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SERIES E: OVERALL NETWORK OPERATION,
TELEPHONE SERVICE, SERVICE OPERATION AND
HUMAN FACTORS

Quality of telecommunication services: concepts, models,
objectives and dependability planning – Terms and
definitions related to the quality of telecommunication
services

Quality of service operational strategy for improved regulatory supervision of providers of mobile telecommunication services

Recommendation ITU-T E.805.1

ITU-T E-SERIES RECOMMENDATIONS

OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T E.805.1

Quality of service operational strategy for improved regulatory supervision of providers of mobile telecommunication services

Summary

Recommendation ITU-T E.805.1 provides guidance to telecommunication regulators on how to achieve their regulatory goals for quality of service (QoS) at reduced regulatory effort and improved operational efficiency, thereby providing desired benefits to consumers and providers of mobile telecommunication services.

Telecommunication regulators involved in QoS supervision often face challenges on how mobile QoS within their respective jurisdictions can be enforced in a cost-effective manner and over a desired turnaround time, while not compromising reliability in QoS assessment outcomes.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Quality of service operational strategy for improved regulatory supervision of providers of mobile telecommunication services

1 Scope

This Recommendation provides guidance to telecommunication regulators on how to execute quality of service (QoS) regulation at reduced effort and improved operational efficiency, thereby providing desired benefits to consumers and providers of mobile telecommunication services. This Recommendation addresses the case of those countries where the national legislation or the QoS framework requires the involvement of regulators in QoS supervision.

The applicability of this ITU-T Recommendation may be limited under some national and regional laws, regulations and policies.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T E.802]	Recommendation ITU-T E.802 (2007), *Framework and methodologies for the determination and application of QoS parameters*.
[ITU-T E.804]	Recommendation ITU-T E.804 (2014), *Quality of service aspects for popular services in mobile networks*.
[ITU-T E.805]	Recommendation ITU-T E.805 (2019), *Strategies to establish quality regulatory frameworks*.
[ITU-T E.806]	Recommendation ITU-T E.806 (2019), *Measurement campaigns, monitoring systems and sampling methodologies to monitor the quality of service in mobile networks*.
[ITU-T E.840]	Recommendation ITU-T E.840 (2018), *Statistical framework for end-to-end network-performance benchmark scoring and ranking*.
[ITU-T G.1000]	Recommendation ITU-T G.1000 (2001), *Communications quality of service: A framework and definitions*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 **execution gap**: The difference that exists between the quality of service (QoS) planned or offered by the service provider (SP) and the QoS actually achieved or delivered. An execution gap is a measure of how much the envisaged QoS as informed by the SP's licence obligations has been translated into tangible QoS achieved or delivered outcomes to the customer.

3.2.2 **perception gap**: The difference that exists between the quality of service (QoS) achieved or delivered by the service provider and the QoS perceived by the customer.

3.2.3 **value gap**: The difference that exists between the customer's quality of service (QoS) requirements and the QoS perceived by the customer. A value gap seeks to describe how many and to what extent the customer's requirements of the service, in terms of quality, have been met.

3.2.4 **alignment gap**: The difference that exists between the customer's quality of service (QoS) requirements and the QoS planned or offered by the service provider (SP) It is a measure of the SP's ability to translate customer-centric indicators and benchmarks into realizable technical measures.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

GIS   Geographic Information System

KPI   Key Performance Indicator

QoS   Quality of Service

RCA   Root Cause Analysis

SLA   Service Level Agreement

SP   Service Provider

5 Conventions

None.

6 Background

It is recognized in [ITU-T E.805] that national regulatory frameworks for QoS can vary between countries based on several factors, like the maturity of the market in terms of competition or the level of cooperation between stakeholders. This Recommendation addresses the case of those countries where the national legislation or the QoS framework requires the involvement of regulators in QoS supervision.

ITU-T Recommendations serve as useful references to stakeholders within the telecommunication industry on issues of QoS. Of key mention is [ITU-T G.1000], which has informed the QoS assessment operations of both regulators and SPs. See Figure 1.
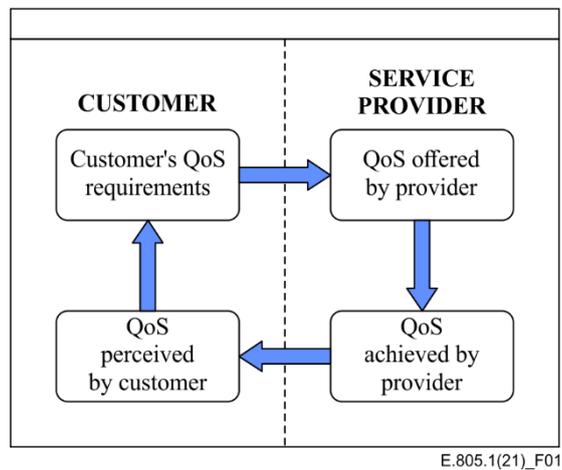
Figure 1 – [ITU-T G.1000] – The four viewpoints of QoS

QoS supervision that is based on the QoS framework model in [ITU-T G.1000] requires that mobile service regulators be empowered with relevant knowledge about the planned and achieved QoS of SPs, and its relationship with the perceived and required QoS of customers. This knowledge, which is often obtained during the regulator's QoS assessment, informs the various regulatory decisions and interventions that need to be taken for the benefit of stakeholders.

However, the perspective from one viewpoint may be inconsistent with another, e.g., QoS achieved by the SP may differ from the QoS-perceived feedback obtained from the customer. This calls for a better collaboration between the regulator and stakeholders (i.e., SPs and consumer association groups) in order to understand their biases and provide a common ground on actions that ought to be put in place to enhance service quality delivery.

7 QoS operational strategy for improved regulatory supervision

Regulators may set objectives and targets on mobile QoS for a defined period. As per regulatory efforts to achieve these objectives, it is expedient for regulators to assess their existing regulatory actions on mobile QoS and determine whether each action was carried out in accordance with the principles of cost-effectiveness, reliability and process efficiency.

Before introducing any new regulation, the regulator must ensure that the necessary resources are available to enforce the regulations and monitor their performance towards the achievement of the intended goals.

In this sense, the operational requirements for the planned regulatory supervision must be carefully studied and understood, especially regarding the setting of the budget, staff capacity, knowledge, equipment and logistics that are required to conduct regulatory supervision.

In the context of QoS regulation, to better select the QoS parameters or key performance indicators (KPIs) to be monitored and reported, as well as their impacts on the consumer, the staff of the regulator should have the necessary skills as a means to continually improve the rules and address the issues that are important to consumers.

In summary, the cardinal principles for any effective operational management, as in [b-HBR], is the achievement of high quality at reduced cost and improved delivery time. These principles, and in particular the six viewpoint approach that follows, offer a useful guide on how to implement a QoS operational strategy. Figure 2 depicts a proposal for operational strategy based on these principles, the objective being to bring regulatory interventions and processes closer to the user experience. The implementation aspects of the operational strategy as in the six viewpoints are deducible from [b-ITU QoS Regulation Manual], which seeks to compile best practice from country case experiences of QoS monitoring and enforcement.
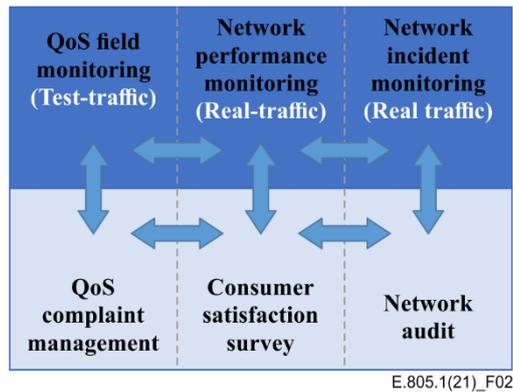
Figure 2 – Six-viewpoints of the QoS operational strategy for regulators

The six viewpoints of the QoS operational strategy for regulators and its operational aspects are further discussed in clauses 7.1 to 7.6.

7.1   QoS field monitoring

QoS field monitoring refers to all measurement methodologies that rely on information on QoS gathered at the level of the end user of the service, i.e., at the interface provided by the mobile device. According to the classification established in [ITU-T E.806], this corresponds to either walk testing (clause 6.2.1 of [ITU-T E.806]), drive testing (clause 6.2.2 of [ITU-T E.806]), unattended probes (clause 6.2.3 of [ITU-T E.806]) or crowdsourced data collection (clause 6.2.4 of [ITU-T E.806]) or a combination of several of these methodologies.

It can be based on either non-intrusive measurement with real traffic (e.g., crowdsourced data collection), as described in clause 7.1.2 of [ITU-T E.802] or on intrusive measurements with test traffic (all measurement types) as described in clause 7.1.1 of [ITU-T E.802].

This type of monitoring is intended to simulate the QoS achieved or preferably provide an objective expression of the customer's perception of services provided by SPs. Test or real traffic can be used to check user-centric QoS parameters for voice and data services, e.g., call set-up time and listening voice quality. These parameters are described in [b-ITU-T E-Suppl.9] as QoS parameters that the test traffic method can better measure as compared to real traffic.

The choice of the measurement methodology plays an important role in the QoS field monitoring strategy, as all of them have intrinsic characteristics and trade-offs that must be taken into consideration. See [ITU-T E.805] and [ITU-T E.806] for guidance on aspects involved in the choice of KPIs, QoS measuring strategy and statistical methodologies.

Remember that, keeping in mind the principles of cost-effectiveness, reliability and process efficiency, the number of KPIs to monitor may be kept at a reasonably low level.

Regulators who seek to implement an operational strategy for QoS field monitoring are in particular advised to consider the practical recommended actions in clauses 6.2.1, 6.2.2, 6.2.3 and 9 of [ITU-T E.806], complemented by the following actions to:

1)   specify the QoS parameters to be monitored as per the QoS regulations or licence,

2)   specify the estimated duration for field measurements;

3)   specify budget or logistics required based on staff size or capacity, i.e., measurements by regulator staff or measurement by a third party;

4)   specify the necessary resources for post-processing;

5)   produce a technical report based on the results and share with SP for improvement;

6)   specify the necessary resources for publishing the results;

7) analyse results to inform future actions on potential review of QoS guidelines or regulations.

The regulator may obtain from QoS field measurement systems the top N (where N is an integer) worst performing geographic or administrative areas as explained in [ITU-T E.840] for the accessibility, retainability and availability KPIs specified in [ITU-T E.804]. For further analysis, as well as the need to facilitate a QoS improvement program, the regulator may have to consider the following options, but more so in accordance with the national legislation or regulatory framework, to:

– determine the level of degradation of worst performing areas;

– examine detailed measurement results with SPs in order to come to a common understanding and explanation of potential root causes;

– request SPs to provide an action plan to resolve or improve poor QoS identified based on this common understanding;

– request SPs to share their improvement results based on the action plan – the regulator may then use its performance measurement system to validate the results;

– geographic information system-layer (GIS-layer) maps can be used to provide visualization of worst areas as per the exact areas where poor service quality is being delivered to consumers;

– if QoS levels are not met after the action plan is put into action, the regulator must analyse the application of further regulatory actions to the SP.

NOTE – For the sake of transparency and equity, the points on service improvement in this clause can be considered in the relevant legislation.

7.2 Network performance monitoring

Network performance monitoring refers to measurement methodologies that rely on information on QoS gathered inside the network conveying the service, i.e., network elements (nodes) and related interfaces, this corresponds to network performance counters.

Network performance monitoring is based on non-intrusive measurement with real traffic as described in clause 7.21.2 of [ITU-T E.802]. Real traffic measurement can be based on network performance counters or call traces.

By nature, such a measurement ignores what happens in the device or at the application level and therefore may not be the most realistic way to assess the end-to-end QoS delivered by the SPs at a user-centric level. However, it has other advantages, like a more macroscopic view and drill-down capabilities, and therefore a possibility to identify issues that can affect several users or services at the same time.

The real traffic measurement tools for performance monitoring can access network performance information from SPs (at the request of the regulation authority), create KPI reports for defined granularity or network aggregation levels and benchmark the outcomes with predefined network performance thresholds.

Regulators who seek to implement an operational strategy for network performance monitoring are in particular advised to consider the following actions to:

1) validate that the required provisions exist in the licence or regulations that grant the regulator right to request information about network performance counters;

2) validate that the required provisions exist in the licence or regulations that require(s) the SP to cooperate with the regulator on performance counter reporting;

3) align with SPs on the appropriate KPI measurement formula based on established standards and relevant vendor supporting documentation;

4) consider the staff size, capacity and budget available to perform measurements;

5)	specify the resources necessary for analysing data sent by SPs or for post-processing data collected by the regulator's performance monitoring systems;

6)	produce a technical report based on the KPI results and share with the SP for improvement;

7)	specify the necessary resources for publishing the results.

It is worth stating that the regulator may request SPs to save measurement data within such retention periods, which enables easier access and review as and when requested.

NOTE 1 – Some of the steps or considerations in the viewpoints in clauses 7.1 and 7.2 can be executed concurrently, while others depend on precedents. Nonetheless, the regulator is not obliged to implement all steps, although this can be advisable.

NOTE 2 – Regulators in respect of points 1) and 2) may have to share and discuss with SPs the project scope and related costs for the implementation of network performance monitoring systems in order to ensure smooth implementation and cooperation.

Furthermore, network performance monitoring may also consider a key assessment criterion called KPI compliance rate, which may be assessed, at network level, as the ratio of the number of days for which compliance was achieved for a given KPI to the total number of days within a given period under review; the period can be monthly or quarterly. This criterion is intended to give a quantitative appreciation of the levels of compliance achieved over a stated period, benchmarked against stated regulatory objectives. Another approach for compliance testing is to apply the techniques explained in Annex A of [ITU-T E.806] with respect to hypothesis testing.

The regulator may obtain from real traffic measurement systems the top N worst performing geographic or administrative areas based on the accessibility, retainability and availability KPIs specified in [ITU-T E.804]. This possibility is dependent on the collection of counters or KPIs at relevant locations inside SP networks, which is not necessarily always possible. For further analysis, as well as the need to facilitate a QoS improvement program, the regulator may have to consider the following actions to:

–	determine the level of degradation of the worst performing areas;

–	examine detailed measurement results with SPs in order to come to a common understanding and explanation of potential root causes;

–	request SPs to provide an action plan to resolve or improve poor network performance identified on the basis of this common understanding;

–	request SPs to share their improvement results based on the action plan – the regulator may then use its performance measurement system to validate the results;

–	potentially use GIS-layer maps to provide visualization of worst areas as per the exact areas where poor service quality is being delivered to consumers.

Traffic measurement parameters, e.g., call congestion and call set-up success rate, may be assessed using busy hour granularity selection or aggregated over the day. However, the associated directives on improvement from the regulator should be ones that are informed by levels of degradation observed.

## 7.3	Network incident monitoring

Among other ways to ensure or motivate SPs to guarantee optimal service continuity for their users, a good knowledge of network incidents constitutes a key part, as it allows the regulator to keep a continuous monitoring eye on the QoS delivered by an SP.

The QoS conditions in respect of network availability, fault repair time and impact of service outages should be documented in the licence, regulations or guidelines on QoS, where applicable. The reporting and repair time requirements on network incidents must be defined and enforced through the application of appropriate penalties or compensations, depending on the legal framework.

Information on service impacting incidents as required to be reported by the SP, may include, but is not limited to, the following:

– brief information on date and time of occurrence and resolution;

– nature of impact per type of service or technology affected;

– QoS parameters and geographical areas affected;

– root cause analysis (RCA) information;

– incident response and recovery action;

– post-incident actions;

– lessons learnt to avert future occurrence;

– consumer management approach.

Service-impacting outages may often trigger consumer complaints to the regulator's desk and should be assessed in conjunction with complaint records.

Network incident monitoring highlights certain common regulatory challenges affecting the industry. For instance, incident records with fibre cuts as the root cause may engender collaborative policy-making interventions between the regulator and the relevant government agencies.

7.4 Network audit

This viewpoint provides the regulator with a better understanding of the capability levels of the SP's network to translate its QoS offered or planned into QoS achieved. In summary, the execution gap (see clause 3.2.1) that may exist between the above viewpoints can be better assessed following an audit activity of the network. In addition, a review of the outcomes of field and network performance monitoring activities will inform largely the need for an audit to validate the network improvement goals of the SP.

The operational strategy for network audit may take into consideration the following actions.

1) To validate that there are provisions in the licence or regulations that grant the regulator right of access to the SP network for its physical inspection and audit activity, elements, links and systems.

2) To gather the necessary baseline information from the SP to review it against measurements results. A list follows of baseline information.

    a) *Network roll-out strategy*: For SPs that are yet to begin deployment having obtained their licence or authorization, it is proposed that regulators review and benchmark their network deployment strategy against stated rollout obligations.

    b) *Network improvement and expansion plan*: This will be required to ascertain remedial measures that SPs are putting in place to continually ensure the network meets acceptable QoS levels. After identifying certain performance breaches on the network, this item may be requested in the form of directives that include potential network technology updates.

    c) *Network redundancy plan*: This is required to ascertain the network's ability to guarantee service continuity in the event of an outage. The assessment outcomes of this plan will inform special surveillance operations on particular SPs whose networks experience frequent downtime. Through periodic reviews of the redundancy plans of SPs, the regulator can collaborate with the industry to address certain teething issues, such as fibre cuts. In some jurisdictions, for example, fibre is considered a critical national infrastructure.

For the control of the network audit, a good solution would be to require SPs, as a licence obligation, to submit semi-annual reports that reflect their actions on points a), b) and c. If required, and only on a sampling basis and again in terms of transparency and equity, the regulator can carry out autopsies to verify the reports of actions taken on plans a), b) and c).

The regulator may review the cost-effectiveness or otherwise of a decision to hire third parties as auditors in relation to the deployment of existing capacities or skills-sets of its employees. Thus, the decision should be about how much an organization could save in training its employees to do the same audit work as an external (third) party.

NOTE – It is possible that some national laws do not permit network audits performed by third parties.

7.5 Consumer satisfaction surveys

This aspect considers the consumer's own assessment of the QoS delivered by the SP. This is referred to as the QoS perceived.

Regulators who seek to implement an operational strategy for consumer satisfaction surveys may consider the following actions to:

1) specify the sampling methodology to estimate the number of consumers to survey;

2) specify the aspects of the mobile service to survey – the survey information may include, but is not limited to: network coverage; service activation; service restoration; network QoS; billing service; customer support services; and customer complaints resolution;

3) specify the planned duration of the survey;

4) draft the survey questionnaire,

5) evaluate the availability of the budget required for the personnel and logistics to carry out the survey and clarify whether the logistics involved need to cover the regulator's internal human resources or third party organization;

6) specify the necessary resources for data post-processing and analysis by the third party or staff of the organization, where applicable;

7) produce the survey report based on the findings obtained;

8) specify the necessary resources (e.g., budget) that may be required to publish the survey results, should it become necessary – the budget should cover cost of publication in print (in a newspaper, etc.) or electronic media (on a regulator's website, in social media, etc.).

This subjective measurement method can be done preferably once a year and the results analysed along with the QoS measurement results obtained in the particular geographic area where the survey is ongoing. The survey is intended to evaluate user-perceived QoS.

7.6 QoS complaint management

The handling of complaints is another operational aspect of the regulator's activities on QoS assessment.

Regulators who seek to implement an operational strategy for QoS complaint management may consider the following:

1) specification of how consumer complaints are received – by telephone, letter, online forms, etc;

2) the complaint may undergo an admissibility check, to validate:

   a) whether the complaint has already been presented to the SP,

   b) that the complaint reflects a breach of retail contract or service level agreement (SLA) between the complainant and the SP;

3) whether the complaint satisfies admissibility checks, and request the complainant to provide further and better details of it;

4) having been satisfied with the details supplied according to 3), supply by the regulator of information to the SP about consumer allegations and attempts to get agreement between them;

5)   if the agreement is not achieved in certain time, formulation of complaint resolution – regulators should impose curative actions on the SP to solve customer complaints;

6)   potential appeal against the resolution by the SP and the consumer.

In addition, this viewpoint seeks to provide a database or an inventory of consumer complaints on QoS. Inasmuch as such invaluable information requires regulatory redress, they are a subtle reflection of user perception of the service. The lead time from when a QoS complaint is filed to when it is resolved is a crucial indicator of the responsiveness of the SP. If an SP fails to satisfy the complaint, regulatory assistance can then be sought. The QoS regulatory guidelines or framework must establish the QoS complaint management process.

NOTE – Some of the steps or considerations in the viewpoints in clauses 7.5 and 7.6 can be executed concurrently while others depend on precedents. Nonetheless, the regulator is not obliged to implement all steps, although this can be advisable.

7.7   Working relationship between the six viewpoints of operational strategy

This clause seeks to explore how the various working aspects of the six viewpoints of the operational strategy relate to each other to improve regulatory supervision and efficiency.

7.7.1   Network performance monitoring and QoS field monitoring

The regulator can analyse the operational aspects required to deploy QoS field and network performance monitoring, as stated in clauses 7.1 and 7.2, respectively, and choose the most cost-effective solutions to fit the regulator's capabilities and needs. The regulator can deploy a QoS field monitoring solution and request the SP to send network performance reports to complement the analysis. Another aspect is that network performance information can be used to identify the potential root causes of service degradations identified through QoS field monitoring solutions. If the regulator has the capacity to implement both QoS field and network performance monitoring solutions, trade-offs on cost-effectiveness and process efficiency should be considered in the selection of QoS indicators or KPIs stated in the licence or regulations.

7.7.2   Network performance monitoring and network incident monitoring

Service downtime can be reviewed by time-correlated analysis with aggregated congestion measurements on a district or site performance basis. This method provides the regulator with an appreciation of the impact of service outages on network performance and consequently on the QoS achieved, so the appropriate regulatory interventions can be taken together with the SP.

7.7.3   Network performance or incident monitoring and network audit

Measurement findings on the availability and performance of SP networks should inform audit campaigns that ascertain whether operational plans on network redundancy, capacity optimization and incident management are being followed through. The frequency of audit may be informed by a legal framework or mutually agreed between the regulator and SP.

For instance, a network improvement plan on poor performance should be reviewed to ascertain whether the submitted plans are being executed in accordance with the proposal of the SP.

7.7.4   Consumer surveys and network performance or QoS field monitoring

A seamless working relationship is required between the consumer affairs unit of the regulator and technical units on QoS to ensure the responses captured during a survey are evaluated and analysed in tandem with test and real traffic measurement information obtained about each SP for a particular survey area and period under consideration. An internal arrangement or procedure agreement may be considered between the technical and non-technical working units on QoS to facilitate process efficiency for improved service delivery.

7.7.5 QoS complaint management and network performance or QoS field monitoring

Inside the regulator, the non-technical units on QoS should liaise with their technical counterparts to achieve smooth resolution of consumer complaints of a technical nature. However, given that the role of the regulator is not the same as that of the SP with regard to resolving complaints, the SP should be required to address the grievances of their complainant within a desired time limit.

The regulator should only intervene if, after the steps in clause 7.6 have been taken, there is still a dispute between the SP and the subscriber. Then the internal cooperation between the complaints department of the regulatory authority and the technical department dealing with the supervision of the quality indicators of the communication networks would have to be activated for further collaborative investigation and resolution.

NOTE – The operational strategy herein described is applicable to mobile network operators only.

8 Benefits of the operational strategy to service providers and consumers

By implementing an operational strategy on QoS as discussed in clause 7, telecommunication regulators can have enhanced oversight on the four viewpoints of the QoS framework model in [ITU-T G.1000]. The said oversight ensures that regulators are better informed to advocate on consumer protection, as well as for the general growth of the industry.

The adoption by the regulatory authority of an operational strategy to measure and report the performance of both the communication networks and the quality of the electronic services provided to end users is useful for determining the content of a national strategic plan for the development of electronic mobile services in a country and for the optimal use of the available radio spectrum. Thus, the purpose of implementing this Recommendation is to ensure transparency and equity in the relationship between the regulator and licensed mobile providers while protecting and informing end users. The result is the development of a competitive environment between providers, thus ensuring a favourable background for investment, while the gain for end users is the possibility of choice of cost and quality in the network to which they will decide to become subscribers.

9 Conclusion

The operational strategy described in this Recommendation and its implementation have cost implications and must be supported by the appropriate legal provisions as may be found in a licence, regulations or statute.

Bibliography

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