



**User Group;
Quality of ICT services;
Part 3: Template for Service Level Agreements (SLA)**

Reference

REG/USER-00044-3

Keywords

ICT, QoS, quality, service, SLA, user

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at

<http://portal.etsi.org/tb/status/status.asp>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 2015.

All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are Trade Marks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are Trade Marks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

GSM® and the GSM logo are Trade Marks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	5
Foreword.....	5
Modal verbs terminology.....	5
Introduction	5
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	7
3 Definitions and abbreviations.....	8
3.1 Definitions	8
3.2 Abbreviations	9
4 SLA Principles	9
5 SLA Contract.....	10
5.0 SLA contract principles.....	10
5.1 SLA Generic Model	11
5.2 Actors and roles.....	12
5.3 High level constraints	12
6 User part: Demand.....	13
6.0 User part composition	13
6.1 The demand: SLO (Service Level Objective)	13
6.2 Geographical features, coverage	14
6.3 Use conditions	14
7 Provider part: Offer	14
7.0 Offer content	14
7.1 Description of the services: Technical features	14
8 Conditions of contract	15
8.0 Main aspects of the contract customization.....	15
8.1 Duration of the contract (agreement).....	15
8.2 Guarantees	15
8.3 SLA management actions.....	15
8.4 SLA Violations.....	16
8.5 Penalties	17
8.5.0 Penalties policies	17
8.5.1 Penalties on delivery delay	17
8.5.2 Penalties on Guaranteed Time To Repair (GTTR)	17
8.5.3 Penalties on Guaranteed Service Availability Ratio (GSAR)	17
8.5.4 Other penalties	18
8.5.5 Payment of penalties	18
8.6 SLA Cost: Type of SLA contract	18
8.7 Cessation	18
9 Building a Service Level Agreement (SLA)	18
9.0 The four stages of building a SLA.....	18
9.1 Start Up	19
9.2 Negotiation	19
9.2.0 Negotiation main principle	19
9.2.1 Offer definition: Service composition	19
9.2.2 QoS Monitoring.....	19
9.2.3 Confirm issues	20
9.2.4 Determine costs and payment	20
9.3 Implementation.....	20
9.4 Review.....	20

10	Revision procedures of SLA contract.....	20
11	Conclusion.....	21
	Annex A (informative): Bibliography.....	22
	History	23

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<http://ipr.etsi.org>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This ETSI Guide (EG) has been produced by ETSI User Group (USER).

This is a revision of the earlier edition which included, among other contributions, parts of the University of Wollongong (AU) SLA template and guidelines have been incorporated, in particular in annex A. The current revision takes into account the changes to parts 1 and 2.

The present document is part 3 of a multi-part deliverable covering the quality of telecom services, as identified below:

- Part 1: "Methodology for identification of indicators relevant to the Users";
 - Part 2: "User related indicators on a service specific basis";
 - Part 3: "Template for Service Level Agreements (SLA)".**
-

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

Quality of Service can be evaluated from different perspectives and therefore using different measurement methods:

- a) The first is related to the reliability of the equipment and can be measured accurately via technical means, although these measures might be expensive because of both the dispersion of the test results and the size of the sample to be tested.
- b) The second is related to the service provision and is closely linked to the use of the service. Therefore appropriate metric have to be defined according to this use.
- c) The last is intended to measure the subjective satisfaction of the customer and there is often no other means than a survey to get it.

In the two first categories, technical means can be used to perform the measurements and in such cases, standards are often useful to achieve a common approach; therefore standards are given as references where appropriate. They include a precise definition of what is meant as a failure: total failure, poor performance, etc.

Assessing these different aspects is of paramount importance to the provider who endeavours to improve the offered QoS. From a user viewpoint, the end-to-end QoS is the most relevant. Hence objective and subjective measurements may be usefully combined for a better assessment of the QoS.

Measurements of every interesting metric all the time might be very expensive and could jeopardize service performances. It is often cheaper and sufficient to get them via a poll. In addition, it may be convenient to rely on a third party to carry out these measurements to avoid any criticism from one of the involved parties.

In the current state of the service provisioning it is worth noting that:

- a) QoS is not a quantity that can be measured using some deterministic meter. The evaluation of QoS can only be performed statistically. Statistical rules apply and to obtain a precision of 1 %, the size of the sample analysed should be as large as 1 000 units and the sample should be taken out of a population 100 or 1 000 times larger. This implies practically that the QoS assessment needs a very large number of measurements.
- b) If an operator commits himself to a 99 % or 99,9 % QoS level, this means that less than 1 item out of 100 or 1 000 is out of the specified range. Adding the traditional sampling ratios and precision of measurement ratios leads to populations as large as 10^6 or 10^7 units.
- c) An SLA that concerns units, dozens or hundreds of anything (leased lines, Frame relay circuits, etc.) with 99 % committed QoS is meaningful if and only if these units are taken out of a very big population.
- d) It is hopeless to expect that screening the "very best" units out of a poor quality population would allow guarantying high QoS level for the selected items. A poor quality product might certainly contain some high quality "nuggets" but the indicators enabling their sorting out are hazardous.
- e) The only means to obtain high level QoS products from an operator is to make sure that:
 - the purchased service is widely provided and the provider is mastering all manufacturing, installation and support processes;
 - the average QoS score of his production is close to the commitment he is intending to negotiate with you;
 - a quality assurance plan exists, has been labelled, is annually monitored and is auditable in accordance with ISO 9000 standard family.

QoS and Reliability in the ICT area, concerns more and more aspects supplementary to the product or service as described in clause 6 in addition to the performance indicators.

The existence of a Quality assurance plan labelled, monitored and auditable is key to the QoS. Moreover, in some aspects like security or charging/billing there are no other means to ensure that the QoS expected is actually provided.

In this context, the achievement of a satisfying SLA requires an in depth analysis of the user needs for which guidance is given in ETSI EG 202 009-1 [i.1] and ETSI EG 202 009-2 [i.2].

1 Scope

In the current competitive world, Quality of Service (QoS) is becoming, jointly with cost, a key parameter in selling and buying telecommunications services. At the same time, technology and liberalization trends are raising new types of concerns unknown with the Plain Old Telephony Services (POTS) using switched connections provided by a single monopoly supplier. As explained in other parts of ETSI EG 202 009 [i.1] and [i.2], the monitoring of a QoS commitment should refer to contractual values set either by governmental rules or in a mutual agreement between the provider and its customer. This is why achieving a SLA is more often perceived as the best means to meet specific QoS requirements while ensuring the optimal cost/quality ratio to the customer and the provider in a win-win perspective.

Nowadays, there are several standards describing QoS measurements but the questions of which indicators are to be monitored and which values they should meet are still open. This part of the document defines a framework for a Service Level Agreement between a customer and a supplier of ICT (Information and Communication Technology) Services. Such framework uses the service specific QoS metrics proposed in ETSI EG 202 009-2 [i.2] to evaluate the Quality of Service, while ETSI EG 202 009-1 [i.1] gives a methodology to identify the indicators relevant to the users.

The present document was written to make available to the providers and users of any kind of ICT services a common basis for mutual understanding about SLA. It aims to establish adequacy between the user's requirements in terms of Service Level Objectives (SLO) and the providers' offer with the associated QoS.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EG 202 009-1: "User Group; Quality of telecom services; Part 1: Methodology for identification of indicators relevant to the Users".
- [i.2] ETSI EG 202 009-2: "User Group; Quality of telecom services; Part 2: User related indicators on a service specific basis".
- [i.3] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive) - (article 17).

- [i.4] Regulation (EC) No 717/2007 of the European Parliament and of the Council of 27 June 2007 on roaming on public mobile telephone networks within the Community and amending Directive 2002/21/EC.
- [i.5] Regulation (EC) No 544/2009 of the European Parliament and of the Council of 18 June 2009 amending Regulation (EC) No 717/2007 on roaming on public mobile telephone networks within the Community and Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services.
- [i.6] Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009 amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorisation of electronic communications networks and services.
- [i.7] Corrigendum to Directive 2009/140/EC of the European Parliament and of the Council of 25 November 2009 amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorisation of electronic communications networks and services.
- [i.8] Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive) - (article 11, 22 and annex III).
- [i.9] 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 sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws (Text with EEA relevance).
- [i.10] Corrigendum to 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 sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI EG 202 009-1 [i.1] and the following apply:

access session: all the processes to establish the terms and conditions of the user access (e.g. authentication, selection of service profile) during the connection of a user to a system

NOTE: See figure 3.

connectivity session: all the processes providing technology-independent interfaces to establish and maintain the access to service composition through different networks

NOTE: See figure 3.

network session: all the processes and events allowing the user to connect to start a service session

NOTE: The network session is composed of the access session and connectivity session. The processes are on different planes, and this is why this composition is called vertical (see figure 3).

service session: all the processes and events in the time interval between initialization and termination of an application implementing a service composition

NOTE: These services are of the same nature and located on the service plane, this is why this composition is called horizontal (see figure 3).

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AU	Australia
E2E	End-to-End
EC	European Council
FCAPS	Fault, Configuration, Accounting, Performance, Security
GSAR	Guaranteed Service Availability Ratio
GTTD	Guaranteed Time To Delivery
GTTR	Guaranteed Time To Repair
ICT	Information & Communication Technology
ID	IDentifier
ITU-T	International Telecommunication Union - Telecommunication sector
MOS	Mean Opinion Score
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
OR	Opinion Rating
PaaS	Platform as a Service
POTS	Plain Old Telephony Service
QoS	Quality of Service
SLA	Service Level Agreement
SLO	Service Level Objective
SME	Small and Medium Enterprise

4 SLA Principles

A Service Level Agreement (SLA) is an agreement formally negotiated between client and service provider.

The SLA serves as a means of formally documenting the service(s), performance expectations, responsibilities and limits between service providers and their users. It deals with managing service quality through the customer experience life cycle. This means managing service quality beyond the in-use phase of the life cycle in order to include sales, provisioning, in-use phase and service termination aspects.

Another key aspect of SLAs is the need to incorporate an element of flexibility of contract, in order to accommodate environmental change that is common within organizations. One way of building flexibility is to separate the areas of agreement that are unlikely to change, from the details that can be altered according to negotiation.

A review process should be put in place and each party to the agreement should discuss and monitor the agreement throughout its life and state who will be responsible for reviewing performance.

It is important to define how the agreement will be monitored and the mechanisms that will be used to resolve issues that may arise during the course of the agreement. If the service levels and standards have been defined clearly, and indicators to measure performance have been established, then, the monitoring will be relatively easy. The agreement should build a process for feedback between both parties, via reporting or another agreed communication method between the representatives of both parties.

A service level is an agreed process which may include one or more of the following elements to describe the service behaviour:

- Service features and service composition.
- Quantitative aspects.
- Quality aspects.
- Conditions of use.
- Cost/tariff.

When both parties have established agreed service levels, the next step is to agree on methods of measurement of service level performance. It is essential to implement a system that will provide credible results; otherwise all parties within the process may lose confidence.

The SLA should be described in two parts:

- The users request their requirements, corresponding to the Demand.
- The offer by provider with the guarantees provided (services offers associated QoS, penalties) corresponding to the offer.

In the first part, in ETSI EG 202 009-1 [i.1], the expression of the request as SLO has been described.

In the second part, in ETSI EG 202 009-2 [i.2], in accordance with the method, indicators which reflect the expected behaviour of the service have been identified. But indicators imply measures whose conditions need to be precisely defined between the provider and his customer.

Therefore it is important that in the SLA the following points are made:

- Who will evaluate it?
- What are the acceptable measuring procedures (test specification i.e. ITU-T recommendation, or ETSI standard and the frequency of measurement, sample size, confidence limits, etc.)?
- In the event of a dispute or disagreement, what are the resolution procedures?
- What are the penalty clauses?
- Who will be the arbitrating body in the event of a disagreement?
- The final stage consists in selecting, among the QoS parameters, the most relevant ones, the level of which will be monitored with respect to the agreed commitments as described in the SLA.

Here should be taken into account the relevant aspects of the current regulation, e.g. the European Directives (Directive 2002/21/EC [i.3] as amended by [i.4], [i.5], [i.6] and [i.7], Directive 2002/22/EC [i.8]) as amended by [i.9] and [i.10] as well as the corresponding national regulation.

5 SLA Contract

5.0 SLA contract principles

A Service Level Agreement (SLA) is a contract that defines an agreement between two parties: user and service provider (see figure 1). It describes the terms and conditions of service provisioning. On the user side, it identifies the user requirements. On the provider side, it indicates the commitments (capabilities) of the provider to the client.

The SLA serves as a means of formally documenting the service(s), performance expectations, responsibilities and limits between service providers and their users.

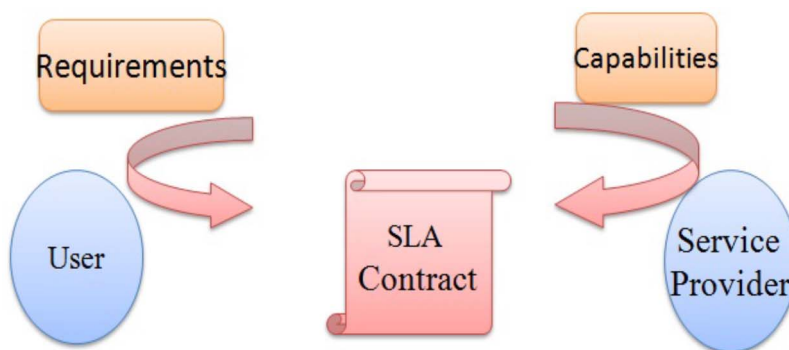


Figure 1: SLA Contract

An effective SLA acknowledges that clients and service providers have responsibilities and obligations to each other. It is important to address these points in the SLA development phase, and acknowledge them in writing. An agreement that clearly defines the roles and responsibilities of both parties will be of particular benefit if problems arise. The SLA should be used in any case as a means to improve the process and the mutual understanding and not to relieve responsibility of one party on the other party.

Parties should consist of 1 or 2 representatives from each party who may have an interest in the outcomes of the service.

An important step in the process is to identify needs and expectations for the specified services. This enables both parties to understand what service attributes are most valued by each group. A service attribute is the aspect of service quality that is most important to the client/customer.

The service provider needs to discuss its capacity and potential constraints on providing the service to the customer/client. This will assist both parties to gain an understanding of each other's requirements and reduce unrealistic expectations. If there are concerns or issues regarding service levels they should be discussed at the negotiations stage, not when a SLA is close to implementation.

The critical areas of service should be identified and both client and service provider need to agree on a minimum level of service to ensure client satisfaction.

It is necessary at this stage, for clients to distinguish their specific needs from broader expectations regarding the service, and to appropriately prioritize service requirements. It may also be appropriate for the provider to detail the range of services they can provide. This way both parties can fully identify their needs and expectations and agree on which services will be provided.

The Service Level Agreement (SLA) describes the terms and conditions under which services are offered. This contract is created in the negotiation phase between providers and consumers. The user firstly chooses an SLA level and expresses his SLOs based on its strategies and needs (QoS requirements, price willing to pay, etc.).

The consumers can personalize the SLA contract according to their needs.

5.1 SLA Generic Model

The Service Level Agreement (SLA) is a document, a contract, that defines the specific and personalized deal required between a service provider and a client.

After having introduced the SLA content, the figure 2 formalizes the SLA generic model. The SLA generic model is composed by:

- 1) Parties (Signatory Parties and Third Parties).
- 2) High level constraints.
- 3) User part, corresponding to the demand: Service Level Objective coverage and use conditions.
- 4) Provider part, corresponding to the offer: Services offered as well as the associated QoS.
- 5) The conditions:
 - Guarantees.
 - E2E Management actions.
 - SLA violation.
 - Penalty.
 - SLA cost.

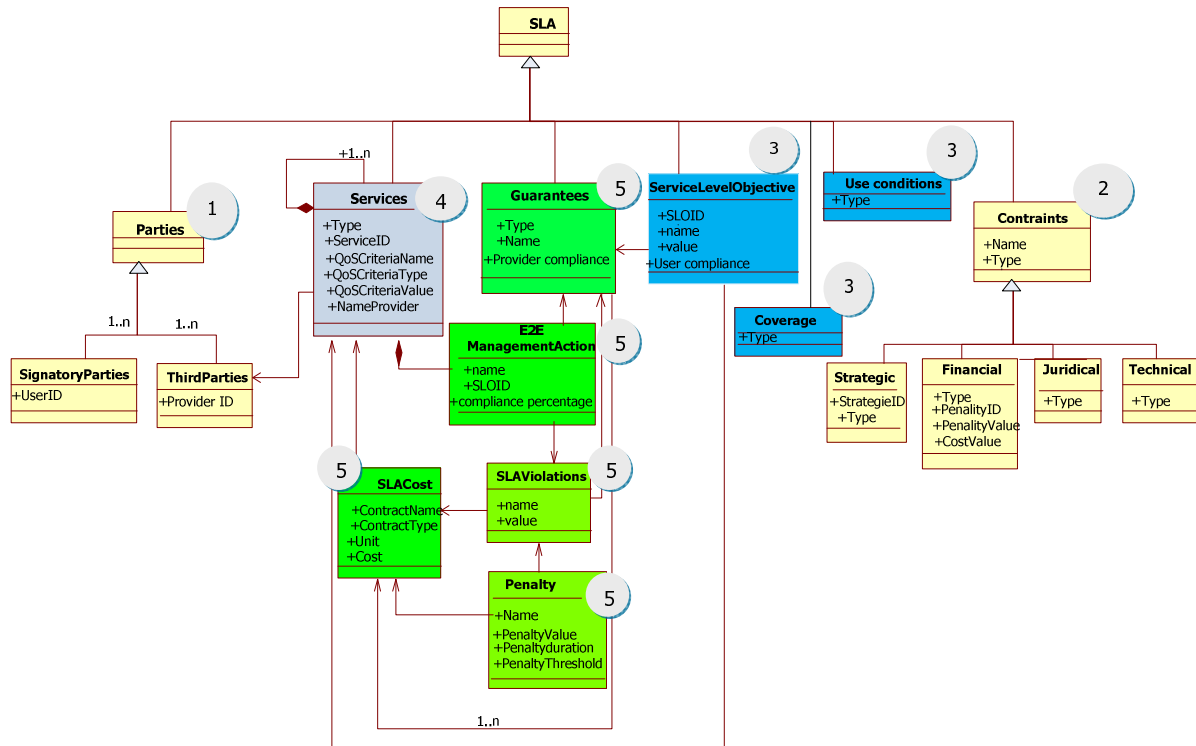


Figure 2: SLA Generic model

5.2 Actors and roles

The Parties represent the contracting entities of a SLA contract (figure 2, bullet 1). These entities are classified as "Signatory parties" and "Third Parties". The first one represents the contractual parties that can include the provider, the end-user, the developer, etc. The second entity represents the trusted third parties involved in the SLA contract including the network provider, the monitoring provider, etc.

Having several parties involved in the contract allows expressing the different partnerships: strategic, outsourcing or a common interest.

5.3 High level constraints

The proposed SLA model includes the conditions imposed by the provider and/or the consumer (figure 2, bullet 2). The following classification of constraints is proposed:

- **Strategic constraints:** They represent either the strategies requested by the user or those applied by the provider. These strategies are sorted by priority order to determine those that are most demanding at the deployment stage. The priorities linked to the strategies allow for determining the SLA contract type. The user can require several strategies (QoS, security, cost, green, etc.) simultaneously according to its needs. For example, a PaaS developer can demand a green and cost-effective platform.
- **Financial constraints:** formulate the conditions related to the payment and usage patterns. The provider can define various options to settle the usage: consumption based (users pay according to the load volume, the transactions, etc.) or subscription-based (fixed fee). An example of use is the free services under certain conditions. Among these conditions, the service will be charged if interval of booking exceeds a certain time or the rate of resource consumption exceeds a specific threshold. The user can specify its own conditions of payment.
- **Juridical constraints:** define legal constraints such as licensing rules, editing rights, etc. Should be relative to the regulation of a country.
- **Technical constraints:** represent the requirements determined by the provider to execute the requested service. For example, the provider may require the user to have a specific browser or device to access to the services.

6 User part: Demand

6.0 User part composition

The user part (figure 2, bullet 3) should be composed of:

- SLO (Service Level Objective).
- Geographical features, coverage.
- Use conditions.

6.1 The demand: SLO (Service Level Objective)

The Service Level Objective (SLO) is the means for the user to express his needs. The objectives expressed by the user may be linked to:

- The consumers: Cloud provider developer, service or network provider may provide information on the consumer profile, such as user number, simultaneous connections number, use peaks foreseen and service transactions number.
- The applications: The user may precise the activity level over the time of the application. For example, he may precise the time periods during which his applications may be intensively accessed.
- The end-to-end QoS: Two objective types are used to express the end-to-end QoS horizontally and vertically (see figure 3).

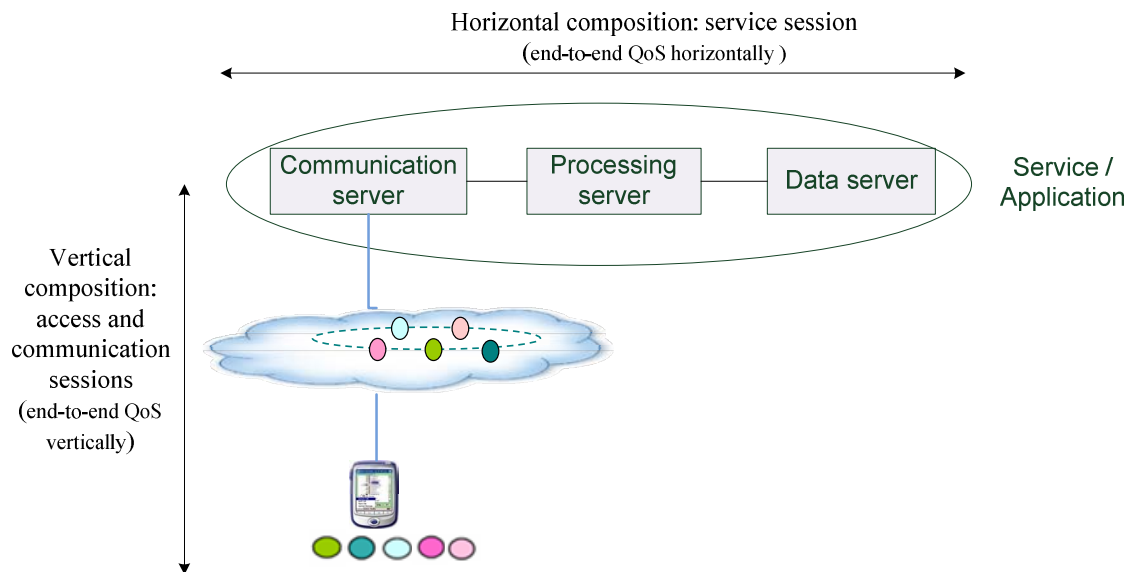


Figure 3: End to End Service Composition

- The E2E objectives, at the horizontal level, define the final service QoS level (compound service) provided to the user. Indeed, if the customer requires a service composition, he may then precise the conditions linked to his operation such as response time, availability rate and scalability. For example, a user wishes a service composed by the three following services: Communication server, Processing server and a data server. This user requires that the processing time of his service be less than 2 s in 90 % of the cases, if the number of requests processed within one second is less than 1 000. On the other hand, if the number of requests is above 1 000 req/s, he may still require a processing time less than 2 s but with a rate of failure less stringent (For example 60 % instead of 90 % of the cases). The SLO linked to this user needs are then the followings:
 - SLO1: E2E processing time < 2 s if the number of requests < 1 000 in 90 % of the cases.
 - SLO2: E2E processing time < 2 s if the number of requests >1 000 in 60 % of the cases.

- The E2E objectives at the vertical level are linked to measurable QoS parameters (round trip time, availability, bandwidth, MTBF and MTTR) to take care of the access services to the services including Cloud services as well as the services used locally by the user.
- The application management: The client may also define objectives linked to the application management and monitoring. For example, if he needs a test environment or a monitoring of his applications, he should precise the strategic test points and the number of tests to achieve over a period of time. He may also specify the elasticity, scalability, availability and provisioning conditions in expressing his objectives.

Service Level Objective (SLO) represents the conditions of end to end QoS (E2E) requested by the user.

EXAMPLE: The service is available 7/7 and 24/24; the processing time < 2 s if the number of req/s is < 1 000 in 90 % of cases.

SLO clauses represent the goals expected by the user.

6.2 Geographical features, coverage

Geographical features have to be specified using maps and tables for user equipment (including nodes, satellite terminal, etc.) specifying every local agreement.

On the particular case of wireless communications there are two schools of thought: one based on the geographical coverage (including landmass and oceans for maritime and aeronautical services) and the other one based on the population. The indicator should be based on both geographical and population coverage.

6.3 Use conditions

In some cases the supply chain may involve several providers with different contracts. In such cases, each contract constraints may impact the E2E QoS. Use conditions are defined by the provider. The use conditions are, for example, related to: the access to the underlying file system, disk types, etc.

7 Provider part: Offer

7.0 Offer content

The offer (figure 2, bullet 4) consist of a composition of services matching the user demand (SLO). The definition and description of the services: network services and application services, management services (see ETSI EG 202 009-1 [i.1], table 1), provided equipment, technical features of the various items should be stated here.

A service is presented with functional part and non-functional (QoS) part that exactly fit their properties. The non-functional part of services is described by four QoS criteria. The providers may propose the same services that are differentiated by their SLA levels, their price and the manner they are built, deployed and managed. To choose effective services according to the deployed applications requirements, the provider should expose the non-functional properties (Quality of Service) of its services.

7.1 Description of the services: Technical features

Services represent the description of the offered services.

Each SLA Contract Services is defined by:

- identifier;
- type (usage or management);
- behaviour (QoS criteria);
- conditions of use;
- etc.

Four criteria are proposed (see ETSI EG 202 009-1 [i.1] to describe the *behaviour* (QoS): availability, integrity, time, and capacity.

- *Availability* represents accessibility rate of the service component.
- *Integrity* represents running without alteration of information (for example: error rate).
- *Time* represents time for request processing (for example: response time).
- *Capacity*: maximum load of the service component (for example: processing capacity).

For each criterion the values are: design, current and threshold values.

First, the design value is measured in the initial deployment phase and represents the maximum processing capabilities of the service.

Secondly, the current value measures the actual capabilities of the service during the runtime.

Finally, the threshold value indicates the limited capabilities beyond which the service becomes abnormal.

QoS performances have always to be checked against specifications. Therefore, technical features have to be specified for each network/service component and each type of envisaged use. Such specifications have to take into account what security features should aim at and how they should be implemented.

8 Conditions of contract

8.0 Main aspects of the contract customization

The contract conditions customize the service level agreement (figure 2, bullet 5). Other data of the contract are:

- Duration of the contract (agreement).
- Guarantees.
- SLA Management actions.
- SLA violation.
- Penalty.
- Cost associated to the signed SLA.
- Contract cessation.

8.1 Duration of the contract (agreement)

Here should be detailed how to deal with the following aspects: Renewal, Price revision, Benchmarking during the contract, Break-up of the contract clause and Cessation.

8.2 Guarantees

The Guarantees represent the provider commitments for a given SLO. Indeed, the user may demand several SLOs that are not necessarily all guaranteed. However, the user can require having guarantees associated with some SLOs (specifying the attribute "Mandatory" when defining these SLOs). The provider indicates, using statistical models, a percentage of compliance with these guarantees.

8.3 SLA management actions

Management represents the actions performed by the provider in order to achieve the required SLOs, for example the dynamic reconfiguration. Indeed, for each SLO, threshold values are defined to indicate that SLA violation are reached. To avoid violation cases, a set of actions will be defined for each SLO conditions.

Figure 4 shows provider management actions to comply with the SLO requirements.

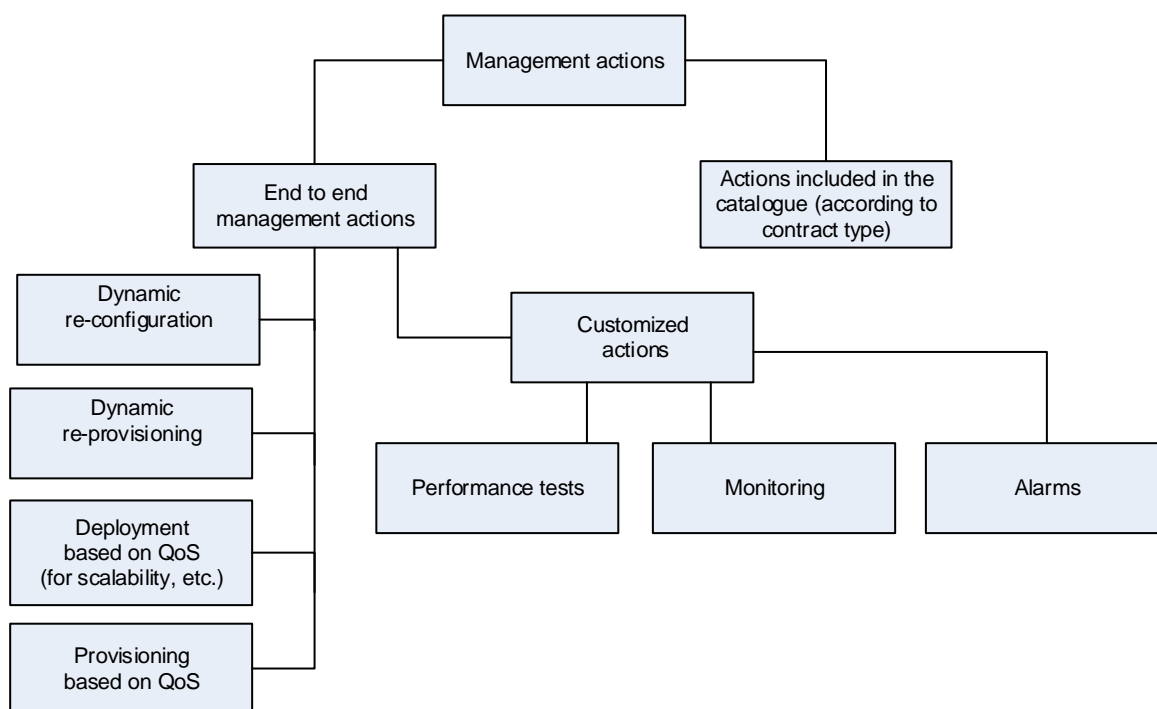


Figure 4: SLA management actions

The Service Provider should comply with the users' SLO to avoid penalties in case of contract violation. To do that, he should assess the consumer objectives to provide the complementary management actions corresponding to his expectations and may include:

- Actions included in the catalogue: i.e. management actions explicitly provided by the provider according to the type of SLA contract chosen by the customer. In other words, the provider may define actions achieved by default for any given type of SLA contract.
- End to end actions for service composition:
 - 1) Management actions.

EXAMPLE 1:

- If SLO1 condition (clause 6.1) is not insured in 90 % of cases, a reprovisionning is done.
 - If SLO2 condition (clause 6.1) is not insured in 60 % of cases, a possible action consists in replacing the required service by an equivalent one (ubiquitous service) able to deal with 1 000 requests per second.
- 2) Customized actions (on demand): i.e. actions to a given demand. In such a case, the provider takes care to customize management actions expected guaranteeing the set of user defined SLO.
 - Performance tests: the provider may use probes to check the application behaviour.
 - Monitoring: the provider may propose monitoring tools to collect information on the application behaviour and its changes over time.

EXAMPLE 2: The provider may propose a monitoring service to trigger alarms in case of applications' dysfunction or their abnormal behaviour. These actions allow the provider to control his offer to comply with the requested objectives and avoid violation cases.

8.4 SLA Violations

SLA Violations represent the threshold values from which a violation of the established contract is detected.

Several factors can generate violations such as:

- Non-compliance to a standard of security or network.
- The degradation of required QoS.
- The applications or services migration to an undeclared administrative domain.
- Poor management of the underlying infrastructure.
- A false estimation and planning of the scaling.
- Failure to comply with the timetables (7d/7, 24h/24) during which the service is due to be available.

EXAMPLE: The provider undertakes to ensure a response time less than 2 s with a compliance percentage equals to 90 % of the time. If the provider does not meet this requirement in more than 10 % of the time, a violation may occur.

NOTE: The SLA violations are taken into account provided the user complies with the use conditions.

8.5 Penalties

8.5.0 Penalties policies

Penalty represents penalties policies used if the provider does not achieve the agreed clients requirements.

EXAMPLE: If the provider fails to hold 100 % of server availability, 10 % of the monthly fees will be then refunded to the consumer.

8.5.1 Penalties on delivery delay

The amount of the penalties related to the disrespect of the delivery date should be computed depending on the delay and on the service importance for the company on a case by case basis. Therefore, a table defining the rules for such a computation have to be defined in the contract.

8.5.2 Penalties on Guaranteed Time To Repair (GTTR)

The amount of the penalties is calculated for each month, each connection and each defect.

This amount is a percentage on the monthly price of each concerned connection. This percentage depends on the actual time to repair and on the commitment agreed between the parties. Table 1 gives an example of such calculation.

Table 1: Example of calculation of the penalty amount

Actual repair time for a 5 hour commitment	Actual repair time for a 8 hour commitment	Penalties
≤ 5 hours	≤ 8 hours	0 %
> 5 hours and ≤ 12 hours	> 8 hours and ≤ 12 hours	5 %
> 12 hours and ≤ 24 hours	> 12 hours and ≤ 24 hours	15 %
> 24 hours	> 24 hours	25 %

8.5.3 Penalties on Guaranteed Service Availability Ratio (GSAR)

The amount of the penalties is calculated for each month and each connection.

This amount is a percentage on the monthly price of each connection concerned. This percentage depends on the difference between the committed availability rate and the recorded one according to table 2.

Table 2: Example of calculation of the penalty amount

Difference between the target and the actual availability rate	Penalties
> 0 and ≤ 2 %	15 %
> 2 % and ≤ 4 %	30 %
> 4 %	50 %

8.5.4 Other penalties

Other types of penalties can be determined, if appropriate, on any QoS parameters, e.g. delay, bandwidth, response time or reliability, etc. Another type of penalty can be to withdraw the contract if the contract conditions are not fulfilled.

8.5.5 Payment of penalties

- Penalty on Guaranteed Time To Delivery (GTTD).

The penalty is deduced from the bill related to the service access fees.

- Penalty on GTTR and GSAR.

The penalties due to the default of the corresponding commitments recorded during a billing period P are calculated on the amount of the bill of this period and deduced from the next bill.

The total amount of penalties is usually limited to 10 % of the overall monthly customer bill.

8.6 SLA Cost: Type of SLA contract

To match the requirements of the various user categories (developer, consumer, service provider), several SLA level can be proposed. The purpose is to provide services matching exactly the wished user strategies (Green, Best effort, dedicated QoS) according to his financial capacities. Of course, more stringent QoS services may be proposed at higher prices. Such SLA contract rating is important as it allows for a distinction between functionally equivalent services but with differing behaviour. In other words, if two services (S1 et S2) have the same functionalities but differing behaviours (QoS), S1 should be considered as different from S2 and should be provided with differing SLA contracts.

EXAMPLE: If the processing time of the S1 service takes a longer time than the S2 service due to differing algorithms, S1 may belong to a "Silver" SLA contract while S2 may belong to a "Gold" SLA contract. As a consequence, the offered services are ranked according to their behaviour (QoS).

8.7 Cessation

If the cessation occurs with the intention of a change of provider, it is wise to anticipate a procedure for adaptation to the new provider services and particularly to recover data if they are stored in cloud services. It is recommended to establish a reversibility plan. It can be necessary to include in the contract a time period for parallel exploitation.

9 Building a Service Level Agreement (SLA)

9.0 The four stages of building a SLA

An SLA management should be specific to each contract. It represents a configuration related to each user. Four stages can be identified:

- Start Up.
- Negotiation.
- Implementation.
- Review.

9.1 Start Up

First of all, the signatory parties (provider and customer) and the stakeholders should be identified as well as the third parties involved in the SLA perimeter (figure 2, bullet 1).

Then identify:

- All the high level constraints (i.e. strategic, financial, juridical (regulation) and technical (figure 2, bullet 2).
- The needs and expectations expressed as SLO (ETSI EG 202 009-1 [i.1] and figure 2, bullet 3).
- The location where the service is required (figure 2, bullet 3).
- The use conditions (figure 2, bullet 3).

9.2 Negotiation

9.2.0 Negotiation main principle

To come to the user satisfaction it is crucial that the service level agreed be compatible with the supplier ability to fulfil the agreement (figure 1).

9.2.1 Offer definition: Service composition

During the negotiation, both parties will select the services to set up a service composition matching to the utmost the user request. This composition of service will contain the application services, but also the management or/and security services.

- 1) The application services (Basic services): are the services offered and exposed in the provider catalogue. They are composed of services elements (services components). Each service element is described by its functional and non-functional aspects (QoS) figure 2, bullet 4.
- 2) The management services (FCAPS: Fault, Configuration, Accounting, Performance, Security) are much used in networks and service platforms.

NOTE: Security aspects:

The interconnection of private systems with the Internet as well as the more and more general use of software in every telecommunication equipment has given rise to the security concerns. Malevolence can nowadays jeopardize any system if it is not protected against attacks. Therefore, any service function has to include security protocols to ensure the integrity of the transferred data. Incidentally, such protocols should not excessively slowdown the traffic or block useful information. Since, here too, a compromise is needed between the speed and the efficiency of the security process, the customer has to define accurately his requirements in this area (Authentication, Authorization, Identification, etc.). Afterwards the security process has to be seen under the QoS aspect as an additional function of the main function of any service. Taking into account that a single attack in this area can lead to a collapse of the whole ICT system of a corporation, the better solution is to carefully identify the threats and then to rely on the certification by a recognized third party that all measures, protocols, standards, etc. are applied by the provider to ensure the security of the users' information and to prevent any damage to someone outside the company by any employee using the company equipment.

9.2.2 QoS Monitoring

End to end QoS monitoring should be done by the service and the user session according to the guarantees (figure 2, bullet 5 and figure 4).

At this stage of the SLA, the providers' commitments on the QoS parameters level should have been specified for every step of the service life cycle. Here should be given all the additional details needed to make reliable and reproducible the measurements of the QoS parameters, in particular those related to the measurement of the technical performance:

- Number, location of probes and type of communications for the measurements of the QoS parameters.
- Who is responsible for the QoS measurements.

- Process to measure the QoS parameters (sample number, frequency of measurements, etc.).
- Content of the questionnaires to determine the MOS or OR values with documentation of the MOS or OR scales.
- Principles and methods of calculation for penalties.

9.2.3 Confirm issues

The following issues should be tackled:

- Are client and service provider roles and responsibilities clearly defined in the contract?
- Have you established a process that will flag problems early?
- Have you established a process to resolve any issue that might arise?

9.2.4 Determine costs and payment

The following issues should be tackled:

- Have you identified what services are free of charge?
- Have you determined costs for additional services where appropriate?
- Have you agreed an appropriate cost transfer mechanism where appropriate?
- Have you agreed on the frequency of billing where appropriate?

9.3 Implementation

Create and sign the Service Level Agreement (SLA):

- Has someone with appropriate authority signed the contract?
- Have you communicated the agreement to staff from both parties?

9.4 Review

A review process should be described:

- Who will be responsible for reviewing performance?
- Which reporting mechanism is set?
- Has a program for adjustment of service levels be defined?
- Has the feedback to the client and service provider been sought?

10 Revision procedures of SLA contract

A review process should be put in place and each party to the agreement should discuss and monitor the agreement throughout its life.

The North American widely-known "How 'ya effect", according to which users are much less satisfied today with services they were completely satisfied with some years or some months ago, shows how important is the continuous analysis of customers expectations.

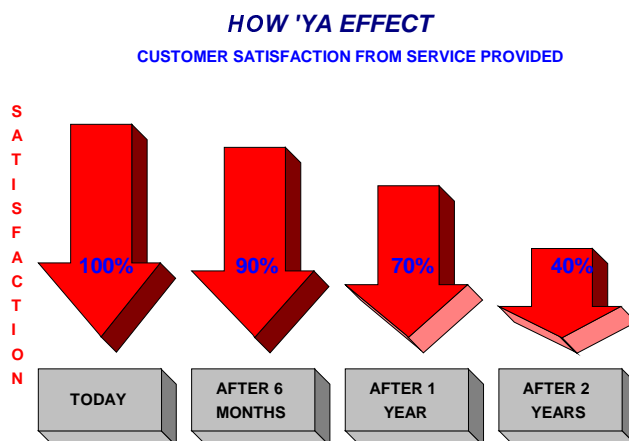


Figure 5: How 'YA effect - The decreasing customer satisfaction from service provided

Who will be responsible for reviewing performance should be stated.

If staff changes in either client or provider areas the new staff needs to be instructed clearly of its responsibilities.

If new services or service features are required, the agreement should be flexible enough to allow for review and change.

A program for adjustment of service levels should be agreed if there is a deviation from agreed performance.

11 Conclusion

This template for SLA provides useful guidance on the users expectations about the QoS to the standard makers, regulators and providers. It is expected also that the users themselves can find here some help, e.g. business users (large corporation and SME) when establishing a SLA with their chosen provider. It is crucial to notice that the important point of this approach is the QoS model that is expected to allow for a better understanding between users and providers as it enables for an efficient synthesis of the user requirements thanks to the SLO. More explicit the SLA contract, better the customer provider relationship.

Annex A (informative): Bibliography

ETSI TR 101 287: "Services and Protocols for Advanced Networks (SPAN); Terms and definitions".

ETSI TR 102 008: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Terms and Definitions".

ETSI EG 201 219: "User requirements; Guidelines on the consideration of user requirements when managing the standardization process".

ETSI ETR 003: "Network Aspects (NA); General aspects of Quality of Service (QoS) and Network Performance (NP)".

ETSI ETR 016: "Business Telecommunications (BT); Serviceability performance objectives for Private Telecommunications Networks (PTN)".

ETSI ETR 301: "Users' Expectations; Virtual Private Networks".

Report of the AFUTT QoS WG (12-2000): "La problématique qualité Télécom".

"The complete guide to preparing and implementing Service Level Agreements". Library Association Publishing: London Pantry, S. & Griffiths, P. (1997).

"Livre Blanc sur la Qualité de Service d'Internet et des Télécommunications", Olivier Couly, Imprimerie du Sud, Mars 2001

"SLA Management Handbook, Volume 2, Concepts and Principles - GB917 v2.5, r2.5", Telemanagement Forum.

NOTE: Available at <http://www.tmforum.org/>.

Recommendation ITU-T E.860: "Framework of a service level agreement".

History

Document history		
V1.1.1	February 2002	Publication
V1.2.1	January 2007	Publication
V1.3.0	April 2015	Membership Approval Procedure MV 20150623: 2015-04-24 to 2015-06-23
V1.3.1	July 2015	Publication