

# The Business Process Design for Service Level Management

Sérgio Roberto Pereira  
PUC-CAMPINAS – CPqD  
Electrical Engineering College – Telecommunications  
E-mail: sergiop@cpqd.com.br

## Abstract

This work aims at establishing the best practices and processes to define the life cycle of an SLA. For such purpose, the network management practices defined in the TMForum scope (according to the view offered by TOM [01] and eTOM [02]) are used as reference. Such best practices are distributed along the network management layer, in order to define the Network Performance indicators and their mapping, with the purpose of achieving Quality of Service indicators; such indicators will be added to other ones in the Service Management layer, extracted mainly from the relationship with the customers. On their turn, these Quality of Service indicators will compose the Service Level Agreement (SLA) defined with the customer at service selling time, along with the entire Service Level Management (SLM) that will be required to maintain the negotiated SLA.

**Keywords:** Business Processes, Quality of Service, Service Level Management, Service Level Agreement

## 1. Introduction

For a long time, networks have been the main discussion focus among telecommunications carriers, mainly due to the fact that voice service was the only item offered to the end customer. With the emergence of other services and the diversification in the service's production chain, new disciplines appeared to support the ongoing business.

Enterprise attention was focused on internal efficiency up to the Seventies; this situation changed during the Nineties, when focus on the customers became the main concern. In fact, the great concern of service providers is now quality as it is perceived by the customers. Even those companies that offered only goods have now found in the services segment the best (if not the only) differentiation opportunities.

The obvious reason for such focus redirection is the intensification of competition; consequently, the service companies had to redirect their strategy towards perceived quality. A powerful tool that enables handling perceived quality successfully is Service Level Agreement (SLA), along with the discipline that supports its implementation – Service Level Management (SLM) – and the specialized treatment that addresses specific Quality of Service (QoS) aspects. Being still a fresh focus for the telecommunications carriers, very little discussion has been produced about the best practices; besides, most of them had been established from analogies to service offer within dedicated data networks. Therefore, there is still plenty of space to determine the business processes that will define how such paradigm must be implemented within the telecommunications sector.

## 2. QoS - Quality of Service

There will always be an interaction between customers and providers in the service production and delivery process. Two components are responsible for service quality perception by the customer in this process: technical quality and interaction quality. In general, technical quality depends on technological factors that can be controlled by the provider. Interaction quality, however, depends on an unpredictable and intangible factor: the customer's perception. This is the comparison between the customer's expectation before the service was provided and the quality he experienced during the interaction process. The most effective way of managing quality under such perspective is to make clear, during the service contracting process, what the customer must expect. For such purpose, a Service Level Agreement (SLA) is established between the customer and the supplier; through this document, the provider and his customers attain a mutual agreement about the service in question.

### 2.1. QoS definition

Defining Quality of Service according to the customer's viewpoint is not an easy task. The difficulty of measuring such parameter lies in the fact that it is something emotional and personal, instead of being a purely technical item. The same service can be perceived in different ways, according to each customer. The customer's emotional condition, education level, specific moments and previous experiences will affect the way a service is perceived.

The customer may evaluate an organization by means of several dimensions: reliability, competence, conformity, access easiness, courtesy, communication, credibility, security, empathy, tangible aspects, etc.

### 2.2. ITU-T's vision on QoS

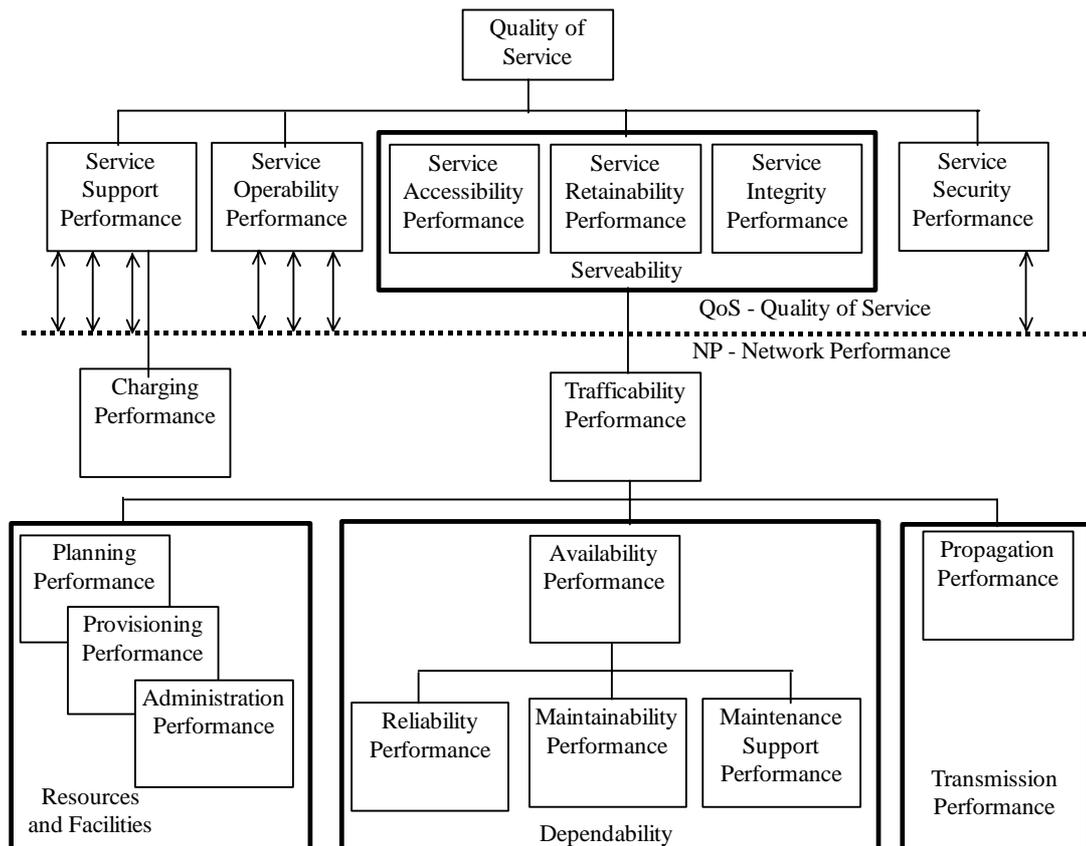
Through its E.800 [04] recommendation, ITU-T created a service quality model that is very useful for the planning of quality improvement programs aimed at telecommunications services. According to the E.800

recommendation, Quality of Service (QoS) is defined as “the collective effect of performance aspects that determine the satisfaction level shown by the users of a service”. The E.860 [05] recommendation, on its turn, describes a generic SLA structure by using an independent approach about service type and adopted technology.

Figure 1 shows what ITU-T understands by QoS. It is seen as the sum of service performance under different aspects:

- *Service Support Performance*: The ability of a carrier to provide the service on a proper basis and to support the use of such service.
- *Service Operability Performance*: It is service operation facility under the customer’s viewpoint, including the characteristics of terminal equipment, intelligibility, etc.
- *Service Security Performance*: It is the protection provided against unauthorized monitoring, fraudulent use, malicious impairment, misuse, human mistake and natural disasters.
- *Serveability Performance*: It is service attainment facility (accessibility), once requested by the user, and the provision of this service while such request lasts (retainability). The Serveability concept describes network response during the establishment, retention and release procedures of any connection associated to a service. Serveability Performance is divided into:
  - *Service Accessibility Performance*: The ability of a service to be obtained, within specified tolerances and other given conditions, when requested by the user.
  - *Service Retainability Performance*: The ability of a service, once obtained, to continue to be provided under given conditions for a requested duration.
  - *Service Integrity Performance*: The degree to which a service is provided without excessive impairments, once obtained.

Such Quality of Service concepts must be mapped by means of certain parameters that can be obtained from network performance, thus establishing a relationship between the Service Management Layer (SML) and Network Management Layer (NML), both defined in the TMN (Telecommunications Management Network) recommendations included in series M.3010 [06].



**FIGURE 1 - ITU-T’s QoS Concept**

### 3. Quality of Service Cycle for Telecommunications Networks

The QoS process starts with the continuous monitoring of network performance and the level of offered services. QoS is measured by observing the service through means that are external to such service, the execution of

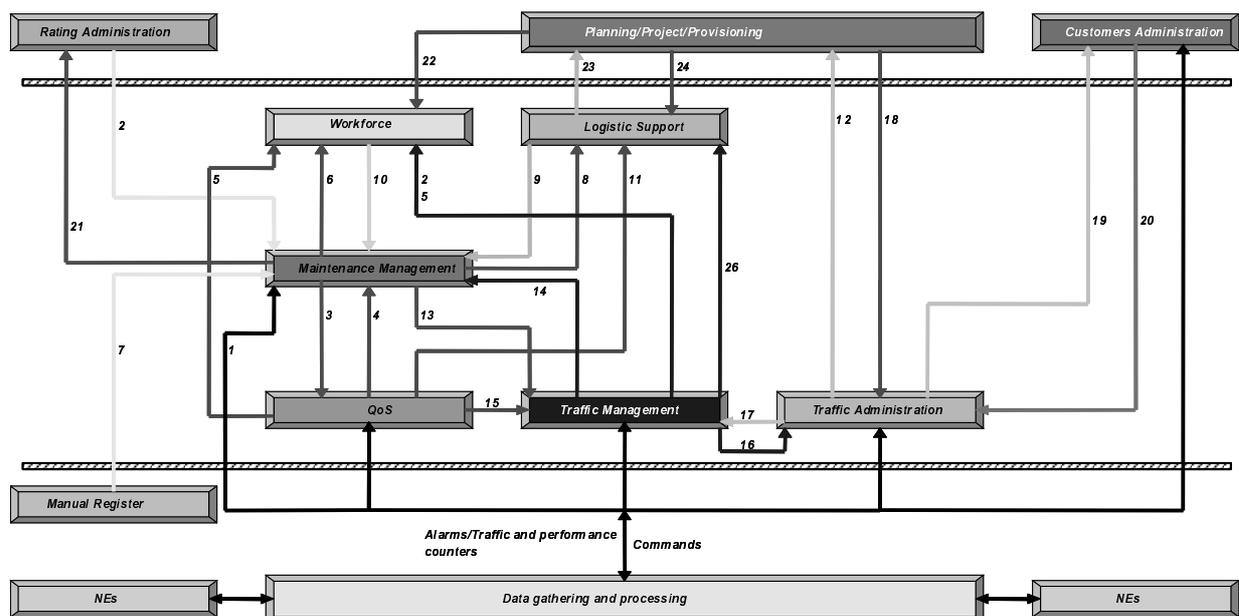
test calls, interviews with customers and performance data from network elements (NEs).

That information obtained during interviews with customers is not handled in the Network Management Layer; it must be performed by QoS Management in the Service Management Layer. This cycle involves the following stages:

- *QoS degradation detection:* It occurs when the monitoring process detects a nonconformity in the measured parameters, in relation to the predetermined ones.
- *Analysis:* Each degradation sign will be correlated to the respective database, in order to determine the probable causes, eliminate any redundancies and determine who must handle the degradation in question.
- *Notification:* QoS Management will notify the management service in charge of degradation handling tasks.
- *Wait for QoS restoration:* QoS Management waits for a notification from the involved management services about root cause elimination. If no notification is received within a predetermined period for that degradation type, a new notification will be issued, addressed also to higher management layers than the previously assigned one.
- *Checking:* Once the root cause is eliminated, a check must be performed to ascertain whether conformity has been reestablished in the previously degraded parameters. Otherwise, a new notification must be issued to the management service involved in degradation restoration and it must include a reference to the previous one, in order to characterize a repeated notification.
- *Record:* After confirming that the degradation had been eliminated, an entry is made in QoS Management's database, containing the identification of those parameters that exhibited any nonconformity, the root cause of degradation and the duration period of such degradation.

### 3.1. Relationship of QoS with the other Management Services

The main relationship links between the QoS Management Service [11] and the other management services defined by the M.3020 recommendation [07] can be seen in Figure 2.



**Figure 2: Relationship of QoS with the other Management Services**

The interfaces related to QoS are the following in this case:

- 1 – Alarms
- 3 – Service order trouble tickets
- 4 – Network degradation indication
- 5 – Indication of Labor performance degradation
- 11 – Indication of Logistic Support performance degradation
- 15 – Degradation of call completion rate

### 4. Service Provisioning Characteristics

Service production exhibits important characteristics, which distinguish it from the production of goods; see

below some of these characteristics:

**Services are intangible** – services are appraised by a set of occurrences experienced by the customer, while the goods are materials that can be possessed, evaluated, weighed and compared more easily.

**Simultaneity** – as a general rule, services are produced at the same time they are consumed. This high contact level generates two important consequences: on the one hand, it enables more flexibility to meet the customers' expectations; and on the other hand, it makes more difficult and critical the task of monitoring the provided service.

Such characteristics prevent the service from being evaluated before the purchase event and make more difficult to evaluate the quality of provided services for the customers.

We can say that service quality as perceived by the customer has two components: technical quality and interaction quality. Generally, technical quality depends on technological factors that can be controlled by the provider, whereas interaction quality depends on a factor that is out of control, that is, the customer's perception. The quality perceived by the customer is the comparison between the expectation he had about the service and what he experienced during service provision. Expectation originates from his needs and other factors, such as past experiences and the service provider's image. Some objective factors will also affect the customer's expectation, such as price and its technical definition.

To improve the technical quality of his services, the provider can modify the factors that affect the delivery of such services, that is, the elements that enable their provision, along with those that affect interaction quality. Technology has been enabling the improvement of services on the technical side, along with interaction quality. Several methods and tools are currently available aimed at the management of the technological base and its operational infrastructure.

What remains to be known is how to help the customer to establish his expectations and conciliate them with the actual offered service. It can be achieved by helping the customer to have a clear knowledge about the technical and operation quality he can expect at contracting time. The balance between expectation control and perceived quality can be attained by means of a discipline known as Service Level Management (SLM).

## 5. Service Level Agreement (SLA)

The SLA is an agreement sealed between the provider and his customers, in order to formally define the quality level that must be achieved during service provision. The purpose here is to turn quality measurement into something objective and quantifiable, by introducing means to control the customer's expectation and consequently to manage the quality he perceives.

The SLA can be put into practice as a complementary document to a service provisioning contract, which defines the technical quality criteria of such relationship. It can include several items, such as agreement description and scope, the respective responsibilities during service provisioning and the detailing of service quality indicators. The SLA is generally associated to one or more services that, on their turn, are composed by several elements that cooperate with each other.

To define the technical criteria, the SLA must refer to other document, known as metrics handbook, which introduces the indicators that will define the agreed quality level. This metrics handbook defines also how these indicators will be measured and the periodicity of such measurements. See below the relationship between the service provision contract, the SLA and the metrics handbook:

*Service Provision Contract:* it defines the provided services and includes a service provision management clause, by referring to the existence of an SLA document and the powers conferred to such document.

*SLA:* it is a description of the agreement, along with the scope, responsibilities, etc., by referring to the existence of a metrics handbook and the powers conferred to such document.

*Metrics Handbook:* it defines the indicators and how they are measured, by whom they are measured and when they are measured. It defines also the indicators' thresholds.

The agreement description and scope define both the customer and the provider, along with the contract that supports the commercial relationship between them; they list also the services that are integral part of the agreement, including the validity term. They can also list the involved areas, both at the customer's and the provider's domain, and the respective responsibilities.

When it details service definition, the SLA complements and equalizes the understanding and the expectations of both parties about every item that composes the agreement. This is attained by referring to the metrics handbook, where the indicators are actually defined.

### 5.1. SLA process

SLA definition is a cyclic process that starts with an evaluation stage, during which a diagnosis of needs is performed and recommendations are created for agreement preparation. This diagnosis is an activity directly linked to the provider's business and involves surveying the needs of potential customers and evaluating market practices and commercial criteria – including the possible impacts on the implementation and cost of the offered service.

The SLA must be then developed. Quality indicators are selected at this moment for every service. The

target customer must be clearly identified, along with the values for the negotiated indicators. The way each indicator will be calculated and the operational procedures that will allow the collection of data for such calculation must also be defined clearly.

Agreement implementation is the next stage. The metrics handbook must be filled and approved, and the service provider must be ready to start the data collection process, so the indicators can be calculated. The way each measurement result will be issued through quality reports must be clearly defined.

After the SLA is put into operation, a monitoring process must be conceived to collect and analyze the data, and to provide information about the agreement progress. This process includes the distribution of quality reports both to the customer and the provider. There will be excellent opportunities to differentiate the service at this moment, by providing the customer with mechanisms to decrease service intangibility. Dynamic reports will enable an objective follow-up of service provision by the customer, thus increasing his quality perception.

The quality data analysis triggers the beginning of a new cycle. The entire process can be restarted, by identifying new service differentiation opportunities, including the enhancement of the provider's internal operational processes, adjustments in the metrics handbook, identification of new indicators and the follow-up of service quality evolution as it is perceived by the customer.

## 5.2. Indicator Selection

The quality indicators shall be selected in a way to:

- Correctly motivate the service provider's and customer's behavior. The indicator must correspond to a collaboration stimulus and must contribute to foster a closer relationship between customer and provider. Although the supplier is responsible for most of the goal achievement procedure, the customer must also commit to it and must be aware of his role in the fulfillment of such goals.
- Depend on the factors that are under the service provider control. In the previous example, it would be incorrect to penalize the provider for the unavailability that was calculated from unjustifiable repairs.
- Be calculated on an objective basis. The data that will be used to calculate the indicator must be readily available. In the previous example, the opening and closing records of repair orders must include time stamps and must identify whether the order is pertinent.

Two other principles can be also followed: the first consists in avoiding the insertion of an excessive number of indicators, while the second determines that the parties must be ready to review the goals, as history data are collected, processed and analyzed.

## 5.3. Metrics Handbook

The metrics handbook is the technical segment of an SLA. The indicators are listed, described and quantitatively defined in this handbook. It defines also the quality goals by specifying thresholds for every indicator.

Entering the rules related to indicators in the metrics handbook is also important for the service provider. Such rules define a condition (which has a business meaning for the indicator) and the corresponding action (which must be triggered if the condition really occurs). With such support, the provider can record the operational actions that must be triggered to handle each detected condition.

The metrics handbook shall include a section dedicated to each indicator, starting by its description and relationship to the business goals. It must be followed by a quantitative item that defines how the indicators are to be calculated – including the origin of performance data that will be used in the calculations, along with the way and periodicity with which these data will be collected, and when and how they will be summarized (if needed). Each section of a metrics handbook can display the following structure:

- **INDICATOR NAME** – Includes the name written out in full and an acronym that identifies it.
- **DESCRIPTION** – Includes a textual description of each indicator and its relationship to the business in question.
- **PERFORMANCE DATA** – Defines the data that must be collected for indicator calculation. Includes also a list of such data, how they are collected and the periodicity of such collection.
- **SUMMARIZING CRITERIA** – The performance data are collected on a periodical basis and must be then summarized, that is, they must have their average value calculated for the longest time intervals (such as hourly, daily, weekly and monthly average, for instance). Please note that this item cannot exist in certain indicators.
- **FORMULA** – The indicators are calculated from a given formula, which defines the way the SLM tool will calculate the indicator, according to the performance data and summarizing criteria.
- **THRESHOLDS** – The thresholds define the value agreed for each quality indicator and are used in the monitoring process. They are also employed to compose the quality reports.
- **RULES** – The rules define a condition (which has a business meaning for the indicator) and the corresponding action (which must be triggered if the condition really occurs).

## 6. Service Level Management (SLM)

This is a set of processes and procedures that must be applied to assure that a proper service level is provided to the customer. The adaptation to service level must be defined in accordance with the involved parties' priorities and within the established costs. The SLM concept was developed to provide the supplier with the required means for a service quality management, based on the definition and management of Service Level Agreements (SLAs).

Once established and implemented, the service level agreements must be managed. The management of SLAs gives birth to a procedure known as Service Level Management (SLM), which assures adequate service levels to the customers.

### 6.1. SLM process

Service Level Management is always associated to a negotiation process: the customers establish their requirements and the business practices that support their goals, whereas the provider translates such needs into a differentiated service package to fulfill them. The SLA is the foundation of such negotiation, while the SLM corresponds to the procedure that supports it.

From the provider standpoint, the SLM is a set of systematic procedures that are put into practice to assure full compliance with the SLA; it includes the following activities:

- Recording the service level indicators, including formulas, thresholds and operational rules.
- Recording the services and relating them to the indicators (defining the SLAs).
- Structuring the services in groups; recording such groups and relating them to the indicators.
- Collecting and summarizing the performance data.
- Calculating the indicators and providing information about the provided services to the customer.
- Monitoring the indicators and defining methods to foresee agreement violation trends.
- Implementing operational processes that enable reverting any agreement violation trends and adopting contingency plans in case of agreement violation.

From the customer standpoint, the important task consists in following up agreement compliance; the following is needed for such purpose, among other items:

- Receiving the information about provided services.
- Validating the indicators and the quality of provided services.
- Reappraising the needs and defining new indicator goals with the provider.

The provider's and customer's activities must be well tuned together and must be reflected in formal agreements. Adequate tools can turn them into something feasible and productive, even with a huge quantity of data and SLAs, thus making quality a manageable item.

### 6.2. SLM Tools

The SLM can become a very complex activity. From the provider standpoint, as previously mentioned, it is a set of procedures that are put into practice to assure full compliance with the SLAs. This includes the maintenance of a record about customers, services, quality indicators and SLAs (which correlate customers, services and indicators). The SLA record includes also the time period spent in the calculation of each indicator and the listed threshold for each monitoring time period. The SLM involves also defining and processing the indicator-associated rules, collecting performance data from service elements, summarizing such data and calculating a value for every indicator based on these data.

Generally, large quantities of information are handled during SLA management, which asks for the support of a computing tool. The essential functions of this tool must automate the systematic procedures that are defined by the SLM:

- Modeling the service level indicators as dynamically as possible, along with formulas, thresholds and operational rules.
- Modeling the services and the elements that compose such services, and relating them to the indicators (defining the SLAs).
- Enabling the monitoring of quality indicators at service element level and at service level. The indicators may be different from one level to the other.
- Collecting and summarizing the performance data.
- Calculating the indicators and providing the customer with information about the quality of provided services.
- Monitoring the indicators and defining methods to foresee agreement violation trends.
- Triggering (by means of warnings) the operational processes that will enable reverting any agreement violation trends and activating contingency plans in case of agreement violation.

The SLA management support tools must be carefully chosen; besides, they must include a set of functions

to fulfill the respective needs.

## 7. SLA Life Cycle

SLA management requires interactions between several processes. To make the handling easier, such management is divided into five phases within its life cycle, as shown by the figure below [03]. Each one of these phases can be mapped to the processes established within TOM [01]. See below a brief summary of the stages to be reached within every life cycle's phase.

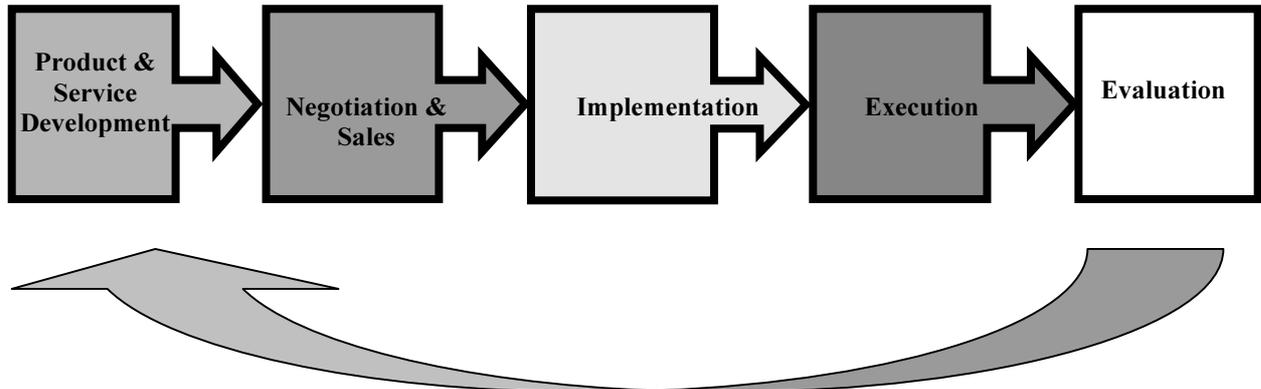


Figure 3: SLA Life Cycle

### 7.1. Product/Service Development

This phase deals with the development of a new service that will include the SLA and its variations, and takes into account the market demand, competitive pressure, internal factors of each company and experience with current SLAs. It can be divided into the following stages:

- Identification of customers' needs
- Identification of new service's characteristics
- Identification of network capabilities
- Development of SLA templates

OUTPUT: New service(s) with SLA templates

### 7.2. Negotiation & Sales

This phase starts when the customer purchases a new service from the company's offer portfolio, with or without any changes. It can be divided into the following stages:

- Selection of SLA parameters for this service
- Cost of this new service to the customer
- Penalties to the provider whenever an SLA violation occurs
- Definition of associated reports

OUTPUT: Signed contract

### 7.3. Implementation

In this phase, the services are provided and the service instance of a given customer is put into practice. It can be divided into the following stages:

- Network provisioning
- Network service configuration
- Service activation

OUTPUT: Tested and accepted service instance

### 7.4. Execution

This phase includes all regular service operations that are covered by the SLA. It can be divided into the following stages:

- Regular service provision and monitoring procedures
- Real time reports and service quality validation
- Handling of SLA violation in real time



- “Problem Handling” process: It receives a notification about the problem and opens a Trouble Ticket; it then determines the problem cause and the priority of the problem to be handled (SLA).
- “Service Problem Management” process: It determines the root cause of the problem and requests the necessary infrastructure changes for a full compliance with the signed agreement.
- “Network Maintenance and Restoration” process: It analyzes the reported problem and takes the necessary actions to restore the affected section of the network.
- “Network Data Management” process: It collects and correlates the data related to the changes, and informs whether the result complies with the contracted services.
- “Service Quality Management” process: It analyzes service quality, notifies about QoS violations and monitors the QoS classes.
- “Customer’s QoS Management” process: It monitors QoS according to SLA definitions. Responds to the customer’s performance requests. Updates the data for “Problem Handling”, so it can report about any violations to the Billing process. And notifies the customer about any taken actions.
- “Rating & Control” process: It applies the proper discounts for any noncompliant SLA.
- “Billing & Collection” process: It generates the bills with the respective discounts, according to what has been agreed in the SLA.

## 8. Conclusion and Future Works

Service providers must find an effective way of assuring service quality, as it is perceived from the customer’s standpoint. The most effective way of performing this task is working on the customer’s expectations about the service, thus increasing his knowledge level in relation to the offered service, through the definition of service quality indicators and their inclusion in SLAs.

The establishment of SLAs generates the need and the opportunity of managing them. In fact, quality management offers the greatest opportunities to differentiate a company and achieve customer loyalty.

To attain an efficient model of service quality management, it is vital to conceive all business processes to which customers and providers (among other actors committed to service delivery) are submitted.

This work proposes a business process establishment model based on proven market standards. It could be extended by designing each one of the possible models, considering that it only exemplifies the “Service provision with SLA and a violation detected by the customer” scenario. Therefore, other scenarios must be developed and the parameters to be included in the metrics handbook must be specified.

## 9. Acknowledgements

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