rate	Probability that a call has, after being successfully set up, to be maintained during a period of time, ending normally, i.e., according to the user's will	≥ 70%		See below
Call drop rate	Probability of a call terminating without any of the users' will - Total number of dropped calls divided by Total number of sampled customers	≤ 3 %		See below
Meantime for repairs	95% of all critical faults should be cleared within 6 hours. 90% - of all non-critical faults should be cleared within 24 hours. also at wholesale level	The meantime to repair Critical Fault shall not be more than six hours. Critical Fault being a situation where 30% or more subscribers or circuits are inoperative. All other fault situations shall be deemed non-critical faults and meantime for repair shall not be more than twenty-four (24) hours.		Statistics
Calls to customer service		> 95% of the calls should be successful.		Statistics

Customer satisfaction on overall quality of service	Number of answers as good quality/Number of customers interviewed. (For conducting customer interview or opinion polls refer to ITU-T Rec. E.125).	≥ 75%		A total of 5000 mobile users are sampled in the 168 districts to achieve the 95% confidence level at an error margin of + 1.39%. The stratified sample allocation to each of the five Operators is per respective market share and network availability in the districts of Ghana. This captures the consumer ratings of service attributes and expectations.

The table below describes NCA's measurement approach (for Call set up time, Call completion rate, Call drop rate, Traffic Channel Congestion Signalling (SDCCH) Congestion Rate):

Table 83 – Description of NCA's mobile QoS measurement method

Benchmark item	Definition
Design of the measure	A measurement script controls call sequence, start time, duration, guard interval etc.
Conditions of the measure	• 2 test phones per operator located in a fixed measurement system; • Test speed is limited to 40km/hr. Tests are conducted in two sessions namely a) morning session (9am-2pm) in business districts. b) evening session (5pm-10pm) in residential areas.
Sample chosen	Test is conducted in all 10 regions of the country. Each region is test-driven on cluster (aggregation of suburbs) basis at least twice in a year (quarterly or half-

	yearly).
Number of measures	Densely populated areas (e.g Greater Accra Region and Ashanti Region may require approx. 2000 call counts per test phone per network where as less populated areas may require 1500.
Rating	% of received samples
Experimenter profile	2 teams of 2 engineers each with experience of this kind of measures.
Results and analysis	• Measurement files in .qmd file format; • KPIs, except Call setup time, are calculated as percentage (%) of total call counts obtained

6.2.3 KPIs related to number portability[88]

KPI	Definition	Target	Actual QoS	Measurement method
Time between the transmission of an authorization request and the transmission of authorization response	N/A	4 hours	N/A	Not specified
For porting requests that reach their final status in each calendar month, % of authorization response that are transmitted within 15 minutes from the authorization request		90%		
For porting requests that reach their final status in each calendar month, % of authorization response that are transmitted within 30 minutes from the authorization request		95%		
Time between the transmission of		4 hours		

[88] Source : MNP directive on QoS

an authorization response being approved and the instruction request				
For porting requests that reach their final status in each calendar month, % of instruction request that are transmitted within 15 minutes from the authorization response being approved		90%		
For porting requests that reach their final status in each calendar month, % of instruction request that are transmitted within 30 minutes from the authorization response being approved		95%		
For porting requests that reach their final status in each calendar month, % of instruction response with simultaneous termination of accounts that are transmitted within 15 minutes from the instruction request		90%		
Time to alert its personnel of failure for any connection with number portability service provider		1 hour		

6.3 Organisation and processes

6.3.1 Staff

The QoS Unit of the Regulatory Administration Division is composed by seven staff who are assigned to QoS monitoring duties, however two engineers per monitoring can be on the field at any given time.

Their roles are:

- Present memo in request for logistics (i.e airtime and fuel);
- Loading of airtime on test phones;

- Measurement taking;
- Export and import of measurement data;
- Post-processing and data reporting.

The entire team monitoring is involved in compliance and enforcement. The setting and review of QoS regulatory framework is with the lead expert on QoS in collaboration with the Legal Division.

The different departments interact with each other on QoS monitoring via a mailing system and meetings.

6.3.1 Processes

There are no precise processes.

Tighter QoS regulation and more QoS monitoring equipment for more intense monitoring of all services are envisaged to improve regulation on QoS.

New services and coverages are given at least 6 months to fine tune. Operators are given three months to improve the service in a locality after which fines are applied from then if licence obligations are in violations. Also, penalties are waived in localities where poor service is due to bad coverage by asking defaulting operators to build a site. Failure to adhere to the directive will imply that the sanction will apply.

Defaulting operators may be asked to compensate customers (who can be identified depending on parameters) with a plan that is approved by the Regulator. For parameters that are difficult to trace to customers individually, fines of Ghc50,000 (approx. 25,000 USD) per parameter is paid per region on a monthly basis. For number portability, different fines apply.

NCA has developed a very sophisticated compensation plan as specified in the table below; however, the mobile operator may present a different scheme and ask for approval.

Table 84 – NCA's compensation plan

Occurence of interruption(s)	Accounted interruption	Compensation
< 4 hours per interruption	None	None

> 4 hours per interruptions	Rounded to 1 day and aggregated with other interruptions (up to 5 days per month)	Pro rata refund of the monthly service charge
< 4 hours per interruption but > 12 hours aggregated interruptions in 1 day		
> 5 days per interruption	Rounded to 1 month	Full refund of the monthly service charge
> 5 interruptions per month with each interruption > 12 hours		

For example, in Q2 2013, NCA has published QoS measurement methods and has sanctioned operators:

Figure 9 – Extract of NCA's Second Quarter 2013 QoS findings

The NCA has notified Operators of publication of these findings and sanctioned operators concerning measurement performed in June. Some of the sanctions included:

MTN has been sanctioned GH₵100, 000.00 for defaulting Call Setup Time obligation in Central and Western Regions.

Tigo has been sanctioned GH₵50, 000.00 for defaulting Call Congestion obligation in Central Region.

Glo has been sanctioned GH₵200,000.00 for defaulting Call Setup Time, Call Completion and Signalling Congestion obligations in Central and Western Regions.

Airtel has been sanctioned GH₵100, 000.00 for defaulting Call Congestion and Call Setup in Central and Western Regions respectively.

Expresso has been sanctioned to build sites in Kasoa in Central region and Essikado in Western region for defaulting Call Congestion in both Central and Western Regions.

Vodafone remained compliant to all the licence obligations in the month of June.

7 Jordan

Table 85 - Main economic and telecommunications market development indicators for Jordan

Country	# of inhabitants [89] (millions)	GDP per capita PPP (US$)[90]	NRA	Penetration rates[91]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Jordan	7	6,148	TRC	7%	118%	3%	2	4

7.1 Policy

7.1.1 Legal context

The Telecommunications Law No.13 and its amendments specify TRC's role with regards to QoS. TRC shall:

- "*specify the minimum level of service quality which must be offered by service providers to meet the needs of Users; this shall be done in consultation with Service providers and shall be without the imposition of any specific technology".*
- *"protect the interests of users and oversee the actions of persons and Service providers to ensure that the conditions of Licenses are observed, including specified service standards, service quality, and prices; and to take the necessary steps in this regard to provide for the punishment of those who violate these conditions".*
- *"gather information related to the telecommunications and information technology sectors in order to prepare and publish reports, pamphlets, and instructions for users, as well as to prepare media programs to increase the public's awareness of the importance of these sectors and their positive impact on the economic and social development of the Kingdom"*

[89] United Nations, June 2013

[90] World Bank, 2012 or 2011

[91] ITU, for 2011

TRC established in 2005 and 2006 a detailed QoS regulatory framework. At that time, TRC carried out a public consultation on QoS on the 15th June 2005. The consultation resulted in the TRC Board Decision No.(3-3/2006) Date (14/2/2006) which authorised the publication of the Instructions for Implementing the QoS framework in Jordan, which introduced the implementation of a QoS framework whereby operators are required to measure, collect and report QoS indicators which are, to the extent possible, uniformly applied across the industry.

In 2009 and 2010, a similar process was conducted to update the framework because of the increasing number of operators in the market and the services they provide and of the existing and emerging technologies that are used to deliver services. This process resulted in the publication of Instructions for implementing the QoS framework in Jordan (Board of Commissioners Decision No (6-11/2010) issued in 15th Jun. 2010).

7.1.2 QoS policy

The 2010 QoS instructions do not describe QoS policies. However, they clearly set TRC's role and Licensees' role.

TRC's role is to:

- Measure some or all QoS indicators;
- Audit the QoS reports submitted by operators;
- Apply the appropriate sanctions when failure to meet targets or to provide adequate information occurs;
- Publish QoS information as it deems appropriate.
- Licensee's role is to:
- Establish and administer measurement systems consistent with the QoS framework in a way to provide all required data;
- Provide biannual reports with respect to the QoS indicators measurement results, using only the standard reporting templates provided by the TRC for this purpose;
- Provide critical outage reports to the TRC;

- Fully co-operate with all TRC requests for information and all verification and audit activities;
- Upon request, publish QoS information that has been approved by the TRC on the Licensee's website for the periods specified by the TRC.

QoS policies/principles are however briefly described in the 2005/2006 documents.

- Burden on service providers should be minimized and efforts should be proportionate.
- The definition of any QoS KPI should be sufficiently exact so as to ensure comparability.
- Measures which are published should permit the public to make comparisons between companies in respect of the indicators covered.
- Measures to be published will focus on service provider effectiveness in keeping its promises to customers in the markets where competition has been established, rather than comprise network performance statistics which on their own may be misleading.
- In the markets where competition has not been established, the focus will be on the service provider's effectiveness in meeting target QoS figures set out by the TRC, rather than comprise network performance statistics which on their own may be misleading.

7.2 KPI, targets and measurements

7.2.1 General KPI

TRC's KPI are listed in Annex (1) of the Instructions for Implementing the Quality of Service Framework in Jordan (issued in 15/6/2010) Annex (1) consists of 9 electronic appendixes named as follows:

- Appendix 1: QoS KPI's for PSTN, Basic ISDN and ADSL
- Appendix 2: QoS KPI's for GSM Mobile Telephony Services and SMS

- Appendix 3: QoS KPI's for Trunked Radio Dispatch services
- Appendix 4: QoS KPI's for Dialup Internet services
- Appendix 5: QoS KPI's for ADSL Broadband Internet service
- Appendix 6: QoS KPI's for Fixed Broadband Wireless Access
- Appendix 7: QoS KPI's for International Calling Services (TDM and VoIP)
- Appendix 8/A: QoS KPI's for Digital Leased Lines and Primary ISDN (Access Part)
- Appendix 8/B: QoS KPI's for Digital Leased Lines and Primary ISDN (Internet Part)
- Appendix 9: QoS KPI's for Voice Interconnect Services

These appendixes have not been provided to us and are not publicly available.

7.2.2 ADSL KPI's measured by customers

TRC has established a website to examine the ground speed wire Internet broadband (ADSL) in order to provide an opportunity for the user of this service to check out and measure the download and the upload capacity. Then, after one year, TRC has conducted a statistical study on the results and make them public to the users. The following KPIs have been measured:

Figure 10 - KPI, targets and measurement methods for ADSL services in Jordan

KPI	Definition	Target	Actual QoS	Measurement method
Average speed of download	Average speed of download in Kbps for speed between 1Mbps and 2 Mbps	No target	N/A	Customer can measure through online tool and contribute to database
Average speed of upload	Average speed of download in Kbps for speed between 1Mbps and 2 Mbps			

Average speed of download	Average speed of download in Kbps for speed between 512kbps and 1 Mbps			
Average speed of upload	Average speed of download in Kbps for speed between 512kbps and 1 Mbps			
Assessment of the service received	Users are allowed to vote once a week to assess the service they received from their Internet Service Provider. They can choose between the following choices: very satisfied, satisfied, neutral, less than expected or bad service			

7.3 Organisation and processes

7.3.1 Staff

No information on staff is available.

7.3.2 Processes

TRC's QoS instructions are describing very precise processes for QoS monitoring:

- **Process for initial implementation of TRC's instructions**: Formal scheduled meetings are organised between the TRC and the Licensees. They are chaired by TRC. The topics discussed are:
    - The methods of calculation;
    - The common format to be used;
    - Review of the proposed KPI;
    - Review of the proposed targets.

  Only issues that are considered by the TRC to be of sufficient priority are addressed. If any operator fails to attend the meetings, then decisions taken is applied to all concerned parties including that particular operator. Representatives of operators are of a position that empowers them with the authority to make binding commitments on behalf of their respective

organizations. The TRC makes every effort possible to have a consensus decisions about any matter under discussion, but in cases where operators fail to agree, without providing a justification acceptable by the TRC or in cases where TRC believes that the agreed decision is against customers' benefit, the TRC takes the appropriate decision and it shall be binding to all parties.

- **Reporting process:**
    - Biannual reports shall be submitted within 20 working days from the end of June and December and reports should include monthly and biannual data. The format is Microsoft Excel. This must contain relevant data provided in all required fields and all methods used to calculate QoS performance must be made in compliance with the requirements.
    - If a Licensee fails to provide the necessary QoS reports, or is late in providing the reports, or if the report delivered is not in compliance, the enforcement procedure applies (see below).
    - All supported documents that are used to produce the required KPI shall be kept by the Licensees for a minimum of 12 months and shall be made available to representatives of the TRC when conducting visits to the Licensees' premises.
    - Where deemed appropriate, the TRC publishes results when it has been established that indicators readings used to measure Licensee performance provide accurate comparison for use by the general public and, more specifically, consumers of telecommunications products and services in Jordan.
    - Upon TRC request, Licensees shall publish information that has been approved by the TRC on their websites.
    - New Licensees or existing Licensee introducing new services or Licensees providing services that are newly included by TRC in the scope of the QoS instructions shall begin to submit reports immediately on the services they provide for the next 6-month reporting period. TRC shall take no action on the reporting or the results of the reports that is due before a year from the date of commercial launch of the service, and then the Licensee shall be committed to the target values defined in the relevant standard TRC forms.

- **Critical outage process**: all Licensees shall inform the TRC about all critical network outages in the form of a Network Outage Report for Critical Outages:
    - Using TRC's template and sent to TRC by e-mail;
    - The e-mail shall be sent within 24 hours from actual outage time in case of unplanned outages, and 5 working days before planned outages.
- Critical outage is defined as those instances affecting the network, the core network or any outage that affects 30% or more of network traffic.
- **Additional surveys**:
    - TRC can conduct objective measurements (test calls or monitoring of real traffic) or subjective measurements (customer satisfaction surveys).
- **Auditing process:**
    - TRC can conduct audits (either with its own staff or with third parties) to validate reported QoS data or investigate anomalies.
- **Enforcement process:**
    - Process for late submission or no submission:
        - when a Licensee fails to submit the required reports within the required timescale, a formal warning is sent and the Licensee has to submit the report within 10 working days.
        - If the report is still not submitted, the issue is escalated to TRC's Board of Commissioners to impose the appropriate sanction on the Licensee (as written in the license).
    - Process for report which is not compliant:
        - TRC returns the report to the Licensee with details of the items in the report that do not comply with the TRC requirements and a formal warning is sent and the Licensee has to submit the port within 10 working days.
        - If the report is not provided within the timescale and/or the Licensee fails to provide a report which complies with the

requirements (without citing specific acceptable justifications) the issue is escalated to TRC's Board of Commissioners to impose the appropriate sanction on the Licensee (as written in the License).

- Process for targets not achieved:
  - The TRC requests a detailed explanation of the reasons;
  - The TRC examines the reasons provided;
  - When TRC considers the reasons provided are valid, TRC informs in writing that the explanation has been accepted and requests a detailed action plan and timetable that will ensure that the necessary steps are taken to improve performance to meet the specified target.
  - If not, the issue is escalated to TRC's Board of Commissioners to impose the appropriate sanction on the Licensee (as written in the License).

It is to be noted that TRC can publish also:

- Its own QoS measurements;
- Customer satisfaction surveys results;
- Public awareness programmes.

8 Morocco

Table 86 - Main economic and telecommunications market development indicators for Morocco

Country	# of inhabitants [92] (millions)	GDP per capita PPP (US$)[93]	NRA	Penetration rates[94]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Morocco	33	5,193	ANRT	11%	113%	2%	3	3

8.1 Policy

8.1.1 Legal context

Two types of documents relate to QoS in Morocco:

- Law 24-96 and the related decree;
- The operators' licenses.

8.1.2 QoS Objectives

ANRT's objectives with respect to QoS are to:

- Increase QoS offered to end-users: the publication of reports on QoS measurements provide them with incentives to increase QoS and enable end-users to make appropriate choices;
- Verify operators' licenses obligations;
- Better understand the market: QoS measurements can show potential anomalies for a given service and are interesting for operators who which to understand strengths and weaknesses of competitors;
- Maintain and increase QoS with competition;
- Ensure good interconnection between operators;

[92] United Nations, June 2013

[93] World Bank, 2012 or 2011

[94] ITU, for 2011

- Assist operators to compete on equal terms;
- Publishing QoS measurements enable to increase QoS in certain competitive situations (in particular when prices are too low).

It is to be noted that there is no specific QoS regulation for FTTH and LTE since these are under deployment.

8.2 KPI, targets and measurements

QoS measurements are largely inspired by international regulation, in particular ITU documents (E.800, P and Q) or regional norms like ETSI or IEEE.

KPIs are defined in operators' licenses and are calculated on a national basis, not regional.

8.2.1 Fixed calls

Table 87 - KPI, targets and measurement methods for fixed calls in Morocco

KPI	Definition	Target	Actual QoS	Measurement method
Fault report rate per fixed access line - % per line	% of non-repetitive faults received per annum (as a percentage of number of fixed telephony lines)	Below 25%	N/A	Statistics from operators
Fault repair time for fixed access line - % of fault repaired within 48 hours	Number of faults repaired within 24 or 48 hours divided by the total number of faults. Only for working days and time is calculated during working days only.	Above 85%	N/A	Statistics from operators
Fault repair time for fixed access line - % of fault repaired within 24 hours			N/A	Statistics from operators
Rate of bill accuracy complaints	% of written complaints received and justified with regards to the amount of the bill compared to the total number of bills over a year	Below 0.25%	N/A	Statistics from operators
Unsuccessful call ratio for international calls (called TEAI)	Number of international calls (from Morocco to outside or from outside to Morocco) which fail at the level of the	Below 7%	N/A	Requests at the level of international

	international transit switch divided by the number of international calls (excluding force majeure cases) – Per annum			transit switches
Call efficiency rate	% of calls which are successful compared to all the number of calls registered	Above 95%	N/A	Statistics from operators
Call failure rate	% of national calls fail compared to all the number of calls registered	Below 5%	N/A	Statistics from operators

8.2.2 Leased lines

Table 88 - KPI, targets and measurement methods for leased lines in Morocco

KPI	Definition	Target	Actual QoS	Measurement method
Supply time	Number of calendar days between the moment a request for a leased line is registered and the moment the leased line is delivered	Below 1 week for 64kbps leased lines, below 2 weeks for below 2Mbps leased lines and below 4 weeks for above 2Mbps leased lines	N/A	Statistics from operators

8.2.3 ADSL

Table 89 - KPI, targets and measurement methods for ADSL in Morocco

KPI	Definition	Target	Actual QoS	Measurement method
Speed rate – upload – peak hour	Between the end-user and the closest Internet Service provider point	No	N/A	To assess performances, permanent measurements are conducted every 15 minutes. Modem used should be the one that is mostly sold in the market
Speed rate – download – peak hour				
Speed rate – upload – outside peak hour				
Speed rate – download – outside peak hour				
% of data loss	% of packet lost in a stream			

Contention rate	Ratio between theoretical speed and user speed between DSLAM and BRAS			
Latency (mls)	Time required for a packet to go from source to destination			
Rate of successful connections	Number of ADSL successful connections divided by total number of connections			
Time to establish connection	Time in seconds required to connect to the Internet Service Provider node from the dial-up request to the end of the log-in message (i.e. when an IP address is received and when connection is effective)			
Web browsing time	Time in seconds necessary to load consecutively all the pages of the test scenario			
Average download time	Time in seconds to load a file (graph or test) from a website			
Download speed	Download speed of a file from a server			

8.2.4 Mobile

Table 90 - KPI, targets and measurement methods for mobile voice and SMS services in Morocco

KPI	Definition	Target	Actual QoS[95]	Measurement method
Voice - TR	% of call set-up on first attempt and held for 2 minutes without drop	No target	96,47% for all calls, 96,64% for on-net calls and 96,14% for off-net calls	Measured over 27 days from 8 am to 1 pm and from 2pm to 9 pm
Voice - Perfect	% of call set-up on first attempt and held for 2 minutes without drop and perfect		2.68%	On different types of cities,

[95] Average value between all operators

	quality (for the 2 callers)			roads, train,
Voice – Acceptable	% of call set-up on first attempt and held for 2 minutes without drop and quality is slightly altered but communication is fine (for the 2 callers)		68.11%	Measures are conducted where there is coverage for all mobile networks
Voice – Bad	% of call set-up on first attempt and held for 2 minutes without drop and quality is significantly altered but it is still possible to understand each other (for the 2 callers)		27.05%	
Voice – Very Bad	% of call set-up on first attempt and held for 2 minutes without drop and communication is very bad (for the 2 callers)		2.16%	
% of calls stopped	A call is considered stopped if on first attempt call is established and maintained more than 5 seconds and less than 2 minutes		N/A	
% of calls failed	A call is considered failed if on first attempt call is not established or not maintained more than 5 seconds		N/A	
RS 2 min	% of SMS not refused when sent out and received within 2 minutes without being altered		N/A	
RS 30 sec	% of SMS not refused when sent out and received within 30 seconds without being altered		N/A	
RS 5 min	% of SMS not refused when sent out and received within 5 minutes without being altered		N/A	
RS >5 min	% of SMS not refused when sent out and received after 5 minutes without being altered		N/A	
% of SMS not received	% of SMS not received		N/A	

About mobile data QoS, the following KPI are tested for data:

Table 91 - KPI, targets and measurement methods for mobile data services in Morocco

KPI	Definition	Target	Actual QoS[96]	Measurement method
% of successful connections for GPRS/EDGE	A connection is successful if it is established at the first attempt	No target	N/A	Measured over 11 days from 10 am to 3 pm and from 4pm to 10 pm For GPRS, only the connection is tested For 3G, 3G data measurements are conducted on a dedicated platform with 3 servers each linked to the operators' network with a guaranteed 10 Mbps link (above speeds offered by operators). Speed are measured in the FTP mode.
Average connection time with GPRS/EDGE	For successful connections only			
% of successful connections for GPRS/EDGE established in less than 5 seconds				
% of successful connections for GPRS/EDGE established in less than 30 seconds				
% of successful connections for GPRS/EDGE established in less than 1 minute				
% of successful connections for GPRS/EDGE established in less than 2 minutes and more than 1 minute				
% of successful connections for 3G	A connection is successful if it is established at the first attempt		Between 98,2% and 98,8% on smartphone, between 98,5% and 99,8% on PC	
% of successful connections for 3G established in less than 10 seconds	For successful connections only		Between 95,8% and 97,4% on smartphone, between 98,08% and 99,6% on PC	

[96] Average value between all operators

% of files sent in less than 2 minutes for 3G	A file is considered as sent in less than x minutes if the file is fully received in less than x minutes and content is correct		N/A	
% of files sent in less than 5 minutes for 3G			N/A	
Average speed for files sent (upload) for 3G	5MB for download, 1MB for upload		Between 115 kbps and 257 kbps on smartphone, between 262 and 554 kbps on PC	
Average speed for files received (download) for 3G			Between 1317 kbps and 1335 kbps on smartphone, between 732 kbps and 2206 on PC	
Maximum speed for files sent for 3G			N/A	
Maximum speed for files received for 3G			N/A	

8.2.5 KPI for VSAT operators and Global Mobile Personal Communications by Satellite

Table 92 - KPI, targets and measurement methods for satellite services in Morocco

KPI	Definition	Target	Actual QoS	Measurement method
Network unavailability	Number of hours per year where the hub station is unavailable	Below 72 hours	N/A	No details
Rate of on-net calls loss	Rate of on-net calls loss	Below 1%	N/A	No details

8.2.6 Customer relationship

For the first time, in 2014, ANRT will monitor customer relationship. The only KPI currently available is the number of complaints.

8.2.7 Number portability

Number portability must be treated within 1 day.

8.3 Organisation and processes

8.3.1 Staff

The “technical control” department is responsible for QoS and is made of four people:

- 1 responsible for the QoS activities;
- 2 engineers for mobile QoS;
- 1 engineer for fixed QoS.

Three additional people work partly on QoS: the department chief, one person of the “operators” department and one person of the ANRT’s communication department.

The “technical control” department also coordinates with other departments: with the “operators” department to compare the KPI provided by operators with measurements done by ANRT, with the legal department to apply potential fines, with the communication department to communicate QoS results.

8.3.2 Process

There is no audit of operators’ measurements but these measurements can be verified by ANRT own measurements. Operators rarely contest ANRT measurements.

Two types of controls are systematically conducted:

- Validity control which consists in:
    - Ensuring the consistency of data;
    - Reviewing the internal procedure used to collect data;

  - Checking with commercial agencies or technical centres whether this internal procedure has been correctly followed;
  - Contacting some customers to verify whether data is accurate;
  - Launching queries on the operators' IT system or asking databases.

- Compliance control which consists in:
  - Comparing KPIs with targets;
  - Concluding on whether target has been achieved.
- Then when ANRT observes a lower QoS, it requires operators to produce a report showing the actions it intends to undertake to improve QoS.
- In case an operator is not compliant with its license's obligation, no fine is planned but the following process is planned:
- Notice is sent;
- Warning is sent;
- License can be withdrawn.

However, this process is only used in extreme cases since the general approach followed is to monitor QoS and to apply successive improvements to the networks. Meetings are organised with operators in that purpose.

9 Norway

Table 93 - Main economic and telecommunications market development indicators for Norway

Country	# of inhabitants [97] (millions)	GDP per capita PPP (US$)[98]	NRA	Penetration rates[99]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Norway	5	65,640	NPT	43%	117%	36%	4	4

9.1 Policy

9.1.1 Legal context

The regulatory objectives for NPT concerning QoS is governed in the national legislative document called "The Electronic Communications Act". The purpose of the Act is to *"secure good, reasonably priced and future-oriented electronic communications services for the users throughout the country through efficient use of society's resources by facilitating sustainable competition, as well as fostering industrial development and innovation".*

The clause 2.2 states the following on the matters of measurement and information on QoS: *"Providers with obligation under § 5-1* [typically providers with significant market power], *first paragraph, shall measure and report on the quality of network and service provided to the end user. The Authority may impose on undertakings providing public electronic communications service that is not covered by subsection one* [i.e. every other provider] *to measure and report on quality of service provided to the end user in accordance with the criteria, definitions and measurement methods as determined by the Authority. The Authority may issue regulations on measurement and information."*

In the Regulations on Electronic Communications Networks and Services (Ecom Regulations), further information on QoS regulation is given: *"Provider with service obligation pursuant to § 5-1, first paragraph, shall measure and report on the quality of the universal service obligation in accordance with the*

[97] United Nations, June 2013

[98] World Bank, 2012 or 2011

[99] ITU, for 2011

criteria, definitions and measurement methods in ETSI EG 202 057 so far criteria are appropriate for the service. Information on the measured quality shall be provided to the authority in the prescribed form every six months at the appointed time, and made public by the provider. The Authority may order the publication. Provider pursuant to subsection one may be required to measure and report beyond the requirements of ETSI EG 202 057."

9.1.2 QoS policy

In general, fines are not seen as a very viable tool for securing QoS in services and/or networks. Instead, dialogue and measures of transparency often give better results. Only in very specific circumstances, would fines be applied.

Telenor has been obliged to provide the voice telephony service as universal service and there are no KPIs linked to that[100].

NPT has an active approach to net neutrality. In collaboration with the stakeholders, national guidelines to net neutrality have been introduced in the market. However, this has not changed the general QoS policy of NPT. The guidelines prescribe non-blocking and non-discrimination of applications and content on the Internet access service. Regarding QoS, the guidelines focus on transparency, requiring that Internet users are given proper information about the capacity and quality of the Internet access service.

Regarding the auction of the digital dividend later this year, there are some specific requirements for certain parts of the spectrum. The buyer must ensure coverage for 98% of the population, and the average capacity shall exceed 2 Mbit/s. LTE will most likely be the preferred technology used. NPT has not yet decided the best way for measuring and controlling these KPIs.

NPT is involved in QoS standardization by following discussions and work of ITU-T (SG 12), ETSI (TCO STQ) and IETF.

NPT is monitoring the market and its current regulatory policy can be summarized as follows:

- Imposing targets on parameters in case of dispute only;
- Customer relationship is "soft regulated" by publishing the call centre response times;

[100] See the 2004 Agreement which includes no QoS obligations

- Requirements would apply to all kinds of operators, but for providers with USO, there are specific requirements. Nothing is measured at the time, because so far QoS is high enough. No action required now, but there are discussions in NPT to change it.
- Customers can stop their contract with the service provider in case of changes to the contract and the contract must include compensation and refund arrangements in the event of discrepancy concerning quality or non-delivery.

At the retail level, NPT runs an online Internet access measurement service (see 9.2.2).

At the wholesale level, these are maintained by contracts between the operators. NPT will often be court of complaint in case of disputes.

9.2 KPI, measurements and targets

9.2.1 Operator's measurements

There are no specific KPIs connected to operating a communications service. It is simply a matter of registration with NPT. For MNOs, there are specific demands related to coverage but these have since many years been fulfilled by their GSM-networks.

Measurements as specified by the legal context are currently not performed. This may change if NPT while monitoring QoS comes to the conclusion that QoS is decreasing. This practice is currently under review internally in NPT.

There are however measurements on resilience for mobile broadband taking part at the moment. NPT keeps in dialogue with the research institute responsible for the project, and monitors their findings. For more information and a live example, see http://demo.robustenett.no/.

9.2.2 NPT's KPIs for fixed broadband

NPT runs an online Internet access measurement service which lets visitors test the following indicators: download capacity, upload capacity and latency. After measurement has been completed, the visitor (if connected to a domestic ISP) can assign his/her result to the subscription they just measured. The results are,

after an automated screening process, added to the statistics pages and provide the public with information.

Table 94 – KPI and measurement methods for fixed broadband services in Norway

KPI	Definition	Target	Actual QoS	Measurement method
Download capacity	HTTP or TCP capacity averaged over about 15 seconds	Not applicable	See nettfart.no	Customer can measure through online tool: nettfart.no and contribute to database
Upload capacity	HTTP or TCP capacity averaged over about 15 seconds			
Latency	Time-lag for data sent from visitor's terminal, to the measurement servers, and back			

9.2.3 NPT's KPIs for call centre

Table 95 – KPI, targets and measurement methods for call centres in Norway

KPI	Definition	Target	Actual QoS	Measurement method
Call centre response time	Enquiries by phone	300 sec	Between 13 and 305 sec for fixed telephony – between 11 and 360 for mobile operators – between 37 and 284 for broadband	Online reporting module
	% answered within 300 seconds	N/A	Between 63% and 100% for fixed – between 73% and 100% for mobile – between 63% and 100% for broadband	
	Enquiries by email	72 hours	Between 6 and 53 for fixed – between 7 and 68 for mobile – between 7 and 54 for broadband	
	% answered within 72 hours	N/A	Between 82% and 100% for fixed – between 62% and 100% for mobile – between 67% and 100% for broadband	
	Enquiries by written letter	5 days	Not published	

9.2.4 Number portability

The ceding company must initiate the portability process within 16 working hours.

9.3 Organisation and processes

9.3.1 NPT organisation

The responsibilities on ensuring QoS in the domestic market are mainly dedicated to the “Networks” department and the “Service Markets” department. On occasions, the “Frequency Management” department is involved as well.

About four or five people are working on QoS regulatory matters, but not on full-time. They have other tasks as well.

Interaction is done on a per project basis. If it is decided to have a closer look at a special issue, a mixed team of experts representing legal, economical and technical resources will be assigned to the task.

9.3.2 Process

Measures of technical nature are to a large extent handled by operator’s own management systems.

In case of disputes, evidence and indications are brought before NPT for further inspections.

NPT does not conduct audits of operators’ QoS measurements on a regular basis.

NPT interacts through whatever form of dialogue is deemed most effective and appropriate.

For the online capacity measurement service, there are some protests from the operators. The main objection is on how results are calculated, meaning that they do not agree that end-to-end measurements performed by the customers are a sustainable way to measure.

The capacity measurements are a permanent service. The response time measurements are collected twice a year, but this is currently up for review by the management of NPT.

QoS measurements and their results are publicly available.

For wholesale services, it is up to the parties to agree how long operators keep the details of their QoS data. For resale, operators are keeping their traffic data until they are no longer needed for the purpose of billing or communication, in practice less than 3-5 months. Such data would also contain indications on quality issues like unavailable services.

10 Oman

Table 96 - Main economic and telecommunications market development indicators for Oman

Country	# of inhabitants[101] (millions)	GDP per capita PPP[102] (US$)	NRA	Penetration rates[103]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Oman	4	27,015	TRA	10%	169%	2%	2	2

10.1 Policy

TRA's broad responsibility with respect to QoS is:

- To provide information to consumers;
- To monitor the service levels of operators to ensure that acceptable performance is being delivered and in particular to verify that operators comply with their broadband commitments and mobile coverage. Indeed, the licences issued by the TRA have within them a set of obligations, which include obligations for the QoS requirements that must be fulfilled by the licensees;
- To encourage improvement in line with international best practices.
- TRA is very active with respect to QoS and has conducted several updates of its regulatory framework.
- In 2007, it issued a QoS framework document which sets TRA's policy and lists KPI and measurement methods. It includes precise definitions too.
- In 2011, it issued new regulations (not publicly available) and gave one year to operators to comply with the new regulations.
- In 2013, a consultation on QoS was also issued.

[101] United Nations, June 2013

[102] World Bank, 2012

[103] ITU, for 2011

TRA has set a framework which is very general and can be adapted rapidly, using consultation processes.

TRA's general approach consists in setting strong targets including for international services and also to define longer term targets which enable to identify TRA's ambition with regards to QoS. For QoS enforcement, TRA considers that the penalty scheme must not be highly punitive (which is highly inefficient for TRA). There should be motivation to improve and there should be a cap on maximum payment.

In its 2007 document, TRA has specified 10 principles which guide QoS regulation in Oman.

1 The first principle relates to TRA's responsibilities which are:

   a. Set a standard framework for the measurement of services for all operators to follow;

   b. Define how measures should be made, so as to ensure comparability between operators and relevance to consumers of all relevant services across the whole of Oman;

   c. Define realistic short and long term performance targets in pursuance of its legal obligations and role in protecting consumer interests;

   d. Consult with interested parties on methods of measurement and the targets that are established;

   e. Compare the performance of services in Oman against international benchmarks and best practice;

   f. Ensure that the measurement of performance of services does not impose an unnecessary additional load on the operators that deliver the services;

   g. Introduce appropriate measures (including sanction) to ensure that performance targets are met both in the short and long term;

   h. Publish comparative performance figures when such are available and of value to users in selection of services from operators.

2 The second principle relates to operators' responsibilities:

a. Set up measurement systems consistent with the framework set out by TRA;

b. Provide regular returns of the measurement results;

c. Aim to meet short and long term service performance targets;

d. Ensure that adequate capacity is installed to meet the required quality of service levels.

3 Principle n°3 states that all operators shall report KPI and comply with targets except: new operators during their 1st year and networks for private use.

4 Principle n°4 states that measurements must be significant and relevant. For example, averaging statistics, while unavoidable, should not prevent particular problem areas to be identified.

5 Principle n°5: measurements should not be sub-divided by market types.

6 Principle n°6: the use of an industry forum is not the best option because the documentation produced in these forums is of little value to users.

7 Principle n°7: information must be provided to the authority.

8 Principle n°8: information must be provided to the public. Operators are expected to publish the quality of service measures required of them every six months and, for each measure, the target and achieved levels should be clearly shown in a standard reporting template.

9 Principle n°9: audit is necessary and should be conducted by a third party.

10 Principle n°10: as it takes time to meet international QoS standard levels, TRA intends to follow a 3 step approach: 1) Measure, 2) Baseline, comparison and setting of standards and 3) Meet the required targets.

10.2 KPI and measurements

While TRA only publishes some KPI related to mobile services and fixed services, the number of KPI to be measured by operators is much more important.

In its 2007 QoS framework document, TRA has designed a structured approach to define KPIs by differentiating KPI per network layer and type of KPI, as it can be seen in the table below:

Table 97 – Overview of types of KPI envisaged by TRA

Network layer	Implementation	Operation	Performance	Other
PoP services (collocation, ducts, masts, etc.)	Initial response time Delivery time Delivery performance	MTTR Availability Security		Complaints Billing Customer satisfaction Security
Raw bandwidth services (DWDM, microwave, etc.)		MTTR Availability MTBF		
Bearer services (E1, STM1, etc.)		Probability of blocking Probability of loss of circuit		
Grooming services (IP, ATM, etc.)		MTTR Availability MTBF Probability of blocking Probability of loss of circuit	Packet delay Packet loss Jitter	
Network services			Unsuccessful call ratio Calls dropped	
Application services		No measure	No measure	

However, it must be noted that this structure does not transpire in the KPI set in operators' licenses.

10.2.1 KPI for mobile services

Table 98 - KPI, targets and measurement methods mobile services in Oman

KPI	Definition	Target	Actual QoS[104]	Measurement method
Percentage of calls dropped	The dropped call ratio is the proportion of incoming and outgoing calls which, once they have been correctly established and therefore have an assigned traffic channel, are dropped or interrupted prior to their normal completion by the user, the cause of the early termination being within the operator's network.	Less than 0,8%	Between 0,13% and 0,57%	Data provided by operators The two first KPI may be measured either by test calls or by analysis of real traffic taken from network equipment.
Percentage of call blocked due to congestion	The blocked call ratio is the proportion of outgoing calls that cannot be completed because the required network resources are not available when the call is made. All operators build a level of contention in to their networks and blocking is an inevitable, but controllable consequence.	Less than 1,1%	Between 0,013 and 0,59	
Percentage of billing complaints resolved within 20 working days	See below	Greater than 96%	Between 99,61% and 100%	

The following KPIs are new KPIs that have been proposed by TRA in 2013 in a consultation:

Table 99 – New KPIs proposed by TRA in its 2013 consultation

KPI	Definition	Target	Actual QoS	Measurement method
% of calls successfully transmitted		Greater than 99%	N/A	N/A
% of successful calls		Greater than 95%		
Call centre availability		More than 99.9%		
% of SMS successfully transmitted in less than 5 minutes		More than 90%		

[104] Minimum and maximum observed on the 2012 QoS Indicators publication

% of SMS successfully transmitted in less than 30 minutes		More than 99%		
Number portability issues (%)		Less than 51%		
Availability of the directory enquiry service		More than 99%		
Interconnection availability		More than 99.5%		
Speech voice quality		More than 3		
Percentage of beneficiaries complaints to the total number of complaints		Less than 1%		
Percentage of billing complaints resolved within 10 working days		Greater than 90%		
Percentage of billing complaints resolved within 20 working days		Greater than 96%		
Response time to answer 90% for operator assisted services		Below 30 s		

10.2.2 KPI for basic voice services[105]

Table 100 - KPI, targets and measurement methods for basic voice services in Oman

KPI	Definition	Target	Actual QoS[106]	Measurement method
Faults per 100 lines per year	Any report of a valid fault on a fixed network access line. Faults in any equipment on the customer side of the network termination point are excluded. Network faults reported against either basic or primary rate access, or single or multi-line analogue access, should be counted as one fault, regardless of the number of channels activated or affected. The count of the number of access lines should be one	Less than 12	Between 0 et 2,47	Data provided by operators For successful calls, The required statistics can be calculated from measurements on all real traffic or from
Percentage of faults to be cleared within 24 hours		Greater than 90%	Between 94,14% and 100%	
Percentage of faults to be cleared within 72 hours		Greater than 99,5%	Not published	

[105] Based on Nawras' license

[106] Minimum and maximum observed on the 2012 QoS Indicators publication

	for basic or primary rate access regardless of the number of channels activated. Fault reports should be assumed to be valid unless there is a specific reason to consider that they are invalid. Cases where a customer reports a fault that is found to be cleared when tested should be counted as a valid report unless the service provider has reason to believe that the fault did not occur. A report that concerns more than one access line between customers and the local exchange (or remote concentrator) should be counted in terms of the number of fault reports received rather than the number of lines affected. However only one fault report should be included for each access line affected. The following should not be included as fault reports: (a) Trouble with Customer Premise Equipment; (b) Cable/line cuts not due to service provider; (c) Faults due to another service provider; (d) Customer not knowing how to use the service ETSI recommendation EG 202 057 / Annex A			measurements on real traffic for outgoing calls in a representative population of local exchanges to a representative set of destinations or using test calls in a representative population of local exchanges. Any combination of the above is acceptable as long as the overall sample size is adequate. This is required to be at least 2% of average traffic volumes. Test measure must be scheduled across the day but at least 30% of measures should be taken during the busy hour.
Unsuccessful call ratio for local and national fixed calls	An unsuccessful call is a call attempt to a valid number, properly dialled following dial tone, where neither the called party busy tone, nor ringing tone, nor answer signal, is recognized by the calling user within 30 seconds from the moment when the last digit of the destination subscriber number is received by the network. ETSI recommandation EG 202 057(Annex D)	Less than 1%	Between 0,05% and 0,32%	
Unsuccessful call ratio for international fixed calls		Less than 2%	Not published	
Percentage of	The total time that is taken for an operator	Greater	Between	

orders for access lines in the served areas completed within 10 working days	to fulfil a customer order for an access line. The overall supply time should be recorded for each individual service and reported on in geographic groups.	than 90%	92% and 98%	
Percentage of orders for access lines in the served areas completed within 5 working days		Greater than 75%	Not published	
Percentage of beneficiaries billing complaints per 1000 bills	Any report of an issued bill that is subsequently found to be in error (i.e. that is found to be inaccurate). This applies to any type of service (fixed, mobile, etc). The complaint is valid as soon as it is reported to the operator. Billing complaints that do not relate to inaccuracy of charge (for instance, that are simply unclear) are not included.	Less than 1,5%	Between 0,30% and 1,20%	
Percentage of beneficiaries complaints to the total number of complaints	Any customer complaint not related to billing that result in action by the operator (apology, refund, etc). This applies to any type of service (fixed, mobile, etc). The complaint is valid as soon as it is reported to the operator.	Less than 1%	Not published	
Percentage of billing complaints resolved within 10 working days	The time taken for an operator to resolve a bill complaint is the duration from the moment a bill is reported to the moment when the consumer agrees that the complaint has been resolved. The duration of the complaint is the time between it being reported to the time it is recorded by the operator is resolved.	Greater than 90%	100%	
Percentage of billing complaints resolved within 20 working days		Greater than 96%	100%	
Response time to answer 90% for operator assisted services	The duration from the moment when the address information required for setting up an operator assist call is received by the network (e.g. recognized on the calling user's access line) to the moment the human operator answers the calling user to provide the service requested. Services provided wholly automatically, e.g. by voice	Below 30 s	Not published	

	response systems, are excluded. The services covered are the services for operator controlled and assisted calls that are accessed with special access codes. Access to emergency services is excluded.			
Availability of interconnection	The availability of interconnection is determined by the proportion of calls that are successfully transferred from one operator to another at a point of interconnection. A successful call transfer is one that does not encounter congestion and does not fail to be completed due to a technical problem such as signalling failure.	More than 99,5%	Not published	
Percentage of payphones in working order to the total number of public payphones	The number of public payphones from which it is possible to access and use the service that are provided at that facility. A working order payphone is a payphone that can be accessed and is capable of providing all its services.	Greater than 96%	Between 99,73% and 99,80%	
Percentage of satisfied beneficiaries with billing quality	A subjective assessment of an operators performance in relation to their provision of service (time and quality), maintenance of service (speed and effectiveness of repair), support (availability and effectiveness, range of products and general customer handling.	Greater than 90%	Not published	Third party surveys every quarter from 12 months after the Effective Date. A random sample should be taken from those customers who have dealt directly with a given operator within the last 3 months. The customers should be surveyed on the overall way in they are treated The measure should exclude customers who respond "don't know" or who refuse to answer.
Percentage of satisfied beneficiaries with the help services		Greater than 90%	Not published	
Percentage of satisfaction with network performance, reliability & availability		Greater than 90%	Not published	
Percentage of satisfaction with maintainability		Greater than 85%	Not published	
Percentage of overall beneficiaries satisfaction		Greater than 85%	Not published	
Percentage of		Greater	Not	

beneficiaries' satisfaction with supplementary services		than 85%	published	

10.2.3 KPI for international services

Table 101 - KPI, targets and measurement methods for international services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Call Set Up Time (Post dialing delay to ring tone)	The call set up time is the period starting when the address information required for setting up a call is received by the network and finishing when the called party busy tone or ringing tone or answer signal is received by the calling party. Where overlap signalling is used the measurement starts when sufficient address information has been received to allow the network to begin routing the call. Calls that are classified as unsuccessful calls should be excluded but calls to ported numbers should be included	Less than 4 seconds	Not published	Data provided by operators For speech quality, The determination of speech connection quality should be based on the "E-Model", which is a transmission rating model for assessing the combined effects of variations in several transmission parameters that effect speech quality (See ETSI standard ETR 250, July 96).. When assessing the quality of a voice service care should be taken to apply the E-Model correctly and to refer to the relevant ITU-T Recommendations.
Percentage of Echo Cancellers Usage at the Central Office	No definition	99,9%	Not published	
Congestion level per Traffic ROUTE During busy hours	No definition	Less than 2%	Not published	
Unsuccessful Call Ratio during busy hour	No definition	Less than 3%	Not published	
Resolution time of a Backbone Link fault impacting traffic	No definition	Less than 4 hours	Not published	
Resolution time of International Gateway fault	No definition	Less than one hour	Not published	

impacting traffic				
Switch Processor Load during busy hours	No definition	Less than 85%	Not published	
Speech Quality	Speech connection quality is a measure of end-to-end speech quality for conversational speech of a voice service call. It is expressed in terms of perceived quality categories from best, to high, medium, low and poor quality ETSI EG 202 57-2/ (Annex H)	Better than 3 degrees	Not published	

10.2.4 KPI for submarine and terrestrial cable and satellite services

Table 102 - KPI, targets and measurement methods for submarine and terrestrial cable and satellite services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Availability	See tables above	More than 99,95%	Not published	Data provided by operators

10.2.5 KPI for calling cards

Table 103 - KPI, targets and measurement methods for calling cards in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Percentage of beneficiaries complaints to the total number of beneficiaries	See tables above	Less than 1%	Not published	Data provided by operators
Number of beneficiaries complaints on international calling cards per 1000 cards	See tables above	Less than 1	Not published	

10.2.6 KPI for public general information services

Table 104 - KPI, targets and measurement methods for data services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Faults per 100 lines per year	See tables above	Less than 12	Not published	Data provided by operators
Percentage of faults to be cleared within 24 hours	See tables above	Greater than 90%	Not published	
Percentage of orders for access lines in the served areas completed within 10 working days	See tables above	Greater than 90%	Not published	
Percentage of orders for access lines in the served areas completed within 5 working days	See tables above	Greater than 75%	Not published	
Percentage of reconfigurations of established connections completed within 4 hours	No definition	Greater than 90%	Not published	
Percentage of beneficiaries complaints to the total number of complaints	See tables above	Less than 1%	Not published	
Percentage of billing complaints resolved within 10 working days	See tables above	Greater than 90%	Not published	
Beneficiaries Satisfaction on a 5 grade scale	See tables above	Not published	Not published	

10.2.7 KPI for dial-up and leased lines Internet

Table 105 - KPI, targets and measurement methods for dial-up and leased lines Internet services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Service activation Time	No definition	Less than 1 working day	Not published	Data provided by operators
Time to access for more than 95 % of the login attempts	No definition	Less than 30 sec	Not published	

Percentage of accessing the ISP node from 1st attempt	No definition	Greater than 80%	Not published	
Percentage of accessing the ISP node from 2nd attempt	No definition	Greater than 90%	Not published	
Percentage of accessing the ISP node from 3rd attempt	No definition	100%	Not published	
ISP node unavailability in one month	No definition	Less than 30 sec	Not published	
Packet loss	The packet loss ratio is the ratio of the number of packets lost to total number transmitted in a population of interest	Less than 1%	Not published	
Availability	See tables above	More than 99%	Not published	
Number of billing complaints per 100 bills issued	See tables above	Less than 1%	Not published	
Percentage of billing complaints resolved within 20 working days.	See tables above	More than 96%	Not published	
Time for refund of deposits after closure if applicable	No definition	Less than 30 days	Not published	
Local latency	No definition	150-200 mls	Not published	
International latency	No definition	200-250 mls	Not published	

10.2.8 KPI for broadband Internet

Table 106 - KPI, targets and measurement methods for broadband Internet services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Service activation Time	No definition	Less than 7 working days	Not published	Data provided by operators

Bandwidth Utilization during the busy hours	No definition	More than 70%	Not published	
% of Broadband connection Speed (download) from ISP node to the beneficiaries – wired services	No definition	100%	Not published	
% of Broadband connection Speed (download) from ISP node to the beneficiaries – wireless services	No definition	More than 80% of specification	Not published	
ISP node unavailability in one month	No definition	Less than 30 min	Not published	
Packet loss	See tables above	Less than 1%	Not published	
Availability	See tables above	More than 99%	Not published	
Number of billing complaints per 100 bills issued	No definition	Less than 1%	Not published	
Percentage of billing complaints resolved within 20 working days.	See tables above	More than 96%	Not published	
Time for refund of deposits after closure if applicable	No definition	Less than 30 days	Not published	
Network latency	No definition	100 mls	Not published	

The following KPIs is a new KPI that has been proposed by TRA in 2013 in a consultation:

KPI	Definition	Target	Actual QoS	Measurement method
Fault rate for 1000 lines		Less than 12	N/A	N/A

10.2.9 KPI for private telecommunications services

Table 107 - KPI, targets and measurement methods for private telecommunications services in Oman

KPI	Definition	Target	Actual QoS	Measurement method

Percentage of beneficiaries to the total number of complaints	See tables above	Less than 1%	Not published	Data provided by operators

10.2.10 KPI for leased lines

Table 108 - KPI, targets and measurement methods for leased lines services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Availability	See tables above	More than 99,95%	Not published	Data provided by operators
Percentage of fulfilment of Supply Time for Connection as per SLA	No definition	More than 90%	Not published	
Beneficiaries Fault Numbers of per leased line per one month	No definition	Less than 10 faults	Not published	
Percentage of resolved faults within the time duration specified in SLA	No definition	More than 90%	Not published	
Resolution time of a Backbone Link fault impacting traffic – international leased lines only	No definition	Less than 4 hours	Not published	

10.2.11 KPI for value added services

Table 109 - KPI, targets and measurement methods for value added services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Percentage of beneficiaries complaints to the total number of complaints	See tables above	Less than 1%	Not published	Data provided by operators
Percentage of billing complaints resolved within 10 working days	See tables above	More than 95%	Not published	
Service fulfilment within one day	See tables above	More than 95%	Not published	
Number of Complaints per 100	See tables above	Less than 5	Not published	

beneficiaries per quarter		complaints		
Number of Billing Complaints per 1000 bills	See tables above	One complaint	Not published	
Speech quality	See tables above	More than 4 degrees	Not published	
Percentage of complaints solved within 2 working days to the total number of complaints – Premium charged services	See tables above	More than 99%	Not published	

10.2.12 KPI for wireless broadband access services

Table 110 - KPI, targets and measurement methods for wireless broadband access services in Oman

KPI	Definition	Target	Actual QoS	Measurement method
Radio Network availability	A radio network is available if a radio bearer that carries customer traffic can be accessed. It is deemed unavailable from the time that the network is reported as being not accessible until the time that it is restored. Availability is measured during the Service Cover Period only. Scheduled Maintenance Periods and any Lost Access Time are exempt.	More than 95%	Not published	Data provided by operators
Customer perception of basic, data, international and all other services provided under the license should be completed through third party surveys every quarter from 12 months after the Effective Date	See tables above	Better than 3,5 degrees	Not published	
Service availability	For any telecommunications services there is a probability that network congestion or technical failure may cause service to be lost and a session to be dropped.	Within 10% from the specificati ons	Not published	

	Service availability is the proportion of time for which the service is working normally over the measurement period deemed unavailable from the time it is reported as being not accessible until the time that it is restored. Availability is measured during the Service Cover Period only. Scheduled Maintenance Periods and any Lost Access Time are exempt.			
Packet Loss	See tables above	Less than 1%	Not published	
Mean packet delay	The delay that would be experienced by a representative number of 128 byte packets crossing the service in the peak hour. This measure would include any processing by the network but not the end device	Less than 100 mls	Not published	
Percentage of beneficiaries complaints to the total number of beneficiaries	See tables above	Less than 1%	Not published	
Percentage of beneficiaries complaints resolved within 10 working days	See tables above	More than 90%	Not published	
Percentage of calls dropped	See tables above	Less than 0,8%	Not published	
Percentage of calls blocked due to network congestion	See tables above	Less than 1,1%	Not published	
Call success rate	See tables above	More than 95%	Not published	
SMS delivery – within 5 min	The elapsed time between sending a text message from one mobile and the receipt of that message on the addressed mobile (which is assumed to be switched on and within coverage area).	More than 90%	Not published	
SMS delivery – within 30 min		More than 99%	Not published	

Data service availability	See tables above	More than 99%	Not published	

10.2.13 KPI for number portability

Two working days is a reasonable time period for authentication process as long as the customer is advised by Recipient Service Provider that he has an obligation with the current service provider for any existing contracts and outstanding bills.

10.2.14 Additional KPI for broadband

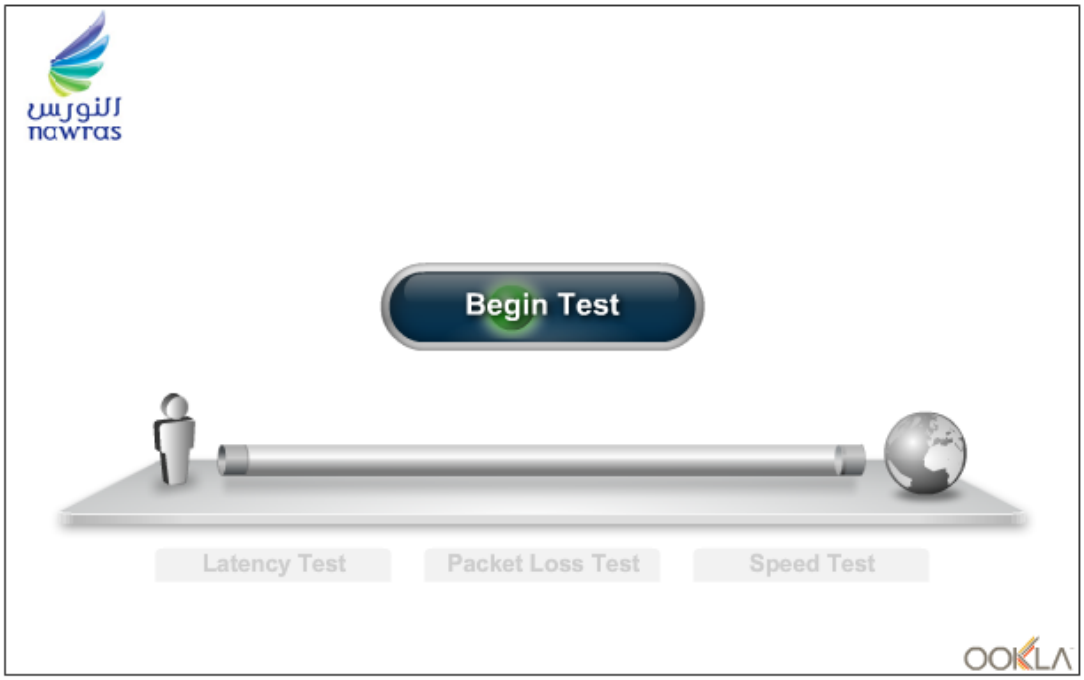
The TRA requires that internet service providers (currently Omantel and Nawras) install special tools to allow their customers to measure their Internet download / connection speed.

These tests measure:

- Latency;
- Packet loss;
- Speed.

A snapshot of Nawras' test website is provided below:

Table 111 – Nawras' website for Internet download/connection speed tests



10.2.15 Additional KPI for mobile

TRA also conducts drive tests where it measures:

- The signal level;
- The mean signal to interference ratio;
- The mean signal quality;
- The mean speech quality;
- The % of dropped and blocked call rates (between 0.45% and 0.65% for the percentage of dropped calls, 0.65% for the percentage of blocked calls).

Figure 11 – Snapshot of results of drive tests conducted by TRA in Oman

10.3 Organisation and processes

10.3.1 Staff

No information is available

10.3.2 Processes

Operators have to publish their QoS measures required every six months and, for each measure, the target and achieved levels must be clearly shown in a standard reporting template. They must record the information for 6 months. In its 2013 consultation document, TRA proposes to request operators to publish measures every 3 months.

Every operator is subject to a twice yearly audit. Audit procedures should include:

- Aim of the audit (i.e. measurements at stake);
- Validation of the data collected;
- Inspection of samples of the QoS data collected by the operator;

- Confirmation of the measures against the definitions given in the QoS Framework for each measure collected;
- Analysis of the reported key performance indicators. This would involve a check on the way in which the raw data collected by the operator is processed to produce their performance indicators;
- Verification of the overall QoS report;
- Recommendations for the audit. Any specific actions, such as revision of targets or requirements for operator improvement will be recorded and dates for action set.

Operators have to report to TRA any major breakdown longer than one hour on critical network elements and have to notify on restoration of such breakdowns.

When operators fail to meet a target, they may be subject to a penalty. TRA has considered several penalty schemes.

- **To impose penalties to be paid for each target missed. This is TRA's preferred approach as it is effective in addressing particular problems.**
- To impose penalties if an operator's global performance assessed for a basket of indicators is not good. The advantage of this approach is that it credits good aspects of the operator's performance as well as penalising the bad.

TRA adds a customer compensation scheme to this penalty scheme. To that purpose, TRA establishes a compensation committee which members are neither working for TRA nor for operators with representatives from consumer protection and telecommunication user bodies (TRA has an observer status). The committee is expected to meet on a regular basis, commensurate with the volume of claims received via TRA. The specific task of the committee would be the rapid resolution of claims. In those circumstances where a claim cannot be resolved, there is the option of escalation back to TRA.

These penalties and compensation schemes have been described by TRA in its 2007 QoS framework document but it has not been possible to verify that this is actually in place.

In its 2013 consultation document, TRA lists the fines it proposes to impose for each KPI when the target is not achieved (5,000 Omani rials).

11 Saudi Arabia

Table 112 - Main economic and telecommunications market development indicators for Saudi Arabia

Country	# of inhabitants [107] (millions)	GDP per capita PPP (US$)[108]	NRA	Penetration rates[109]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Saudi Arabia	29	24,571	CITC	16%	191%	6%	1	3

11.1 Policy

11.1.1 Legal context

According to the Telecommunications Act, CITC has to provide the necessary protection to end-users and service providers.

CITC has taken several decisions/actions in relation to QoS.

- In its 2003 decision N°24/1424, CITC defined the QoS indicators and target values for the universal and dominant service providers (namely STC). Chapter 8 of the CITC Bylaw indeed requires dominant and universal service providers to report on QoS KPI and targets approved by CITC.
- In 2006, CITC issued its regulatory framework on QoS (decision N°141/1427).
- In 2006, CITC issued a public consultation on Regulatory Policies for Licensing of Fixed and Mobile Services in the Kingdom of Saudi Arabia which includes key policy choices in relation to QoS.
- Finally, the most recent document issued by CITC is the 2009 Quality of service scheme which updates and defines the CITC QoS policy, obligations, KPIs, etc. As the market situation changed between 2003

[107] United Nations, June 2013

[108] World Bank, 2012 or 2011

[109] ITU, for 2011

and 2009 with the issuance of several licences for service providers in Saudi Arabia, CITC has reviewed the QoS regulations in this document.

This latter document is therefore the main document to consider in relation to QoS in Saudi Arabia.

CITC recognises that QoS regulation is not a static process and that QoS regulation may evolve, especially when competition increases. CITC reserves the right to add, remove or modify indicators and targets.

11.1.2 QoS policy

CITC considers that QoS regulation aims at protecting end-users and wholesale customers in services where no or limited competition exists. However QoS regulation should minimize the administrative burden costs to operators.

CITC's objectives with regards to QoS are:

- To ensure **good service quality is provided to end-users for services where there is no or limited competition;**
- To support the transition of the telecommunications market to a **higher level of competition** resulting in lower prices, a wider range of services, and faster services development;
- To stimulate a competitive market and End-user satisfaction by **enabling comparison between alternative Service Providers** in a market;
- **To increase the competitiveness of new entrants** by enabling them to compete on quality with established market players;
- To ensure Interconnect and Wholesale Customers **are treated equitably and provided a good quality of service**;
- **To limit the administrative costs** for Service Providers by using only the most relevant QoS Indicators for End-users and Wholesale and Interconnect Customers.

CITC is of the view that QoS KPIs and targets can also be used to:

- Ensure service quality in rural areas;
- Choose a service provider (for end users);

- Compare each other (for service providers);
- Avoid price/quality trade-offs.

CITC has considered 3 possible approaches[110] for QoS regulation in Saudi Arabia.

- Direct regulation where CITC sets the QoS indicators and standards, details measurement methods and procedures and obliges operators to comply and where industry is slightly involved except for measurements.
- Co-regulation where CITC defines the high level indicators, but the details are defined by an industry working group.
- Self-regulation where no QoS indicators are imposed and CITC intervenes only to resolve conflict within the industry.

CITC has chosen the first approach as it considers it will take time for the market to reach full competition and because there is currently a perceived need to improve service quality. CITC considers that if competition develops, QoS regulation may be relaxed.

With regards to KPI, CITC believes that they should:

- Be key for users;
- Practical and measurable;
- Refer to services and not to specific technologies;
- Be based on a common methodology to ensure comparability between operators;
- Relate to all end-users.

[110] Public consultation on Regulatory Policies for Licensing of Fixed and Mobile Services in the Kingdom of Saudi Arabia which includes key policy choices in relation to QoS

11.2 KPI and measurement

CITC identifies 3 types of KPIs.

- KPIs for end-users (voice, Internet, mobile, business data). Dominant and universal service providers and mobile operators have to provide KPI and comply with targets while other license holders and ISP only have to provide KPI. Licence holders are exempted for the first 12 months after their commercial launch or if they have less than 10% of subscriber market share.
- KPIs for wholesale services (bitstream, Line sharing, wholesale leased lines, etc.). Dominant service providers have to provide KPI and comply with targets. KPI are reported for each wholesale customer and for themselves internally.
- KPI for interconnect services. Dominant service providers have to provide KPI and comply with targets. For SIP based interconnect service, other licence holders also have to comply with codec (ITU G.729) and delay standards. KPIs are reported for each wholesale customer and for themselves internally.
- NB: dominant service providers are exempted from publishing KPI is there is a SLA with penalties which imposes higher targets than those defined by CITC.

11.2.1 Fixed voice services QoS

The table below presents the KPI, targets if relevant and measures:

Table 113 – KPI, targets and measurements methods for fixed voice services in Saudi Arabia

KPI	Definition	Target	Actual QoS[111]	Measurement method
Installation time	Time from when an order is received and accepted until the service is installed and ready to use.	90% in 5 busines	Between 91.0% and	Statistics provided by operators

[111] Data for the year 2012

	Time taken to complete each customer order and then calculate the percentage of orders completed within the target timeframes. All orders received after normal business hours will be considered as next day orders. Statistics include all orders completed during the month, but exclude: cancelled orders, wrong address given by the customer, customer premises closed or inaccessible for installation of termination point, installation order withheld due to payment difficulties (e.g., deposit and any upfront payments), for orders involving a change of Service Provider, delay caused by actions of the other Service Provider.	s days	99.0%	
Fault repair time	Time from receiving the fault report until the service is restored and ready to use. Number of fault reports received and the time taken to repair each individual fault are measured. Then the percentage of faults repaired within 24 hours is calculated. The time starts from receiving and registering the customer fault report.	90% in 24 hours	Between 79.0% and 92.0%	
Response time, Customers response centre	Time taken to answer a customer call that passed the IVR until an answer is received from the Customer Response Center operator. Number of calls received from customers *that passed the IVR* and the time taken to answer each such call are measured. Then the percentage answered by the operator within 60 seconds is calculated.	80% in 60 seconds	Between 75.0% and 99.0%	
Unsuccessful call rate (%)	Number of call attempts that could not be completed due to technical problems for which the Service Provider is responsible (e.g., network congestion, line failure), divided by the total number of calls during the Busy Hour (%).	< 2%	Between 0.53% and 1.72%	
Call drop rate (%)	Number of established calls during the Busy Hour that are dropped due to technical problems for which the Service Provider is responsible (e.g., network failure), divided by the total number of established calls during the Busy Hour (%).	< 2%	Between 0.04 and 0.06%	
Fault rate per 1000 fixed access services	A fault report describes a disrupted or degraded service and is submitted by the customer to the published point of contact of the Service Provider. A valid fault needs to be attributable to the fixed access line.	50 faults per 1000 lines per quarter	Between 1.20 and 1.60	

	The number of fault is the calculated by divided the total number of faults reported by customers during the reporting period by the average number of customer's access lines during the period. Fault reports should be assumed to be valid unless there is a specific reason to consider that they are not. Cases where a customer reports a fault that, when tested, is found to have been cleared should be counted as a valid report. This would be the case unless the Service Provider has reason to believe that the fault did not occur. Statistics shall include all valid fault reports in the month, except those resulting from: cable cuts not due to the Service Provider, faults due to other Service Providers, customer not knowing how to use the service, when the line has been checked and found to be trouble-free, faults in any equipment on the customer side of the network termination point, faults which are attributable to the Service Provider's core network or to other networks, damage caused to the Service Provider's network by any other entity.			
Voice quality standard	Mean Opinion Score (MOS) provides a numerical indication of the perceived quality of received media after compression and/or transmission. The MOS is expressed as a single number in the range 1 to 5, where 1 is the lowest perceived quality and 5 is the highest perceived quality. ITU-T recommendation P.862 describes a method for predicting the assessment of speech quality. The test can be done using an automated system, which uses a special algorithm to simulate the human ear, to evaluate the speech quality for a sample of calls transmitted over the communications medium under test. MOS indicator is between 1 and 5.	MOS > 3.5	Between 3.93 and 4.27	MOS tests shall be conducted by Service Providers on a yearly basis, or as directed by CITC.

11.2.2 Mobile voice services QoS

The table below presents the KPI, targets if relevant and measures:

Table 114 - KPI, targets and measurements methods for mobile voice services in Saudi Arabia

KPI	Definition	Target	Actual QoS[112]	Measurement method
Response time, customer response centre	Time taken to answer a customer call that passed the IVR until an answer is received from the Customer Response Center operator. Number of calls received from customers that passed the IVR and the time taken to answer each such call are measured. Then the percentage answered by the operator within 60 seconds is calculated.	80% in 60 seconds	Between 57.0% and 96.0%	Statistics provided by operators
Unsuccessful call rate (%)	Number of call attempts that could not be completed due to technical problems for which the Service Provider is responsible (e.g., network congestion, line failure), divided by the total number of calls during the Busy Hour (%).	< 2%	Between 0.14% and 1.63%	
Call drop rate (%)	Number of established calls during the Busy Hour that are dropped due to technical problems for which the Service Provider is responsible (e.g., network failure), divided by the total number of established calls during the Busy Hour (%).	< 2%	Between 0.0% and 0.85%	
Voice quality standard	Mean Opinion Score (MOS) provides a numerical indication of the perceived quality of received media after compression and/or transmission. The MOS is expressed as a single number in the range 1 to 5, where 1 is the lowest perceived quality and 5 is the highest perceived quality. ITU-T recommendation P.862 describes a method for predicting the assessment of speech quality. The test can be done using an automated system, which uses a special algorithm to simulate the human ear, to evaluate the speech quality for a sample of calls transmitted over the communications medium under test. MOS indicator is between 1 and 5. Mean Opinion Score (MOS) provides a numerical indication of the perceived quality of received media after compression and/or transmission. The MOS is expressed as a single number in the range 1 to 5, where 1 is the lowest perceived quality and 5 is the highest perceived quality.	MOS > 3.5	Between 3.68 and 3.92	

[112] Data for the year 2012 between all operators

Geographic radio service coverage mapping	Radio service reception for mobile and nomadic services, in a specified geographic area, at a level necessary to meet target QoS levels for those services. Service Providers shall publish service coverage maps in a format suitable for web browsing, per major city and per province, including highways, with updates at least yearly. Service Providers shall estimate radio service coverage (outdoor and indoor signal strength) by a combination of radio coverage prediction and measurements for mobile services. The published information shall include current service coverage, and may include service coverage specified in national roaming agreements with other Service Providers, with: green marked areas for good reception both at street level and indoors at ground level in function rooms facing the outside, yellow marked areas for good reception at street level (no penetration loss). Good reception means that relevant QoS targets are met.	Map updated at least yearly	Between 91.1% and 99.0%	

11.2.3 Internet access and business data services QoS

The table below presents the KPI, targets if relevant and measures:

Table 115 - KPI, targets and measurements methods for Internet access and business data services in Saudi Arabia

KPI	Definition	Target	Actual QoS[113]	Measurement method
Installation time	Time from when an order is received and accepted until the service is installed and ready to use. Time taken to complete each customer order and then calculate the percentage of orders completed within the target timeframes. All orders received after normal business hours will be considered as next day orders. Statistics include all orders completed during the month, but exclude: cancelled orders, wrong address given by the customer, customer premises closed or inaccessible for installation of termination point, installation order withheld due to payment difficulties (e.g., deposit and any upfront payments), for orders involving a change of Service	90% in 10 business days	Between 89.0% and 96.0%	Statistics provided by operators

[113] Data for the year 2012

	Provider, delay caused by actions of the other Service Provider. Time from when an order is received and accepted until the service is installed and ready to use			
Fault repair time	Time from receiving the fault report until the service is restored and ready to use. Number of fault reports received and the time taken to repair each individual fault are measured. Then the percentage of faults repaired within 24 hours is calculated. The time starts from receiving and registering the customer fault report. Time from receiving the fault report until the service is restored and ready to use	90% in 24 hours	Between 84.0% and 96.0%	
Response time, customer response centre	Time taken to answer a customer call that passed the IVR until an answer is received from the Customer Response Center operator. Number of calls received from customers that passed the IVR and the time taken to answer each such call are measured. Then the percentage answered by the operator within 60 seconds is calculated. Time taken to answer a customer call that passed the IVR until an answer is received from the customer response centre operator.	80% in 60 seconds	Between 75.0% and 99.0%	
Fault rate	The number of fault reports per 1,000 fixed access services. A fault report describes a disrupted or degraded service and is submitted by the customer to the published point of contact of the Service Provider. A valid fault needs to be attributable to the fixed access line.	50 faults per 1000 lines per quarter	Between 1 and 5	
IP data transmission throughput measurement	IP data transmission throughput in the upstream and downstream directions compared to the ‘best efforts’ speed specified in the subscriber’s service agreement. Customer surveys shall be conducted by Service Providers on a quarterly basis, or as directed by CITC. This is done by a group of End-users (test group) using throughput test to collect statistics for further processing. It should cover both the busiest hours of the day and hours with lower Internet traffic load.	Minimum 50% of stated best efforts speed	Between 36.0% and 38.0%	
Number of circuits placed in service in agreed time	Time from when an order is received and accepted until the service is installed and ready to use. Service Providers shall calculate the time taken to complete each order and then calculate the percentage of circuits placed in service by the date initially agreed with the End-user. Statistics include all circuits placed in service in the data	95%	Between 95.1% and 99.88%	

	collection period, but exclude: cancelled orders, wrong or insufficient address/location information given by the customer; customer's premises closed or inaccessible, for orders involving a change of Service Provider, delays caused by actions of the Service Provider.			
Service availability	The percentage of time the circuits are available for service. Time circuits are actually in service divided by total time in the month (%). Statistics include all service outages in the measuring period, except: planned outages, faults due to other Service Providers, damage caused to the Service Provider's network by any other entity.	99,7%	Between 99.5% and 99.9%	

11.2.4 Wholesale services QoS (bitstream access, line sharing, bitstream access links and backhaul services)

a. Bitstream access

Table 116 - KPI, targets and measurements methods for bitstream services in Saudi Arabia

KPI	Definition	Target	Actual QoS[114]	Measurement method
Installation time	Average time from order received and accepted until the service is installed and ready to use. Installation time is measured from order received to service provisioned, according to the scope of service defined in the Reference Offer for Data Access. The DSP shall calculate the average delivery time for all connections supplied in the month.	5 business days	Not published	Statistics provided by operators
Number of fault reports per 1,000 fixed access services	A fault report describes a disrupted or degraded service and is submitted by the wholesale customer to the point of contact of the service provider. A valid fault needs to be attributable to the fixed access line and not be invalid for any other reason. Fault reports should be assumed to be valid unless there is a specific reason to consider that they are not. Cases where a wholesale customer reports a fault that, when	50 faults per 1000 lines per quarter	Not published	

[114] Data for the year 2012

	tested, is found to have been cleared should be counted as a valid report. This would be the case unless the service provider has reason to believe that the fault did not occur. Statistics shall include all valid fault reports in the data collection period, except those resulting from: cable cuts not due to the service provider, faults due to other Service Providers, when the line has been checked and found to be trouble free.			
Fault repair time (service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use..	80% in 24 hours	Not published	
Fault repair time (non service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	80% in 36 hours	Not published	

b. Line Sharing service

Table 117 - KPI, targets and measurements methods for Line sharing services in Saudi Arabia

KPI	Definition	Target	Actual QoS[115]	Measurement method
Installation time (capacity available)	Average time from order received and accepted until the service is installed and ready to use. Installation time is measured from order received to service provisioned, according to the scope of service defined in the Reference Offer for Data Access. The DSP shall calculate the average delivery time for all connections supplied in the month. Average time from order received and accepted until the service is installed and ready to use.	22 business days	Not published	Statistics provided by operators
Fault rate	A fault report describes a disrupted or degraded service and is submitted by the Wholesale Customer to the point of contact of the Service Provider. A valid fault needs to be attributable to the fixed access line and not be invalid for any other reason. This number is calculated by divided the number of reported faults per 1.000 customers lines by the total number of faults reported by the Wholesale Customer during the reporting period.	50 faults per 1000 lines per quarter	Not published	

[115] Average between all operators

	Fault reports should be assumed to be valid unless there is a specific reason to consider that they are not. Cases where a Wholesale Customer reports a fault that, when tested, is found to have been cleared should be counted as a valid report. This would be the case unless the Service Provider has reason to believe that the fault did not occur. Statistics shall include all valid fault reports in the data collection period, except those resulting from: cable cuts not due to the Service Provider, faults due to other Service Providers, when the line has been checked and found to be trouble free.			
Fault repair time (service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use. It counts the number of fault reports received, measure the time taken to repair each individual fault starting from the time of receiving the fault report, and then calculate the percentage of faults repaired within target timeframes.	85% in 10 hours	Not published	
Fault repair time (non service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 36 hours	Not published	

c. Bitstream access link

Table 118 - KPI, targets and measurements methods for bitstream access link in Saudi Arabia

KPI	Definition	Target	Actual QoS[116]	Measurement method
Installation time (capacity available)	Average time from order received and accepted until the service is installed and ready to use.	12 weeks	Not published	Statistics provided by operators
Installation time (capacity not available)	Average time from order received and accepted until the service is installed and ready to use.	24 weeks	Not published	
Fault repair time (service	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 10	Not published	

[116] Average between all operators

affecting)		hours		
Fault repair time (non service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 36 hours	Not published	
Service availability	The percentage of time the circuits are available for service.	99%	Not published	

d. Backhaul service

Table 119 - KPI, targets and measurements methods for backhaul services in Saudi Arabia

KPI	Definition	Target	Actual QoS[117]	Measurement method
Installation time (capacity available)	Average time from order received and accepted until the service is installed and ready to use.	12 weeks	Not published	Statistics provided by operators
Installation time (capacity not available)	Average time from order received and accepted until the service is installed and ready to use.	24 weeks	Not published	
Fault repair time (service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 10 hours	Not published	
Fault repair time (non service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 36 hours	Not published	
Service availability	The percentage of time the circuits are available for service.	99%	Not published	

[117] Average between all operators

11.2.5 Transmission link, data local access and internet services QoS (wholesale services)

a. Transmission link service

Table 120 - KPI, targets and measurements methods for transmission link services in Saudi Arabia

KPI	Definition	Target	Actual QoS[118]	Measurement method
Installation time (equipment available)	Average time from order received and accepted to service installed and ready to use. It is measured from receipt and acceptance of a correct order to service provisioned and ready to use. Service Providers shall calculate the average delivery time for all connections supplied in the data collection period. The time should be measured in elapsed weeks (including all public holidays, etc.) from the date of order.	10 weeks (RIO)	10	Statistics provided by operators
Installation time (equipment not available)	Average time from order received and accepted to service installed and ready to use.	20	20	
Fault repair time (service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use. It counts the number of fault reports received, measure the time taken to repair each individual fault, and then calculate the percentage of faults repaired within the target timeframes. The time starts from receiving and registering the customer fault report.	85% in 20 hours (RIO)	100 %	
Fault repair time (non service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 72 hours (RIO)	100%	
Service availability	Time from receiving the fault report until the service is restored and ready to use. It counts the number of fault reports received, measure the time taken to repair each individual fault, and then calculate the percentage of faults repaired within the	99,7% yearly (RIO)	Between 99.9 and 100.0%	

[118] Average between all operators

	target timeframes. The time starts from receiving and registering the customer fault report.			

b. Data local access service

Table 121 - KPI, targets and measurements methods for data local access services in Saudi Arabia

KPI	Definition	Target	Actual QoS[119]	Measurement method
Installation time (equipment available)	Average time from order received and accepted to service installed and ready to use.	10 weeks (RIO)	Not published	Statistics provided by operators
Installation time (equipment not available)	Average time from order received and accepted to service installed and ready to use.	20 weeks (RIO)	Not published	
Fault repair time (service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 20 hours (RIO)	Not published	
Fault repair time (non service affecting)	Time from receiving the fault report for service faults until the service is restored and ready to use.	85% in 72 hours (RIO)	Not published	
Service availability	Time from receiving the fault report until the service is restored and ready to use.	99,7% yearly (RIO)	Not published	

c. Internet services

Table 122 - KPI, targets and measurements methods for Internet services in Saudi Arabia

KPI	Definition	Target	Actual QoS[120]	Measurement method
Bandwidth	Percent utilization of connection links to the national	Max	Not	Statistics

[119] Average between all operators

[120] Average between all operators

utilization for national Internet links 10 and interconnecting links between ISP and FDSP[121]	Internet broadband core network. Facilities based Data Service Providers (FDSPs) shall measure the peak traffic load in the month for the connection links for each Internet Service Provider (ISP): between ISPs and the FDSP, between the FDSP and the national broadband core network, and divided by the total bandwidth available for the connection links (%). The peak traffic load is defined as the number of bits transferred during the busiest 5 minute period of every month.	90% for 3 consecutive months	published	provided by operators
Bandwidth utilization for international Internet links11[122]	Percent utilization of connection links to the point of presence of international Internet. For each ISP, the FDSP shall measure the peak traffic load in the month for the connection links to the first point of presence of international Internet and divide by the total bandwidth available for the connection links (%). The peak traffic load is defined as the number of bits transferred during the busiest 5 minute period of every month.	Max 90% for 3 consecutive months	Not published	

11.2.6 Interconnection links QoS

a. SS7-based interconnect link

Table 123 - KPI, targets and measurements methods for Interconnection link services in Saudi Arabia

KPI	Definition	Target	Actual QoS[123]	Measurement method

[121] Service Providers should closely monitor their links when loading level exceeds 80%. However, purchasing additional bandwidth is required if the bandwidth utilization of the terrestrial links exceeds the 90% loading level for a period of at least 3 consecutive months and if there is no better alternative plan to maintain the QoS.

[122] Service Providers should closely monitor their links when loading level exceeds 80%. However, purchasing additional bandwidth is required if the bandwidth utilization of the terrestrial links exceeds the 90% loading level for a period of at least 3 months and if there is no better alternative plan to maintain the QoS.

[123] Average between all operators

Installation time (new connection)	Average time from order received and accepted to service installed and ready to use. Installation time is measured from receipt and acceptance of a correct order to service provisioned and ready to use. Service Providers shall calculate the average delivery time for all connections supplied in the data collection period. The time should be measured in elapsed weeks (including all public holidays, etc.) from the date of order.	20 weeks (RIO)	Not published	Statistics provided by operators
Installation time (additional link capacity available)	Average time from order received and accepted to service installed and ready to use.	10 weeks (RIO)	10	
Fault repair time (service affecting)[124]	Time from receiving the fault report until the service is restored and ready to use. Service Providers shall count the number of fault reports received, measure the time taken to repair each individual fault, and then calculate the percentage of faults repaired within the target timeframes. The time starts from receiving and registering the customer fault report.	85% in 10 hours (RIO)	100%	
Fault repair time (non service affecting)	Time from receiving the fault report until the service is restored and ready to use.	85% in 36 hours (RIO)	100%	
Service availability	The percentage of time the link is available for service. The time the links are actually in service divided by the total time in the month (%).	99,7% yearly (RIO)	Between 99.9% and 100.0%	
Unsuccessful call attempts	Percentage of unsuccessful call termination attempts. Service Providers shall count the number of call termination attempts that could not be completed due to technical problems for which the Service Provider is responsible (e.g., network congestion, line failure) divided by the total number of call termination attempts during the Busy Hour (%).	< 2%	Between 0.13% and 1.66%	

[124] The Quality of Service reports filed with CITC must include information on action taken to repair the remaining proportion of faults and the time taken to repair them.

b. SIP based interconnect link services

Table 124 - KPI, targets and measurements methods for SIP based interconnect link services in Saudi Arabia

KPI	Definition	Target	Actual QoS[125]	Measurement method
Installation time	Average time from order received and accepted to Interconnect Link Service ready to use by the other Service Provider. Installation time is measured from receipt of a correct order until the Interconnect Link is provisioned and ready to use. Service Providers shall calculate the average delivery time for all Interconnect Links supplied in the month. The time should be measured in elapsed weeks (including all public holidays, etc.) from the date of order.	< 6 weeks	Not published	Statistics provided by operators
Fault repair time (service affecting)	Time from receiving the fault report until the service is restored and ready to use. Service Providers shall count the number of fault reports received, measure the time taken to repair each individual fault, and then calculate the percentage of faults repaired within the target timeframes. The time starts from receiving and registering the customer fault report.	85% in 10 hours	Not published	
Fault repair time (non service affecting)	Time from receiving the fault report until the service is restored and ready to use	85% in 36 hours	Not published	
Service availability	The percentage of time the SIP Interconnect Link is available for service. The time the SIP Interconnect Link is actually in service divided by the total time in the month (%).	99,8%	Not published	
Unsuccessful call attempts	Percentage of unsuccessful call termination attempts. Service Providers shall count the number of call termination attempts that could not be completed due to technical problems for which the Service Provider is responsible (e.g., network congestion, line failure), divided by the total number of call termination attempts during the Busy Hour (%).	< 2%	Not published	

[125] Average between all operators

Delay standard for voice services	The maximum roundtrip delay for voice calls. End-to-end roundtrip delay measured at different IP destinations in the interconnecting Service Provider's network. The measurements shall be made by each SP at the interconnection point between the Service Providers when required by CITC or as a result of user complaints.	95% in 25 ms	Not published	

11.3 Organisation and processes

11.3.1 CITC organisation

No information available.

11.3.2 General processes

The following process is used in Saudi Arabia for QoS monitoring.

- Operators report KPI every quarter and each report show monthly results. They publish the reports on their own websites.
- During seasonal or special events, such as the Hajj period, at the starting and ending of Ramadan, and any other events designated by CITC, a special report on QoS achieved as directed by CITC must be provided.
- CITC may carry out an audit, and/or engage an independent third party to carry out an audit, either periodically or when it suspects a difference between reported and real QoS values as a result of customer surveys, consumer complaints, complaints made by other operators, etc.
- Where a QoS report indicates that a mandated target has not been achieved, the operator shall provide an explanation as to why the target value was not achieved and what specific steps it has taken or intends to take to correct the problem.
- CITC advises the operator within 30 days of receipt of any QoS report whether it accepts the explanation (if CITC does not reply within 30 days, the explanation is deemed accepted).

- If CITC does not accept the explanation, CITC issues a decision setting out the additional steps that the operator shall take and the associated timing. CITC can also require additional reporting.
- If the operator continues to miss the mandated target value for a period of 6 months after the decision, CITC may impose penalties.
- CITC may conduct customer quality satisfaction surveys (for example on Internet throughputs) from time to time which can be used to set new targets which may be published. Comments can be made by operators within 3 weeks.

For mobile operators, a specific process is followed as they shall estimate radio service coverage (outdoor and indoor signal strength) by a combination of radio coverage prediction and measurements for mobile services and publish service coverage maps, in a format suitable for web browsing, per major city and per province, including highways. The published information shall include current service coverage and it may include service coverage specified in national roaming agreements with other operators, with:

- Green marked areas for good reception both at street level and indoor at ground level in function rooms facing the outside;
- Yellow marked areas for good reception at street level (no penetration loss);
- Good reception means that relevant QoS targets are met.

These maps shall be updated at least yearly.

‘

12 Singapore

Table 125 - Main economic and telecommunications market development indicators for Singapore

Country	# of inhabitants[126] (millions)	GDP per capita PPP[127] (US$)	NRA	Penetration rates[128]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
Singapore	5	61,803	IDA	37.2 %	157.1%	105.0 %	2	3

12.1 Policy

12.1.1 Legal context

As a statutory body, IDA's various roles are defined under legislation such as the Info-communications Development Authority of Singapore Act (Cap. 137A), the Telecommunications Act (Cap. 323), and the Postal Services Act (Cap. 237A).

12.1.2 QoS Policy

Policies and Regulations constitute a large part of IDA's efforts to create a conducttive Info-communications environment that is both pro-consumer and pro-business. To ensure sustainable growth and competition in a multi-operator, multi-network environment, IDA formulates and develops short- and medium-term policies, as well as standards, codes of practices and advisory guidelines - all of which are enforceable by IDA - pertaining to issues such as licensing, interconnection, resource and competition management, to name a few.

Throughout its Policy and Regulations work, IDA is committed to the principles of:

- Promoting effective and sustainable competition;

[126] United Nations, June 2013

[127] World Bank, 2012

[128] http://www.ida.gov.sg/Infocomm-Landscape/Facts-and-Figures/Telecommunications/Statistics-on-Telecom-Services/Statistics-on-Telecom-Services-for-2013-Jul-Dec

- Promoting facilities-based competition to the greatest extent possible;
- Relying on market forces;
- Adopting proportionate regulation;
- Remaining technology-neutral; and
- Providing a transparent and reasoned decision-making process.

These principles are aimed at creating an environment that allows free and fair competition, so that consumers' interests are protected and they benefit from greater choices and the proliferation of innovative products and services. In recognition of the dynamic nature of the industry, IDA also progressively fine-tunes and reviews its policies and regulations.

In this context, IDA regularly reviews the QoS requirements to take into account, industry and technology changes, as well as changes in consumer demand. This is to ensure that the requirements remain relevant. IDA also consults the industry and public before deciding on the parameters and standards to be adopted.

IDA includes in its regulations technical specifications from the ITU's recommendations that are of relevance to consumers. In setting the QoS framework, IDA ensures that the parameters and standards set are meaningful and reflective of the regulatory and policy objectives of the telecommunication regulator. Singapore is also one of few countries known to have imposed QoS standards on telecommunication services for compliance purposes.

12.2 KPI, targets and measurement

Measurements are carried out by the operators and the results are reported quarterly on IDA's website. A distinction is made between different technologies and between KPIs for compliance and KPIs for monitoring.

12.2.1 KPIs for retail broadband access

This is applicable to Broadband Access Service Providers (BASPs) providing fixed-line broadband services to residential and/or business end users, and who have more than 10% market share in the fixed-line residential or business broadband markets.

Affected BASPs who offer higher or equivalent Service Level Agreements or Guarantees to their end users can request for an exemption from complying

with the QoS framework. A BASP can also request for an exemption if it can demonstrate that its end users have agreed to accept a lower QoS standard.

Where the BASP is not subject to IDA's minimum QOS standards or is exempted from compliance, the BASP has the responsibility to inform the end user of the service level it will be providing and the fact that it does not comply with IDA's minimum QoS standards.

Table 126 - KPI, targets and measurements methods for retail broadband access in Singapore[129]

KPI	Definition	Target	Actual QoS	Measurement method
Network Availlability	Network Availability = (Total operational minutes – Total minutes of service downtime) / Total operational minutes x 100%	> 99.9%	99.99%	Network Availability is the measure of the degree to which the access network is operable
Network Latency	95th-percentile of ping round-trip	N/A	N/A	If more than one network latency figure is available for either the local or international network, BASPs must also submit one weighted average network latency figure for the relevant segment
Local Network Latency		≤ 50 ms	8 ms / 28 ms	"Test-calls" at 5-minute intervals during the 3 busiest consecutive hours for broadband Internet usage every day, excluding Sundays and public holidays.
International Network Latency		≤ 300 ms	180 ms / 210 ms	
Bandwidth Utilization	Highest Bandwidth Utilisation = (peak utilisation level in each segment) / (total bandwidth available for that segment) separately, for each link in the local	≤ 90% [not to exceed 90% for 3 or more consecutive months]		"Daily" MRTG Graphs at 5 minute average during peak hours

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http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/StandardsQoS/QualityofService/Qos_webpage_bb.pdf

	network			

The following additional KPIs are for monitoring, only:

- Service Activation Time:
    - % of service accounts activated within 5 working days or on a date agreed/specified by customers;
    - Total number of applications received for the period;
- Customer service support:
    - Number of customer complaints received per 1000 subscribers;
- Multiple TCP Throughput:
    - Local for Residential and Business;
    - International for Residential and Business;
- Single TCP Throughput:
    - Local for Residential and Business;
    - International for Residential and Business;
- International Bandwidth Utilisation [only for Internet Exchange Service Providers (IXSP) to provide on the behalf of BASPs].

12.2.2 KPIs for 2G mobile telephone service

This is applicable to Facilities-Based Operators ("FBOs") providing 2G Public Cellular Mobile Telephone Service ("PCMTS"). Please note that all FBOs providing 2G PCMTS are required to submit to IDA their QoS performance for the "Compliance Indicators" and "Monitoring Indicators" as set out below, on a quarterly basis. For consistency, IDA applies the same QoS standards for the 2G PCMTS performance survey conducted by IDA.

Table 127 - KPI, targets and measurements methods for 2G mobile services in Singapore

KPI	Definition	Target	Actual	Measurement

			QoS	method
Service Coverage: on street level coverage	Coverage on defined test routes	> 95%	99.93% to 99.96%	
Service Coverage: in-building coverage	Average per building	> 85% for public areas		For public areas, only

The following additional KPI are for monitoring, only:

- Network Availability:
    - for Base Stations (BS) Mobile Switching Centre (MSC);
        - Total outage time (hrs/min) in a month;
        - No. of day with >15min outage;
        - Worst outage time over 24hr period in a month;
- Network Congestion During Busy Hour:
    - Total number of base stations/cells as at end period;
    - % of network congestion for the busiest cell during busy hour;
    - % of cells with >5% reduced GOS during busy hour;
- Success rate for PSTN and Mobile Originated Calls achieved (QoS ranges from 99.17 to 99.69):
    - Success rate for PSTN and mobile originated calls during busy hour in the busiest/worst cell locality.
- Average Call Set-up Time for:
    - Land to mobile calls;
    - Mobile to land calls;
    - Mobile to mobile calls.
- Drop call rate of PSTN and mobile originated calls during busy hour;
- Drop call rate of PSTN and mobile originated calls;
- Localities where drop call rates exceeds 5%;

- Complaints on coverage per 1000 subscribers.

12.2.3 KPIs for 3G mobile telephone service

This is applicable to Facilities-Based Operators ("FBOs") providing 3G Public Cellular Mobile Telephone Service ("PCMTS"). Please note that all FBOs providing 3G PCMTS are required to submit to IDA their QoS performance for the "Compliance Indicators" and "Monitoring Indicators" as set out below, on a quarterly basis. For consistency, IDA applies the same QoS standards for the 3G PCMTS performance survey conducted by IDA.

Table 128 - KPI, targets and measurements methods for 3G mobile services in Singapore

KPI	Definition	Target	Actual QoS	Measurement method
Service – coverage Nation-wide outdoor Coverage	Total number of samples (> - 100 dBm) / total number of samples * 100%	> 99% coverage with -100 dBm or better (average)	94.6% - 97.4%	Minimum of 100 000 test samples per month for outdoor coverage: drive and walk testing
In-building coverage		> 85% coverage with -100 dBm or better (per building)	N/A	
Tunnels coverage		> 99% coverage with -100 dBm or better for new tunnels (per tunnel)	N/A	
		> 95% coverage with -100 dBm or better for existing tunnels (per tunnel) (99% coverage standard for monitoring not subject to penalties)		
Call Success Rate - Across all cell localities	Total number of successful calls / total number of call attempts * 100%	> 99%	99.5% - 99.6%	Average monthly success rate

Call Success Rate - In the busiest cell locality		> 95%	N/A	
Call Success Rate - For each cell locality		> 70%	N/A	
Call drop rate - Across entire month	Total number of failed calls / total number of successful call attempts * 100%	< 1%	0.3 - 0.6	Average monthly drop rate
Call drop rate - During busy hour		< 2%		
Call drop rate - During hour with worst performance		< 2%		

The following additional KPI are for monitoring, only:

- Network Availability:
    - for Base Stations (BS) Mobile Switching Centre (MSC);
        - Total outage time (hrs/min) in a month;
        - No. of day with >15min outage;
        - Worst outage time over 24hr period in a month;
- Network Congestion During Busy Hour:
    - Total number of base stations/cells as at end period;
    - % of network congestion for the busiest cell during busy hour;
    - % of cells with >5% reduced GOS during busy hour;
- Average Call Set-up Time for:
    - Land to mobile calls;

- Mobile to land calls;
- Mobile to mobile calls.

- Complaints on coverage per 1000 subscribers.

12.2.4 KPIs for fixed telephone service

Table 129 - KPI, targets and measurements methods for fixed telephone services in Singapore[130]

KPI	Definition	Target	Actual QoS	Measurement method
Availability of telephone exchange equipment	Faults related to software and hardware	≥ 99.99%	N/A	N/A
Availability of access network		≥ 99.85%	N/A	N/A
Direct Exchange Lines (DEL)	N/A	N/A	N/A	To be separately measured for residential and business DELs
Telephone installation and activation	% of phones installed within 5 working days or date specified by customer	≥ 95%	100%	N/A
Telephone installation and activation	% of phones installed within 4 working days after date specified above	100 %	N/A	N/A
Telephone fault repair time	% of faults fixed within 24 hours	≥ 90%	97.65% - 100% (residential) and 98.93 - 100 (business)	N/A N/A
Telephone fault repair time	% of faults fixed within 72 hours	≥ 99.9%	100% (residential) and 99.96% - 100%	N/A

[130] http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/StandardsQoS/QualityofService/QoS_webpage_-_DEL.pdf

			(business)	
No. of Faults reported	Per 100 DELs	< 0.5	N/A	N/A
Telephone Fault Reporting Service	% of total calls handled	≥ 95%	N/A	N/A
Telephone Fault Reporting Service	Average waiting time	N/A	N/A	For monitoring
Telephone Fault Reporting Service	% of trouble reports within 30 days of installation and activation	N/A	N/A	

12.2.5 KPIs for leased lines

This is applicable to digital local leased circuit service providers (i.e., Facilities-Based Operators (FBO) who own and operate the circuits). It is not applicable to resellers.

Local Leased Circuits (LLCs) refer to domestic private leased circuits with either point-to-point or point-to-multi-point configurations, providing dedicated/ transparent telecom links to end users or licensees for carrying any voice/data/video traffic using the SDH technology. It includes LLCs used for connections to international IPLC gateways but exclude other domestic infrastructure or data services such as managed data services and backhaul for access to international capacities via submarine cables or satellites.

- Service providers who offer higher or equivalent Service Level Agreements or Guarantees to their end users can request for an exemption from complying with the QoS framework. A service provider can also request for an exemption if it can demonstrate that its end users have agreed to accept a lower QoS standard.

- Where the service provider is exempted from compliance, the service provider has the responsibility to inform the end user of the service level it will be providing and the fact that it does not comply with IDA's minimum quality of service standards.

Table 130 - KPI, targets and measurements methods for leased lines services in Singapore[131]

KPI	Definition	Target	Actual QoS	Measurement method
Service Reliability	[Sum [Per circuit minutes – per circuit outage minutes] / Sum [Per circuit minutes] } x 100%	≥ 99.9%	N/A	N/A
Provisioning Time	[Total no. of leased circuits provided within date agreed with customers] / [Total no. of leased circuits required] } x 100%	≥ 95%	N/A	N/A
Mean Time to Repair	[Total no. of hours taken to repair faults for all leased circuits] / [Total no. of leased circuit faults reported]	≤ 3 hrs	N/A	N/A

12.2.6 KPIs for Opennet's Provisioning of residential and non-residential end-user connection service[132]

Opennet is the operator responsible of building, managing and operating a open high quality fibre platform for Singapore's Next Generation Nationwide Broadband Network.

Table 131 - KPI, targets and measurements methods for Opennet services in Singapore

KPI	Definition	Target	Actual QoS	Measurement method
% of **residential** orders provisioned within 3 business days	[Total number of residential orders submitted which are provisioned within three business days] / Sum [total number of residential orders submitted - total number of residential orders submitted which are rejected/cancelled within 3 business days] } x 100%	≥ 98.0%	N/A	Calculation for each calendar month

[131] http://www.ida.gov.sg/~/media/Files/PCDG/Licensees/StandardsQoS/QualityofService/QoS_webpage_-_leased_ckt.pdf

[132] http://www.ida.gov.sg/Policies-and-Regulations/Industry-and-Licensees/Standards-and-Quality-of-Service/Quality-of-Service

% of **residential** orders provisioned within 7 business days	[Total number of residential orders submitted which are provisioned within three business days] / Sum [total number of residential orders submitted - total number of residential orders submitted which are rejected/cancelled within 7 business days] } x 100%	100.0%	N/A	
% of **non-residential** orders provisioned within 4 calendar weeks	[Total number of residential orders submitted which are provisioned within three business days] / Sum [total number of residential orders submitted - total number of residential orders submitted which are rejected/cancelled within 4 calendar weeks] } x 100%	≥ 80.0%	N/A	
% of **non-residential** orders provisioned within 8 calendar weeks	[Total number of residential orders submitted which are provisioned within three business days] / Sum [total number of residential orders submitted - total number of residential orders submitted which are rejected/cancelled within 8 calendar weeks] } x 100%	100.0%	N/A	
% of Residential End-User Connections delivered to OpenNet's Requesting Licensees in working condition	[Total Number of Residential EUCs installed in a month –(Number of Installation-Related Faults and/ or No Fault Found cases for Residential EUCs installed in that month)] / [Total Number of Residential EUCs installed in that month]	98%	Between 98.26% and 98.50%	Calculation for each calendar month
% of Non-Residential End-User Connections delivered to OpenNet's Requesting Licensees in working condition	[Total Number of Non-Residential EUCs installed in a month –(Number of Installation-Related Faults and/ or No Fault Found cases for Non-Residential EUCs installed in that month)] / [Total Number of Non-Residential EUCs installed in that month]	99%	Between 99.06% and 100%	
% of Residential End-User Connections with Installation-Related Faults which are repaired within 1 hour of the Appointed Time	[Total Number of Installation-Related Faults on Residential EUCs scheduled for repair in a month and which are Repaired by OpenNet within 1 (or 72) Hour(s) of the Appointed Time] / [Total Number of Installation-Related Faults on Residential EUCs scheduled for repair in that month]	90%	N/A	
% of Residential		99.9%	N/A	

End-User Connections with Installation-Related Faults which are repaired within 72 hours of the Appointed Time				
% of Non-Residential End-User Connections with Installation-Related Faults which are repaired within 1 hour of the Appointed Time	[Total Number of Installation-Related Faults on Non-Residential EUCs scheduled for repair in a month and which are Repaired by OpenNet within 1 (or 72) Hour(s) of the Appointed Time] / [Total Number of Installation-Related Faults on Non-Residential EUCs scheduled for repair in that month]	90%	N/A	
% of Non-Residential End-User Connections with Installation-Related Faults which are repaired within 72 hours of the Appointed Time		99.9%	N/A	

12.2.7 Number portability[133]

Full Mobile Number Portability that allows anyone who wishes to keep their current number when they switch mobile operator, to do so by the next working day is implemented since 2008. Both pre-paid and post-paid mobile subscribers can make use of this solution to retain their original phone numbers.

12.3 Organisation and processes

12.3.1 IDA organisation

The IDA's Competition and Resource Development team is the team that handles QoS matters, within which there are various sub-teams. IDA are unable to give specific figures as numbers do change and responsibilities overlap.

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[133] http://www.ida.gov.sg/Policies-and-Regulations/Regulations/Store/Consumer-Guide-To-Full-Mobile-Number-Portability

12.3.2 Process

Operators who fail to comply with the telecommunications QoS standards would have to pay a financial penalty ranging from S$5,000 to a maximum of S$50,000 for each instance of non-compliance. IDA will consider all relevant factors such as

- the extent of impact of the non-compliance;
- the cause of the non-compliance;
- the efforts taken by the service providers to meet the QoS standards;
- any challenges faced by the service providers in meeting the QoS standards.
- Higher penalties may be imposed for:
- serious failures and/or;
- continuing or repeated breaches.

IDA regularly reviews the QoS requirements to take into account industry and technology changes, as well as changes in consumer demand, to ensure that the requirements remain relevant.

13 Unit Arab Emirates

Table 132 - Main economic and telecommunications market development indicators for Unit Arab Emirates

Country	# of inhabitants [134] (millions)	GDP per capita PPP (US$)[135]	NRA	Penetration rates[136]			# of main competitors	
				Fixed telephony	Mobile	Broad-band	Fixed	Mobile
United Arab Emirates	9	42,080	TRA	23%	149%	11%	2	2

13.1 Policy

13.1.1 Legal context

The Federal Law by Decree No. 3 of 2003 - Telecom Law (Article 13 and 14) and the Executive Order of Federal Law by Decree No. 3 of 2003 regarding the Organisation of the Telecommunications Sector (Article 11 and 47) are the basis of TRA's regulation.

Article 13 of the Telecom Law indeed states: *"The Authority shall exercise its functions and powers under this Federal Law by Decree and its Executive Order to: […] 3) ensure that Licensees meet quality standards of performance and adhere to the terms and conditions of the Licenses granted to them".* Also, article 14 of the Telecom Law states*: "The Authority shall have the competence to issue Licenses in accordance with the provisions of the Law, as well as issue regulations, instructions, decisions and rules regulating the following: […] 3) the conditions, level and scope of services provided by the Licensees to subscribers, universal service and emergency services including the standards and quality of the provided services, terms of supply, the handling of subscriber complaints and disputes, provision of information to subscribers, usage of subscriber personal information and the provision of bills to subscribers".*

[134] United Nations, June 2013

[135] World Bank, 2012 or 2011

[136] ITU, for 2011

Both grants the TRA to regulate any requirements related to QoS and perfomance. Based on these instruments, TRA published its regulatory policy in relation to QoS in December 2009.

13.1.2 QoS policy

TRA's regulatory policy document is a very brief document which describes TRA's policy (less than one page) and lists KPIs. TRA's policy is:

- Operators shall provide timely and accurate QoS data to TRA;
- QoS data submitted by operators shall be in accordance with KPIs;
- The TRA shall inform the operators on any reporting specifications, the form, the format and due dates related to the provision of QoS data;
- Operators shall maintain any and all records and/or supplemental information necessary to substantiate the QoS data submitted by operators for a period of one year;
- The TRA may at its discretion:
    - Request supplemental information or an audit in order to confirm and/or clarify any QoS data submitted by operators;
    - Modify the KPI as well as any other reporting related aspect;
    - Impose performance level obligations upon operators;
    - Publish KPI or oblige operators to publish KPI.

All operators ("Licensee") have to provide KPI listed in annexes.

TRA follows a pragmatic approach. It monitors the data collected and where required, on a case by case basis, TRA runs campaigns where it addresses specific concerns related to certain issues. TRA can on a case by case basis conduct audit on the requested QoS information. For example, recently, TRA conducted an analysis of an increase in complaints related to billing. Such analysis was followed up by audit of the information provided by licenses (licensee's internal audit), a workshop and set KPIs for lowering the amount of billing complaints.

TRA also conducts its own study on mobile QoS and coverage.

It is important to note that TRA issued in 2006 a Number Portability policy document.

13.2 KPI and measurement

13.2.1 Operators' measurements (fixed and mobile)

The table below presents the KPI, targets if relevant and measures:

Table 133 - KPI, targets and measurements methods in the UAE

KPI	Definition	Target	Actual QoS[137]	Measurement method
Call Center - Waiting Time to Speak to an agent	Average queue time in seconds a customer spent waiting; from the time the customer selects the IVR choice to speak to an agent until the customer is connected to an agent	No target	6 to 72 s	Operators statistics
Average number of delivery days for fixed lines	The total average order delivery time in days to deliver orders to customers, calculated by the ratio: number of days required to complete all orders in that month / number of orders completed that months		Between 0,1 and 3,3	
% of orders delivered within 7 days of application	The % order delivery intervals within 7 days of application date is calculated by the ratio: orders completed within 7 days of application date / Total orders completed		Between 90 and 99,9%	
Non-completed orders after 60 working days from its application	Held orders ("waiters"), are the number of orders not yet completed with the application date at least 60 working days prior to last calendar day of the month.		Between 0 and 140	
Number of reported faults per 1000 subscriber lines	Reported faults per 1000 lines is calculated by the ratio: total number of faults reported on service x1000 /total number of lines		Between 11,8 and 29,1	

[137] Average between all operators

Average hours to resolve reported faults on Services	Time to resolve reported faults on services is the average elapsed hours to resolve reported faults on services and is calculated by the ratio: total number of working hours taken for all faults cleared during the months/ total number of cleared faults		Between 11 and 22 hours	
Fixed network availability	The Network Availability is a measure of the time the network is available to provide services to users. It is the probability that a fixed network can perform all its required functions		Between 99,98% and 100%	
Network Effectiveness Ratio – Fixed network	The Network Effectiveness Ratio (NER) is the ability of a network to deliver a call to its destination. It is calculated as defined by ITU-T Recommendation E425: total answered calls + total unanswered calls (Unanswered calls refer to any causes of the release of a connection (in every phase of the call) as defined in Annex A of ITU-T Recommendation E425) / total calls		Between 96,5% and 97,7%	
Mobile network availability - Core	The mobile core network availability was calculated in a such a way that affected subscribers are considered to be the weighting factor, as the formula: 1- total duration of outages in sec x number of affected customers/ (30x24x60x60xnumber of customer)		100%	
Mobile network availability – Access	For the mobile access (wireless) network, the report is a calculation of the total downtime of the Radio Network Controller (RNC) and the Base Station Controller (BSC), as the formula: 1- total durations of RNC and BSC outages in sec x number of cells connected to RNC or BSC/ (30x24x60x60xnumber of cells connected to RNC or BSC)		Between 99,98% and 100%	
Mobile call completion successful rate 2G	The Call Completion Success Rate is calculated as: [The Call Setup Success Rate X (1 – Call Drop Rate)] X 100		Between 98.02% and 99.36%	
Mobile call completion			Between	

successful rate 3G	Alternatively it can also be thought of as the percentage of call attempts that resulted in a normal call termination. It is calculated separately for 2G and 3G networks		99,34% and 99,66%	
Call set up success rate 2G	The Call Setup Success Rate of the system is the percentage of call attempts that resulted in a successful call initiation.		Between 98,29% and 99,64%	
Call set up success rate 3G			Between 99,6% and 99,81%	
Call drop rate 2G	Call Drop Rate of the system is the percentage of successful initiations that dropped. It is calculated by: (# "of dropped calls")/(# "successful assignments") ×100 It is calculated separately for 2G and 3G networks		Between 0,25% and 0,30%	
Call drop rate 3G			Between 0,14% and 0,27%	
Delivery speed for 2Mbps	Lowest download speed during peak hour / subscriber speed		Between 93.6% and 104.6%	
Delivery speed for 4Mbps				
Delivery speed for 16Mbps				
Broadband – average number of delivery days	The total average order delivery time in days to deliver orders to customers, calculated by the ratio: number of days required to complete all orders in that month / number of orders completed that months		Between 0,1 and 3,05	
Broadband - % of orders delivered within 7 days of application	The % order delivery intervals within 7 days of application date is calculated by the ratio: orders completed within 7 days of application date / Total orders completed		Between 91,4% and 99,9%	
Broadband – uncompleted orders after 60 working days	Held orders (“waiters”), are the number of orders not yet completed with the application date at least 60 working days prior to last calendar day of the month.		Between 0 and 176	

Broadband - Number of reported faults per 1000 subscriber lines	Reported faults per 1000 lines is calculated by the ratio: total number of faults reported on service x1000 /total number of lines		Between 25 and 55	
Broadband - Average hours to resolve reported faults on Services	Time to resolve reported faults on services is the average elapsed hours to resolve reported faults on services and is calculated by the ratio: total number of working hours taken for all faults cleared during the months/ total number of cleared faults		Between 18 and 23	
Successful dial up connection	The ratio of the number of dial up connection established and connected successfully calculated as: total number of dial up attempts answered by the Internet server/Total number of dial up attempts		Between 80.5% and 96%	

13.2.2 TRA's mobile QoS and coverage measurements

The table below presents the KPI, targets if relevant and measures:

Table 134 - KPI, targets and measurements methods for mobile services in the UAE

KPI	Definition	Target	Actual QoS[138]	Measurement method
Call Completion Success Rate	It us the measure of calls that were successfully set up and normally terminated	No target	98.27% and 98.62% outdoor- 98.42 and 99.06% indoor	The survey has covered more than 11, 000 Km of the UAE's roads between April – July, 2012 at peak hours during working days. All of the emirates and major highways were covered. The TRA has performed thousands of test calls during the survey in addition to similar tests were conducted indoor for 34 static venues. The TRA has employed a
Call Setup Success Rate	Percentage of attempts that resulted in successful		98.81 and 99% outdoor – 99.02 and 99.28% indoor	
Call drop rate	This refers to the disconnection of mobile calls		0.36 and 0.49%	

[138] Average between all operators

	by the network during a 120-second call-holding period for each call		outdoor – 0.61% and 0.22% indoor	"state of the art" test equipment that has been used in more than 160 organizations and 70 countries. The equipment measures KPI that directly relate to the public's experience through Outdoor (in-car user experience) and Indoor user experience. The ratio of the voice calls attempts in regard to Mobile Originated Calls /Mobile Terminated Calls is 1/1. The call test scenario consisted of a 120 seconds holding period followed by a 45 seconds idle time.
Voice Quality	The overall voice quality rate is equal to the average voice quality on the downlink and uplink which refers to the network's ability in achieving an acceptable level of voice quality using the Mean Opinion Score (MOS) measure and **2.8 score has been set as the MOS threshold**		94.96 and 97.48% outdoor – 97.14 and 97.20% indoor	
Service Coverage in single mode (2G)	This is based on signal strength and refers to the network's ability in achieving a signal strength of -100 dBm or higher		99.97 and 99.98% outdoor	
Service Coverage in dual mode (2G/3G)			99.23 and 99.94%	
Data transfer in dual mode – HTTP download	Rate at which data is transmitted over the application protocol levels. Provided in kilobit-per-second (kbps) FTP (File Transfer Protocol): used to upload files from a workstation to a FTP server or download files from a FTP server to a workstation. Large file (5 MB) is used for the test. HTTP (Hyper Text Transfer Protocol): used to transfer files from a Web server onto a browser in order to view a Web page that is on the Internet. Small file (500 KB) is used for the test.		694-1003 kbps outdoor / 763 – 1490 indoor	
Data transfer in dual mode – HTTP upload			209-230 kbps outdoor / 176 – 219 indoor	
Data transfer in dual mode – FTP download			1796-2977 kbps outdoor / 2325-3329 indoor	
Data transfer in dual mode – FTP upload			190-248 kbps outdoor / 200-2011 kbps indoor	
Data transfer in 4G – HTTP download			499-3956 kbps outdoor / 759-3450 kbps indoor	
Data transfer in 4G – HTTP upload			183-926 kbps outdoor / 240-276	

			kbps indoor	
Data transfer in 4G – FTP download			526-2962 kbps outdoor/ 1039-2375 kbps indoor	
Data transfer in 4G – FTP upload			179-374 kbps outdoor/ 206-243 kbps indoor	

13.2.3 Number portability

The end to end porting process (the time taken between a valid port request being received and the completion of the provision of the service on the recipient operator network) must be lower than 5 working days for fixed number portability and 1 working day for mobile number portability.

Operators have to report: the number of porting requests, the number of porting made and the number of ports which were not affected during the timescales.

13.3 Organisation and processes

13.3.1 TRA organisation

TRA has 2 departments monitoring/in charge of QoS data (Technology- and Regulatory Affairs Department). However depending on campaigns or other investigations other department may get involved.

The number of staff depends on the case by case study, but one from each of the two departments is dedicated to QoS.

Their roles vary from drafting regulatory instruments – analysing the data provided by licensees to conducting workshops and prepareingreports.

13.3.2 Process

After the issuance of the list of KPI, The TRA has conducted extensive workshops where the methods of calculating, the measurements and the definition of what to measure are being set.

Operators provide data as per the Instructions on a quarterly basis, and as per request, and the TRA monitors the mobile coverage periodically.

The TRA publish yearly a report on QoS provided by the two operators.

In some instances TRA conduct workshops.

Penalties are issued according to the Telecom Law.

- Article (79) repeated (1) states: *"A person shall be penalized with a fine of not less than AED 50,000 and not more than AED 200,000 if he/she/it violates any other provision of the Law, its Executive Order, regulations, decisions, instructions or rules issued thereto."*
- Article (79) repeated (2) states: *"The Board may impose administrative fines against the Licensees for violating the provisions of the Law, its Executive Order, decisions, regulations, policies, or instructions issued by the Board or Authority. The Cabinet shall issue a decision with the schedule of the violations and fines imposed on the Licensees. Each violation shall not be of more than AED 10,000,000."*

It does not appear that TRA issued any fine in the past.

14 List of acronyms

In this list, acronyms of the benchmarked regulatory authorities are not listed (they are defined in section 0).

2G	Second Generation of telecom cellular network
3G	Third Generation of telecom cellular network
4G	Fourth Generation of telecom cellular network
ABR	Answer Bid Ratio
ADSL	Asymmetric Digital Subscriber Line
ASR	Answer Seizure Ratio
ATM	Asynchronous Transfer Mode
BASP	Broadband Access Service Providers
BCCH	Broadcast Control Channel (channel used in GSM to broadcast the specificities of each Base Station)
BEREC	Body or European Regulators for Electronic Communication
BMT	Bill Management System
BRAS	Broadband Remote Access Server
BS	Base Station
C-LOG	Canadian Local Ordering
CATS	Customer Access Tail Service (name for half circuit leased lines in Bahrain)
CDN	Competitor Digital Network (used in Canada)
Coax	Coaxial cable
CPICH	Common Pilot Channel – in UMTS, this is a downlink channel broadcast by Node Bs with constant power and of a known bit sequence
CQR	% of call set-up on first attempt and held for 2 minutes without drop and marked 3 or 4 (ITU ref P.800 MOS)

CRA	Communications Regulatory Authority
DEL	Direct Exchange Lines
DSLAM	Digital Subscriber Line Access Multiplexer
DNS	Domain Name Service
DQ	Telephone Directory Enquiries
DSL	Digital Subscriber Line
DSP	Digital Signal Processing
DWDM	Dense Wavelength Division Multiplexing
Ec/I0	The Ec/I0 parameter is a very important parameter in 3G which refers to the portion of signal which is usable: it is the ratio between signal strength (Ec) and noise floor/interference (I0).
EDGE	Enhanced Data rates for GSM Evolution
ETSI	European Telecommunications Standards Institute
EUC	End User Connection (used in Singapore)
FBO	Facilities Based Operator (used in Singapore)
FDSP	Saudi
FTTH	Fibre To The Home
FTP	File Transfer Protocol
GDP	Gross Domestic Product
GOS	Grade of Service (= number of lost calls/number of offered calls)
GPRS	General Packet Radio System
HSDPA	High-Speed Downlink Packet Access
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
ICMP	Internet Control Message Protocol (Protocol used by network devices, like routers, to send error messages indicating, for example, that a requested service is not available or that a host or router could not be reached)

IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ILEC	Incumbent Local Exchange Company
IP	Internet Protocol
IPDR	IP packet discard ratio
IPDV	One way IP Packet Delay Variation
IPER	IP packet error ratio
IPLC	IP Leased Circuits (used in Bahrain, Singapore, etc.)
IPLR	IP packet loss ratio
IPTV	Internet Protocol Television
ISP	Internet Service Provider
ITU	International Telecommunications Union
IXSP	Internet Exchange Service Providers
IVR	Interactive Voice Response
KB	KiloBits
Kbps	Kilobits per seconds
KPI	Key Performance Indicator
Km	Kilometre
LHV	% of videos set up and held for 2 min without drop
LLC	Local Leased Circuits
LLU	Local Loop Unbundling
LNI	Local Network Interconnection
LNP	Local Number Portability
LSC	Local Service Confirmation
LSR	Local Service Request
MB	MegaByte

Mbps	Megabits per second
Mls	Millisecond
MNO	Mobile Network Operator
MOS	Mean Opinion Score
MPLS	MultiProtocol Label Switching
MSC	Mobile Switching Centre
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
MVNO	Mobile Virtual Network Operator
N/A	Not Applicable
NER	Network Effectiveness Ratio
NPAC	Number Portability Administration Centre
NRA	National Regulatory Authority
OLO	Other Licenses Operator (used in Bahrain)
PC	Personal Computer
PCMTS	Public Cellular Mobile Telephone Service (used in Singapore)
PESQ	Perceptual Evaluation of Speech Quality
PING	Packet Internet Groper
PoP	Point of Presence
PPP	Purchasing Power Parity
PSTN	Public Switched Telephone Network
QoE	Quality of Experience
QoS	Quality of Service
RIO	Reference Interconnection Offer
RNC	Radio Network Controller
RS	% of SMS not refused when sent out and received within xx minutes

	without being altered
RSCP	Received Signal Code Power – In UMTS, the power measured by a receiver on a particular physical communication channel
RSSI	Received Signal Strength Indicator (Measurement of the power of a radio signal)
RTT	Round Trip Time
SDCCH	Standalone Dedicated Control Channel – Channel used in the GSM technology for most short transactions, including initial call setup step, registration and SMS transfer
SDH	Synchronous Digital Hierarchy
SG	Study Group
SHR	% of call set-up on first attempt and held for 2 minutes without drop
SIP	Session Initial Protocol
SLA	Service Level Agreement
SMP	Significant Market Power
SMS	Short Message Service
SMS	Service Management System
Std Dev / St Dev	Standard Deviation
STM1	Synchronous Transport Mode 1 (155 Mbps)
STQ	Speech and multimedia Transmission Quality
TCP	Transmission Control Protocol (one of the core protocols of the Internet protocol suite)
TV	TeleVision
UAE	United Arab Emirates
ULMP	Unbundled Local Metallic Path (sometimes called LLU)
UMTS	Universal Mobile Telephone System
USA	United States of America
USO	Universal Service Obligation
VCQR	% of videos set up and held for 2 min without drop and marked 3 or 4

VPQR	% of videos set up and held for 2 min without drop and marked 4 (perfect)
VSAT	Very Small Aperture Terminal - Technology used to transmit narrowband data or broadband data through satellite
wk	Working (for working day)
WLR	Wholesale Line Rental

15 Table and figures