Deliverable D.A2a
Business SLA Management

Keywords:
Service Level Agreement, Service-Oriented Infrastructure

Due date of deliverable: [31st May 2009]
Actual submission to EC date: [12th June 2009]
Resubmission to EC date: [31st October 2009]

Start date of project: 1st Jun 2008
Duration: 36 months

Lead contractor for this deliverable: TID
Revision: V.1.4 (20th October 2009)

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)

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<th>Dissemination level</th>
<th>PU</th>
<th>Public</th>
<th>Yes</th>
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## Document Status

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<tr>
<td>Complete version submitted to reviewers</td>
<td>24 April, 2009</td>
</tr>
<tr>
<td>Comments of reviewer 1 received</td>
<td>4 May, 2009</td>
</tr>
<tr>
<td>Comments of reviewer 2 received</td>
<td>10 May, 2009</td>
</tr>
<tr>
<td>Revised deliverable submitted to PMT</td>
<td>26 May, 2009</td>
</tr>
<tr>
<td>PMT Approval</td>
<td>03 June, 2009</td>
</tr>
<tr>
<td>Resubmission Reviewer</td>
<td>Luciano Baresi, PMI</td>
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<tr>
<td>Comments of reviewer received</td>
<td>8 October 2009</td>
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<th>Changes</th>
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<td>0.1</td>
<td>07th April 09</td>
<td>Juan Lambea</td>
<td>Template</td>
</tr>
<tr>
<td>0.2</td>
<td>16th April 09</td>
<td>Juan Lambea</td>
<td>Adaptation to the new delivered template and updated sections 3 4.3 and 4.4.</td>
</tr>
<tr>
<td>0.3</td>
<td>20th April 09</td>
<td>Beatriz Fuentes</td>
<td>Introduction, State of the Art</td>
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<tr>
<td></td>
<td></td>
<td>Alfonso Castro</td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td>23th April 09</td>
<td>Oscar Dueñas</td>
<td>eTom/SID information added</td>
</tr>
<tr>
<td>0.5</td>
<td>24th April 09</td>
<td>Juan Lambea</td>
<td>Implementations details</td>
</tr>
<tr>
<td>0.6</td>
<td>21th May 09</td>
<td>Juan Lambea</td>
<td>Updated with reviewer recommendations</td>
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<td></td>
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<td>Oscar Dueñas</td>
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<td>0.7</td>
<td>25th May 09</td>
<td>Beatriz Fuentes, Alfonso Castro</td>
<td>Updated with reviewer recommendations</td>
</tr>
<tr>
<td>0.8</td>
<td>1st June 09</td>
<td>Beatriz Fuentes, Alfonso Castro</td>
<td>PMT recommendations updated</td>
</tr>
<tr>
<td>0.9</td>
<td>2nd June 09</td>
<td>Juan Lambea</td>
<td>PMT recommendations updated</td>
</tr>
<tr>
<td>1.1</td>
<td>9th Sept 09</td>
<td>Juan Lambea, Beatriz Fuentes, Alfonso Castro, Oscar Dueñas</td>
<td>Implementing reviewer recommendations</td>
</tr>
<tr>
<td>1.2</td>
<td>16th Oct 09</td>
<td>Carlos Bueno, Juan Lambea</td>
<td>Updated sections 1, 4.3.5, 4.4.2, 4.4.3, 4.4.4, 4.4.5, 5 with reviewer comments and A2 internal proposes</td>
</tr>
<tr>
<td>1.3</td>
<td>20th Oct 09</td>
<td>Oscar Dueñas, Carlos Bueno, Juan Lambea, Theocaris Tsigkritis, Liliana Pasquale</td>
<td>Updated sections 4.4.5, 6 with reviewer comments, CITY &amp; PMI comments and A2 internal proposes.</td>
</tr>
<tr>
<td>1.4</td>
<td>20th Oct 09</td>
<td>Beatriz Fuentes, Alfonso Castro</td>
<td>Generate annex B answering internal reviewer recommendations</td>
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Executive Summary

The main concept of SLA@SOI project is a systematic grounding of SLAs from the business level down to the physical infrastructure. At the business level, the project entails an automated e-contracting lifecycle that covers the whole interaction between service providers and customers. This starts from the commercial product definition to the negotiation and sales process. Finally, the management of the post-sales relationship including SLA monitoring and customer behaviour analysis is included.

Service providers require the management of service level agreement (SLA) contracts in business terms, e.g. for minimizing financial penalties for service-level violations or maximizing service-level measurement based customer satisfaction metrics. A considerable number of languages (i.e. WSLA, WSAgreement, WS-Policy) have been developed that are used for specifying SLAs between service providers and consumers. These languages are focused on the specification of functional and quality properties of web services. However, they do not provide support for specifying information that would be necessary in a business context. Early initiatives have been launched for developing an information model to represent business concepts such as SID (Shared Information/Data).

SID is the information model of the Tele Management Forum’s New Generation Operations Systems and Software (NGOSS) program. It is a set of comprehensive standardized information definitions aiming to be the common language for building easy to integrate OSS (Operational Support System) and BSS (Business Support System) solutions.

In this document the Business SLA Model based on WS-Agreement is introduced, aiming to improve the quality perceived by customers and their satisfaction. Upon this model a basic Business SLA Framework has been implemented covering the whole commercial lifecycle.

Finally, a deep study of the SID has been done in order to determine the mapping of the main concepts in the business SLA@SOI model, and identifying the modules or classes that need to be further extended.
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1 Introduction

This deliverable describes the architecture, design and implementation of the business SLA management framework which has been created within the first year of the European research project SLA@SOI. This includes a specification of a standardized model for Business Service Level Agreements (SLAs) characterization, including domains as Market/Sales, Product, Customer, Service, Partner and Common Business. Also, it includes the implementation of relevant components.

A motivating business scenario highlighting the idea behind this project is the service provider who is enabled to offer services with differentiated, dependable and adjustable SLAs and can negotiate concrete SLAs with (individual or groups of) customers in an automated fashion. This business goal imposes requirements on software providers (to provide components with predictable non-functional behaviour) and infrastructure providers (to support an SLA aware management of resources). Of course, complete business value chains can be easily composed on top of this infrastructure.

This document starts with a review of the state of the art. Then, the Business SLA Model is introduced, and then, Section 4 describes the basic Business SLA Framework that has been implemented for the initial phase of the project. The goal of this conceptual model is to identify key entities at the business level, and to explicate the relationships between them. The model is built based on the Web-Services Agreement Specification (see reference [9]) and the Web Service Description Language (WSDL), [10], and extends the SLA Model in [11] specified as part of the A5 Work Package. Also, the document contains the part of the SID model used to enrich the SLA Model with business issues.

Once the Business SLA Model has been established, a business SLA basic framework is build.

In section 5 it is presented a useful web tool created and used to manage business information, such as the creation of product, SLA Templates and policies. This tool, that is graphical and simple, could help business administrator to create such information in order to be used and consumed by end customers when they search for a product, contract and use it.

Finally, an analysis is made in order to determine how its concepts and principles map to the TM Forum Information Framework (SID, Shared Information Data).

The Figure 1: Schematic representation of the structure of this section represents the structure of this deliverable:
Figure 1: Schematic representation of the structure of this section

The document is organized in the following sections:

i) Section 2: presents the state of the art about business SLA management

ii) Section 3: builds a Business SLA Model, first identifying the Business SLA Parameters and then including them into the SLA Model Definition already specified by work package A5 (see document [11]).

iii) Section 4: describes the business SLA basic framework

iv) Section 5: describes the appearance and usage of Business Web Tool. This tool will be used to create necessary business information for the proper framework performance in a graphical and automatic way.

v) Section 6: describes the relationship of the Business SLA Model built in Section 3 and the SID.

vi) Section 7: presents the conclusions and next future steps

This document serves as formal deliverable D.2a for reporting the work progress of work package A2 at project month 12.
2 Summary of State of Art

In this section a summary of the state of the art regarding business SLA Models is presented. A more detailed analysis has been included in deliverable D.B5a [1].

2.1 TeleManagement Forum’s (TMF) Shared Information and Data Model (SID)

Shared Information Data (SID) model [2][3] is the information model of the Tele Management Forum’s New Generation Operations Systems and Software (NGOSS) program.

SID is a set of comprehensive standardized information definitions aiming to be the common language for building easy to integrate OSS (Operational Support System) and BSS (Business Support System) solutions.

The SID model focuses on what are called “business entity” definitions and associated attribute definitions. A business entity is a thing of interest to the business such as customer, product, service, or network, while its attributes are facts that further describe the entity. Together, the definitions provide a business-oriented perspective of the information and data that it is needed to run in an organization.

The adoption of the SID as the industry’s standard information model is growing rapidly, with many service providers, system vendors, equipment vendors and systems integrators using the SID as the basis for their development and integration. And the influence is widening as the principles are adopted by other industry forums through the TMF industry liaison program.

2.2 Web Services Agreement (WS-Agreement)

WS-Agreement [4][5] is a Web Services protocol for establishing agreement between two parties, such as between a service provider and consumer, using an extensible XML language for specifying the nature of the agreement, and agreement templates to facilitate discovery of compatible agreement parties.

The specification consists of three parts which may be used in a composable manner: a schema for specifying an agreement, a schema for specifying an agreement template, and a set of port types and operations for managing agreement life-cycle, including creation, expiration, and monitoring of agreement states.

There are two topics that are directly relevant to the A2 Work package: the SLA lifecycle management and the Price Offer Specification. While the first one is already covered in the current definition, the Price Offer Specification will have to
be included by means of an extension of the WS-Agreement, adding service
description terms and constraints to fulfill the price-related functionality.

2.3 Web TM Forum SLA Management Handbook

SLA Management Handbook series [6] is a handbook to assist two parties in
developing a Service Level Agreement (SLA) by providing a practical view of the
fundamental issues. The parties may be an "end" Customer, i.e., an Enterprise,
and a Service Provider (SP) or two Service Providers. In the latter case one
Service Provider acts as a Customer buying services from the other Service
Provider. For example, one provider may supply network operations services to
the provider that supplies leased line services to its customers. These
relationships are described as the Customer-SP interface and the SP-SP interface.

The perspective of the SLA Management Handbook series is that the end
Customer, i.e., an Enterprise, develops its telecommunication service
requirements based on its Business Applications. These requirements are
presented to a Service Provider and the two parties begin negotiating the specific
set of SLA parameters and parameter values that best serves both parties. For
the SP, the agreed-upon SLA requirements flow down through its organization
and become the basis for its internal management and control of its Quality of
Service (QoS) processes. For the Enterprise Customers, the SLA requirements
serve as a foundation or a component of its internal network services or business
services. The SLA requirements define and limit the offer and the consumption of
the service for the both parts that are joined. It means that affect to the
consumption of the customer and the offer, service level and support of the
service by the service provider.

2.4 TMForum Service Delivery Framework (SDF) Catalyst Project

The Syndicated Services Catalyst Project [7][8] tries to demonstrate a new
concept that standardizes the product lifecycle management, service provisioning,
event generation, and subscription across Service Provider domains to facilitate
service syndication and end-to-end management of the services.

A Syndicated Service is a self-contained service that has been created and
established in a hosted environment by a Service Provider and is ready to be used
(or "on-boarded") by another Service Provider. From these syndicated services, it
is possible to create commercial agreements or SLAs associated with the
syndicated services.

The Service Provider who can syndicate services must expose service access,
usage, assurance, and billing capabilities. The Service Provider on-boarding the
service will use these capabilities to unify and extend to syndication partners its
own product management process including updates to fulfillment, assurance,
and billing processes.

The Catalyst project presents new concepts used in the new environment of
contracting services. It tries to demonstrate the profits of the syndication of the
services in order to be used by other service provider or the events generation in
order to improve the quality and the management of services. This is one of the
topics of interest in SLA@SOI, which aims to provide an end-to-end management of the service lifecycle, from the creation to the monitoring of the services.

### 2.5 Web Service Level Agreement (WSLA)

Web Service Level Agreement (WSLA) [9] is a novel framework for specifying and monitoring Service Level Agreements (SLA) for Web Services. SLA monitoring and enforcement become increasingly important in a Web Service environment where enterprises rely on services that may be subscribed dynamically and on demand.

Although WSLA has been designed for a Web Services environment, it is applicable as well to any inter-domain management scenario such as business process and service management or the management of networks, systems and applications in general. The WSLA framework consists of a flexible and extensible language based on XML Schema and a run-time architecture comprising several SLA monitoring services, which may be outsourced to third parties to ensure a maximum of objectivity. WSLA enables service customers and providers to unambiguously define a wide variety of SLAs, to specify the SLA parameters and the way how they are measured, and to relate them to manage resource instrumentations. Upon receipt of an SLA specification, the WSLA monitoring services are automatically configured to enforce the SLA.

This specification is directly relevant to the Work package A2, since it includes definitions for the various parties, the SLA parameters and how they are computed, as well as the definitions for the parties' obligations, such as Service Level Objectives (SLOs) and Guarantees.
3 Business SLA Model

This section presents the Business SLA Model as a series of inter-related UML Class Diagrams. The starting point was the identification of the main concepts of the SLA model from the business point of view. The result was a collection of Business SLA Parameters, summarized in Appendix A: Business SLA Parameters. Based on these identified parameters, a Business SLA Model is built, extending the SLA Model specified as part of the A5 work package (reference [11]).

Since the SLA Model defined in the Work Package A5 is a conceptual framework covering all the levels in the SLA context, we have selected only those categories and UML diagrams of DA5a deliverable that are directly related to the business level. This involves mainly the Service Level Agreements and SLA Templates sections. In order to avoid confusion, this chapter is split into sections that share the name with those SLA Model sections. At the end of the chapter, new sections with Billing and Monitoring models from the Business point of view are presented.

In each section, the corresponding UML Diagram taken from [11] is shown, followed by a description of the main concepts. If needed, new attributes are attached to the already defined classes. When new classes become necessary to accommodate the complete set of business parameters, a new UML diagram is depicted. Salmon-pink colour will be used to clearly identify the new components.

In this first release of the document, assessment inside Customer Relationship Management has not been studied, implemented, and presented. However, a basic model for violation and penalty management has been studied and developed during this period. Such a model can be placed as part of post sale framework that will be enhanced in subsequent periods.

According to the SLA®SOI Description Of Work, one of the objectives of the Business SLA Model definition is to provide a consistent model for different agents inside the chain value like Business Department, Sale Department and Customer Department. This part of the model is very important and shall be addressed and enhanced in the next release of this document.

An ontology has been created in order to look for new approach to the business model which would be used in advanced solutions (see Appendix B: Business SLA Ontology). This ontology covers the main concepts, properties and their relationships of the business SLA Model.

3.1 Service Level Agreements

The following figure, taken from [11], represents the main classes related to SLAs:
In the following paragraphs, a brief description of the main classes is presented.

Class Descriptions

3.1.1 **ServiceAgreement**

*ServiceAgreement* is defined in [11] as an “agreement” between a *Customer* and *Service Provider*. The “agreement” exists when both parties “agree”. *ServiceAgreements* are codified by SLAs.

The class *SLA* denotes a (written) *Service Level Agreement* between a *Customer* and a *Provider* concerning the delivery of a *Service*.

D.A5a. [11] describes some of the aspects that each SLA must specify:

i) the specific parties involved in the *Agreement* – e.g. minimally the *Customer & Provider*, but also any third-parties such as the *Consumer* (if different from *Customer*), *Observer & Verifier* (cf. monitoring).

ii) Start and end-times specifying the period during which the Agreement is effectively delivered.

iii) a (non-empty) set of *GuaranteeTerms*, and optionally; one or more *BusinessValues* and/or *MonitoringPolicies*.

At the business level, the following parameters of SLAs have been identified:

Change Procedures: methods to specify changes in service’s requirements and how to carry them out. For example, a customer subscribed to a service which provides reports wants a new or a more detailed report. The process description should clarify how to ask for it, and the steps of the negotiation process.

i) Update Procedures: specification of the upgrade expectations (once a year, 6 months...), the distribution media (e-mail, CD...), the procedures for releasing and installing patches, and what to do if upgrade fails.
ii) SLA update procedures: specification of the interaction process between the Service Provider and the Customer concerning the updating of the SLA itself or of the information contained in the SLA (i.e. ServiceDescription, QoS).

iii) Backup & Recovery Mechanisms: specification of the mechanisms the ServiceProvider will use to insure service continuity during and following the occurrence of a disaster and the Customer support required to assist with disaster recovery. This kind of information could be more interesting for customers who are intermediate Providers and want to ensure a good availability level of the service to their end customers.

iv) Support Information, including:
   a. Contact points: one for technical aspects and a different one for administrative issues. It includes a complete description: names, phone and facsimile numbers, postal and email addresses, etc.
   b. Assigned resources: description of the support capabilities including the scope of the offered services, the periods when supporting service is accessible, the means of contact, etc.
   c. Support process: ProcessDescription objects specifying for example the mechanisms to notify problem resolution state to the customer.

v) Termination information: specifies the conditions and the process to terminate an agreement. The termination process could be launched following a bilateral or an unilateral decision. In any case, the SLA should specify the foreseen reasons to end an agreement, and the methods and periods to send the corresponding notification, as well as possible fees or expenses due to services being delivered up to the effective date of termination.

vi) Tariffs and Billing. The SLA should specify the price at which the Service is delivered to the customer, as well as the billing mechanisms. This part of the model will be explained in detail in section 3.6.

3.2 Service BusinessValue

The class BusinessValue denotes the value (or ‘worth’) of Obligations to the ‘obligated’ party (Customer or Provider). In the A5 model 2 kinds of BusinessValue are considered – namely;

i) Cost – which comes in 2 flavors:
   a. Penalty, denoting a punitive measure on the obligated party in the case the Obligation is not fulfilled,
   b. Reward, denoting (potential) benefits for the obligated party in the case the Obligation is fulfilled.

ii) A Priority level – defines the importance of the associated Service Level Objective (SLO). It is intended to aid in the resolution of conflicts between Obligations, i.e., in the case of two events that affect different
functionalities of a service happen, this value could be used to specify which one is attended first.

3.3 Service Level Objective (SLO)

The class SLO (Service Level Objective) serves to specify the ‘Quality of Service’ (QoS) properties of a Service, and is expressed as a target for a Key Performance Indicator (KPI) such as average response time, completion time, availability, etc. See Section 3.5 for more details.

3.4 SLA Templates & Service Descriptions

The following figure, taken from [11], represents the main classes related to SLAs and Services:

![Figure 3: SLA Templates & Service Descriptions]

3.4.1 Class Descriptions

ServiceDescription

DA5.1a defines a ServiceDescription as a representational artefact that completely describes a Service.

ServiceOfferDescription

The class ServiceOfferDescription is the symbolic correlate of a ServiceOffer - i.e. it denotes the concrete description of the offer. The ServiceOfferDescription defines the functionality that will be delivered under an agreement:

i) A ServiceDescription describing the offered Service.

ii) Technical information, i.e. redundancy level, routing alternatives, transport restrictions. This kind of information is necessary when the Customer is a
ServiceProvider that needs technical details in order to assess if the offered service is valid to build his own service.

iii) Equipment: description of the Service Provider equipment to be located on customer premises and its requirements of space, power and environment, as well as how SP staff can access it.

### 3.5 Monitoring

This section outlines the main concepts involved in the monitoring process at the business layer. Most of the parameters and measurements used to assess the QoS are usually provided by the service and infrastructure levels (WPA3 & WPA4). At business level all such indicators are combined in order to calculate the global QoS of the offered service.

This involves different activities:

i) Select data meaningful to Customer taking into account that very technical indicators are useless for customers.

ii) Detect the most important aspects of the service and then the relevant indicators. For example, a periodical polling could indicate to the provider that his customers find images more important than sounds in a specific service.

iii) Combine parameters to get one that assess the quality of the service being offered. Following the former example, the service quality indicator (QI) can be equal to 90% image QI plus 60% sound QI.

iv) Assign values to quality indicators for different service offers. In our example, Gold service QI = 90% image QI + 80% sound QI, common service QI = 80% image QI + 60% sound QI.

In general, business service quality indicators are a combination of one or more service and infrastructure quality indicators according to business policies.

There are other kinds of quality measures which can be considered as business level quality measurements, as those of support, billing and any other facility provided by Service Provider with the service itself.

The following UML class diagram represents the most important conceptual object types and their relationships:
3.5.1 Class Descriptions

KPI

A KPI (Key Performance Indicator) is used to define measurable and exposed properties associated with a service, such as response time and throughput. The properties are used to express service level objectives. A ServiceDescription can have one or more KPIs.

A compound service will have KPIs derived from the KPIs of the atomic services, but it may also have new parameters. For instance, an audiovisual service composed out of an image service and an independent audio service: it will inherit parameters like quality of the sound or quality of the image, but it will have a new KPI to indicate if the audio and the video are synchronized.

Metric

A Metric is a definition of values of parameters that are measured from a service providing system (MeasurementDirective) or computed from other metrics and constants (Function). Metrics are the key instruments to define exactly what a KPI means by specifying how to measure or how to compute it.

A Metric definition includes data collection and monitoring intervals.

Example

A metric measures an invocation counter of an application server for a particular operation. How to access the counter is defined in a measurement directive. A composite metric “average number of invocations in a minute interval” is defined by a function specifying a time series of readings of the resource metric and computing the averages from this time series.
MeasurementDirective

Measurement directives define how parameter values are to be measured by the organization that makes a metric's value available. How the measurement is conducted and which information is needed for this purpose depends strongly on the particular system to which measurement is applied. Some systems expose standard management interfaces such as SNMP, but other types of measurement require probing, which requires an interface to the probing system.

Function

A Function specifies how to compute a metric's value from the values of other metrics and constants. Functions are central for describing exactly how KPIs are computed from measurements.

MonitoringPolicy

The MonitoringPolicy describes the monitoring activities: parameters to be collected and measures to be made, data collection and measurement intervals, and aggregation intervals.

MonitoringReportsPolicy

The SLA should include a description of the monitoring reporting activities. This includes:

i) Reports: content and format of performance reports, frequency of report production and delivery, delivery mechanism and associated distribution list.

ii) Changes in reports: specifies how the customer can perform changes in the report content, format, frequency etc, including a description of the notification procedures for changes made by the Service Provider.

3.6 Billing

This section is intended to specify a conceptual model dealing with the billing part of the project. The following figure shows an overview of the main billing domain business entities:
3.6.1 Class Descriptions

BillDescription

A BillDescription describes the detailed structure of the customer’s bill. It indicates when to initiate the bill creation, as well as the frequency of the billing. It also specifies the billing mechanisms, detailing how the billing is built (for instance, specifying a time criterion like minutes or seconds or events subject to billing).

BillFormat

A BillFormat represents the presentation format of the bill. This bill may be sent to the customer through various media (for example, email, post mail ...).

BillAlteration

This class represents a deduction that can be applied to the billing charge. The type attribute indicates the nature of the discount, i.e. a promotion, a reduction due to a violation of the signed SLA, or even an increase derived from a penalty applied to the Customer.

Customer

This class encapsulates all the customer data needed to contact him, i.e. name, address, e-mail, phone number.

PaymentMethod

This class represent the method used for payment. As an example, two subclasses have been included in the figure:
*BankTransfer*, which includes the name of the financial institution and the account number where the bill will be charged.

*CreditCard*, defined by the card number and the expiration date.

Other payment methods can be added by extending the *PaymentMethod* class.
4 Business SLA basic Framework

4.1 Overview
The business SLA basic framework is the result of the study of SID model and definition of the data model, the study of WS-Agreement standard and the definition of the basic interaction of the eContracting module (that implements the previous features).

The focus has been put in these basic points:
- Commercial creation (in terms of products and offers).
- Business SLA template creation.
- SLA negotiation & creation.
- Notification of business violations & querying SLA status.

4.2 High-Level design goals
We can describe high-level design goals of basic business SLA framework:

- Study in depth which business terms are necessary to take care of.
- Define how it is possible to express the business terms in an agreement and its template.
- Study eTOM and SID model in order to define a consistent business model adapted to SLA@SOI.
- Study WS-Agreement in order to define an extension of it, oriented to include the business model of the project.

4.3 Requirements
The requirements that are described in this section are mainly provided for the work in A2 work package and the others work packages that have a strong relationship with A2, like A1 and A5. Also we have considered some requirements from B1 and B5.

It is possible to summarize the requirements that have been implemented in the Business SLA Framework for year 1 in SLA@SOI as follows:

- A simple tool that allows create, view and store basic business information for the high level elements:
  - Products
  - Offers
  - Policies
  - Business SLA templates

- A module to be integrated in the SLA framework, that allows establish a business SLA and launch the negotiation and provision in the other SLA levels (software & infrastructure).

- The module has to be capable of applying policies that give an increase or discount in the price, depending of the parameters filled by the customer in the business SLA offer. Also, it is possible define some kind of rewards based on some SLO aspects (expressed like a discount).
Also the module has to receive the violations from the framework and store and resent it to the customers (ADHOC).

The following sections describe deeply these requirements.

### 4.3.1 Requirements codification

In order to summarize the requirements, we define a codification for tagging each requisite.

We have the first letters corresponding to:

EC : EContracting (Mayor module name)

We have a second level with other letter related to:

- G: Generic Business Framework Requirements
- C: Commercial creation
- N: Negotiation
- A: Assessment
- P: Post sale management

And finally we have a 3 digit number, that it is numerated sequentially.

Example:

EC.G.1 Creation product tool

### 4.3.2 Generic Business Framework

**EC.G.1 Retrieving Business SLA Templates**

It is necessary to obtain the Business SLA templates for a specific product.

**EC.G.2 Establish an Business SLA offer for a Customer**

It must be possible for a customer to submit a Business SLA offer to contract a offered product (and the IT services that are included inside the it).

**EC.G.3 Business Violation Information for a Customer**

It must be possible to send Business Violation information to a Customer that established a Business SLA before.

### 4.3.3 Commercial creation

**EC.C.1 Product Creation**

It is necessary have a tool for the creation of the products information and overall information regarding to the commercial creation. The information of a product creation are: name, description, brand ...

**EC.C.2 Offering and Prices Creation**

It is necessary have a tool for defining the offers and prices for the products. We can have different offers with different economic features and prices.

**EC.C.3 Get Price for services**
It is necessary to obtain price items from the services in order to include these business terms in the prices creation of a product.

EC.C.4 Bundle Creation
It must be possible to associate some services in a service bundle.

EC.C.5 Datamodel definition
It must be possible to store information about the business terms, products, offers, etc.

4.3.4 Negotiation, assessment & post-sale management

EC.N.1 Simple negotiation step
It has to have the possibility to have no negotiation process to accept an agreement. This should be the simplest way to make an agreement.

EC.N.2 Obtaining the SLA
The result of the negotiation process has to be the SLA.

EC.A.1 SLA personalization
The SLA must be changed in terms of personalization of prices supported by customer requirements about the changes of these values in the templates for him. For instance we can have a special reward for a customer or a discount because we have a more flexible guarantee term.

EC.A.2 Policies definition
It must be possible to define policies. These policies can be associated to discounts, rewards or recharges.

EC.A.3 Policies detection
The change of a parameter in the template should be detected and matched with the defined policies. For instance if a customer modify a guarantee term parameter of the service, it is necessary to increase/decrease the price.

EC.P.1 Evaluation of penalties
It is necessary to evaluate the violations of guarantee terms by identifying the service provider that did not deliver services according to the agreed terms, and computing the corresponding penalties.

EC.P.2 Communication of Violations
It is necessary to communicate to the customer all the violations that have been produced on business SLAs.
### 4.3.5 Features

In the below table, it is depicted the features of the framework that eContracting is interested on and that will be implemented. These features are provided by eContracting to the use cases.

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Feature Description</th>
<th>User Role</th>
<th>Expected Business Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Management</td>
<td>Service provider needs a way to publish and manages the products that will be purchased by the customers.</td>
<td>Service Provider</td>
<td>Support of the complete product lifecycle from creation to retirement.</td>
</tr>
<tr>
<td>Product Discovery</td>
<td>Service providers and customers need a way to query for the available products and the templates related to them.</td>
<td>Service Customer, Service Provider</td>
<td>Supports a very expressive and powerful way to discover different products from the requirements given.</td>
</tr>
<tr>
<td>Assessment</td>
<td>Customization of agreements taking into account the requirements of service provider and customer, such as the profiling of the customer</td>
<td>Service provider</td>
<td>Support for customization of agreements for Customers and Service Provider</td>
</tr>
<tr>
<td>Violation Management</td>
<td>Management of the agreement violations, and identification of the related penalties.</td>
<td>Service Provider</td>
<td>Evaluation of the agreement violations received.</td>
</tr>
<tr>
<td>Billing Management</td>
<td>Service providers need a way to generate the bill for customer from the agreement signed, taking into account discounts or rewards according to the violations communicated.</td>
<td>Service Customer, Service Provider</td>
<td>Bill generation and settlement among service providers.</td>
</tr>
<tr>
<td>SLA Reporting to customers</td>
<td>Customers can configure reports. Reports include billing information. They are automatically</td>
<td>Service Customer</td>
<td>Better transparency of provider against customer. Better post-sale support.</td>
</tr>
</tbody>
</table>
4.4 Architecture

4.4.1 Physical architecture

The work developed in the Work Package A2 has been compacted into the eContracting module in the SLA@SOI framework, described in Deliverable D.A1a [17].

4.4.2 Overall software architecture

This section presents the relationship among the eContracting and other modules of the SLA@SOI framework for the ad-hoc demonstrator. Figure 6: Overall architecture diagram taken from [17], reproduce the technical architecture of the project.

eContracting realizes the business-level management of customer requests and the interaction between a service provider and his customers. In order to do that, it offers interfaces to the customer (adhoc) to retrieve SLA templates related to the offered services and to propose agreements based on the templates given in order to be able to contract the services customers are interested on. In order to be able to do the mentioned business-level management, eContracting introduces some specific parameters (Business terms), that will be explained later, and will allow eContracting make an evaluation of specific aspects such as the price of the offer.

In this way, Policies (specific Business Rules) will be created to help in the assessment of the final price allowing applying a discount or recharging over the initial price of the SLA.

In order to know if the framework is able to deliver the services requested and to provision them into the services platform, eContracting will contact Negotiation module. This one will take into account the technical requirements included in the proposed agreement by the customer to check the availability of the services on the platform and order their provisioning in the case it could be possible.

The Adjustment module is in charge of receiving all the monitoring events from the services platform. After analyzing them, it will decide when a SLA violation arises. Then, it will inform customer about the violation. eContracting module will also be informed about any SLA violation that affects the business layer (i.e. when a customer has unfulfilled his obligations, or when a penalty or reward should be applied).

This information could be forwarded to the customer.

Violation and Penalty management has been developed in this period and, as has been commented above, is part of the post Sale framework. This means that it allows framework and customer to know about the behavior of services and, in some cases, apply the corresponding consequences (economic penalties). In subsequent periods, this will be extended in order to improve and develop the representation of Business SLA violation evidences and how the post sale framework will make possible the arbitration of the mentioned tasks and the management of the penalties associated. In subsequent periods, it will be
studied and develop the assessment of SLAs and SLA templates, that will allow the framework to customize them, in base on the customer profiles retrieved from Business Support System (BSS).
Figure 6: Overall architecture diagram
4.4.3 eContracting software architecture

**eContracting Module Architecture Diagram**

In the eContracting module we have the following components:

![Diagram](image)

**Figure 7: eContracting architecture diagram**

The objective of eContracting module is to be the component that interacts with ADHOC and Negotiation, Provision and Adjustment modules (as a part of the SLA Framework). Then eContracting exports some interfaces to ADHOC and consume others as you can see in the diagram.

**Business Terms**

This module is in charge of describing all the business terms related with a Business SLA template. These terms are specifically related to business aspect that will be included inside the SLAs. These terms are based on the parameters presented in the Business SLA model section and summarized in Appendix A: Business SLA Parameters. These aspects describe terms such as the description and the prices for the services delivered in the whole SLA, how the framework will periodically inform to the customer about the behaviour of the contracted services or the conditions under which an SLA could be terminated.

In year 1, only some of these terms were taking in to account at Business layer inserting them inside the Business SLA and their later processing. Because of the importance of these terms, in the following periods they will be included at all levels, including them in the process negotiation of all layers. To do this, as in the Business SLA, these terms will be inserted inside of subsequence hierarchy SLAs (SW and HW SLA), adjusting those parameter to the characteristics of the
corresponding layer for their processing (in example the prices are different at all layer because they represent different issues). Bellow it is presented an example of a piece of SLA that contains these Business parameters. In a later section it will be explained how these parameters have been inserted as part of WSA. It is based on a complete business schema focused in business issues that are not contemplated in WSA. This is a metamodel that has its own entity in SLASOI. Also these items were expressed in coremodel terms. Then Business schema uses coremodel expressions inside.
Figure 8: Business Schema
The package that has the functionality is org.slaatsoi.business.schema.

Following, it is explained the meaning of each parameter:

- **Contact Point**: This parameter stores the important contact data of the customers or service providers such as, their whole names, telephone and fax numbers or the email address.
- **Service Description**: This parameter gives a description of the purpose of the whole service.
- **Update Process**: This parameter explains how a SW service could be updated. This parameter provides the information about the frequency of updating process, how the customer will receive the actualization or the instructions to install it.
- **Reporting**: It specifies the information needed by the framework in order to generate the reports for the customer. Here it is specify, a basic description of what the report offers, the report type (i.e. only penalties, all activity), the report method (i.e. by email, post), the frequency of the report (diary, monthly) and what the report has to content.
- **Monitoring**: Here it is specified what parameters are interesting for the customer to be monitored, the associated unit and how it has to be monitored (i.e. in terms of frequency). This information is just used to report customer, and might not be correlated with Guarantee terms of the SLA.
- **Termination clause**: Here it is specify the conditions under which an SLA could be terminated, either by customer or by service provider. Here it is specified, the method to communicate the end of the SLA or the associated fees if there is anyone.
- **Support**: It specifies the information related to the contact point in case of customers need to notify an error in the behaviour of the services contracted. It specifies a telephone number and the days and hours of availability.
- **Support Procedures**: It specifies how the support team will responds to an error communicated by the customer, that is, the level of severity of the errors and the associated times to respond to them.
- **Backup and Recovery Mechanism**: It specifies two important mechanism:
  - **Backup**: Specifies how the system will make a backup of the important information in terms of the frequency, the mechanism type (full, mirror, incremental) and the estimated time needed to do this.
  - **Recovery**: Specifies how the system will perform a service recovery in case of a fatal error in terms of the mechanism type (full, mirror, incremental) and the estimated time needed to do this.
- **Product Offering Prices**: It specifies the prices related to the delivery of the services. Here it is explained the billing frequency and the components that compose the final prices (amount of money and type of price). For instance, a one time charge (subscription charge) or the monthly price for the service usage. Here, it is also included, an entity referring to the modification of the initial prices. This means that it is expressed when a product has a discount or recharge basing on, for instance, product promotions.

As an example, bellow it is depicted how some parameters are inserted into an SLA. Specifically, here it is described: the Contact point, the Support, the Reporting and, finally, the Termination Clauses parameter.

This piece of code was extracted from a business SLA Example [18].

```xml
<wsag:ServiceDescriptionTerm wsag:Name="ContactPoint"
wsag:ServiceName="IntermediateService">
<BusinessSchema:BusinessTerm>
  <ContactPoint>
    <Name>Contact Point Name</Name>
    <Email>Contact Point Email</Email>
    <PhoneNumber>+34606352187</PhoneNumber>
    <Fax>+34606352187</Fax>
    <Address>Contact Point Adress</Address>
  </ContactPoint>
</BusinessSchema:BusinessTerm>

<wsag:ServiceDescriptionTerm wsag:Name="Support" wsag:ServiceName="IntermediateService">
  <BusinessSchema:BusinessTerm>
    <Support>
      <PhoneNumber>+34606352787</PhoneNumber>
      <AvailablePeriod>
        <DayOfWeek>AllWeekDays</DayOfWeek>
        <TimePeriod>
          <InitTime>00:00:00</InitTime>
          <FinishTime>23:59:00</FinishTime>
        </TimePeriod>
      </AvailablePeriod>
    </Support>
  </BusinessSchema:BusinessTerm>
</wsag:ServiceDescriptionTerm>

<wsag:ServiceDescriptionTerm wsag:Name="Reporting" wsag:ServiceName="IntermediateService">
  <BusinessSchema:BusinessTerm>
    <Reporting>
      <ReportDescription>Reporting Description</ReportDescription>
      <ReportFormat>TEXT</ReportFormat>
      <ReportType>All activity</ReportType>
      <ReportMethod>Email</ReportMethod>
      <ReportFrecuency unit="day" value="1" />
      <DeliveryFrecuency unit="day" value="1" />
      <DeliveryMechanism>email</DeliveryMechanism>
      <ReportContents>
        <Content>
          <ContentName>partys</ContentName>
          <ContentDescription>names partys implied</ContentDescription>
        </Content>
        <Content>
          <ContentName>Parameter</ContentName>
          <ContentDescription>Monitoring parameters</ContentDescription>
        </Content>
        <Content>
          <ContentName>Error</ContentName>
          <ContentDescription>Errors finded</ContentDescription>
        </Content>
      </ReportContents>
    </Reporting>
  </BusinessSchema:BusinessTerm>
</wsag:ServiceDescriptionTerm>

<wsag:ServiceDescriptionTerm wsag:Name="TerminationClauses" wsag:ServiceName="IntermediateService">
  <BusinessSchema:BusinessTerm>
    <TerminationClauses>
To obtain more information, see the section 4.6 Business SLA Implementation.

**Common**

This module contains the following basic components:
- Constants
- Configuration
- Datamodel for data persistence (beans and daos)
- Other general framework classes and objects

The detail of data model is widely explained in section 3.

The package is org.slasoi.eContracting.common.

**Business WebServices**

This module is in charge of manages the web services for eContracting (server and client part). The interfaces and operations supported are the following:

*QueryCatalogue interface*
  - queryProductCatalog operation
  - queryCatalog operation

*ProposeAgreement interface*
  - proposeAgreement operation

*QuerySLAStatus interface*
  - QuerySLAStatus operation

*NotifyDeliveryStatus interface*
  - NotifyDeliveryStatus operation

More detail in next sections.

The package is org.slasoi.eContracting.common.WS.
Product Discovery

This module offers the functionality needed by a Customer (or in some cases a Service Provider) to access information about the available Products for purchase. Basically this entails two different tasks:

1) Maintaining and managing the Service Registry for each Service Provider in which the details about the different Services / Products are stored and
2) Expose this information to end Customers as a result of their queries.

The package is org.slasoi.eContracting.productDiscovery. The product discovery functionality has been initially implemented in year 1 as a keyword-based search tool. The planning for the following periods is to investigate whether category searching techniques can be used in the improvement of the online searching, in order to generate more relevant results. This type of search is based on a previous classification of the products according to some of their characteristics, sometimes made in a manually way. According to that, a product could be included in different categories. Category searching will allow the customer to find products according, as commented above, to some of their specific characteristics in which they were classified, such as the service type (travel agency or data storing) or the service provider that offers them.

According to the explanation above, other researching area for the following periods could be which categories are interesting for the final customers who purchase the products. The objective of this kind of search is to allow customers to find and select products for its purchase according to some specific characteristics or to their preferences.

As commented, Discovery process introduced by eContracting module and the one introduced by the A5 module have different meanings. In this way, eContracting module discovery will search for specific commercial offers (products) according to the parameters specified, whereas the objective of the discovery process introduced by A5 Module will support ‘SLA aware’ service-discovery, which goal is, in the end, to find specific SLA Templates, that is completely opposed to specific services.

Product Lifecycle Management

A Product will need to go through different stages during its lifecycle (such as creation, negotiation, provisioning, initiation, termination, etc.) This module is in charge of managing the transitions between these stages indicating to the appropriate modules when they have to perform specific operations.

This module will, for instance, make use of the functionalities described in the Provisioning interface to indicate when a new Product has to be provisioned and initiated following the successful end of the negotiation process.

The package is org.slasoi.eContracting.productLifeCycle.

Business Negotiation

The module is in charge of relations between end Customer and the Service Provider, according to a predefined signaling protocol and a term nomenclature
that both parties can understand. During this process the Business Rules will have to be applied to get to the final agreed SLA.

The Business Rules are specific constraints related to commercial or business characteristics of the services offered by the service provider and that have implications (i.e. they have to be followed) in negotiation processes. The business rules have been applied in an automatic way in the negotiation process. For instance, they can provoke that the negotiation is refused or finish...

The package is org.slasoi.eContracting.businessNegotiation.

**Events Monitoring**

The actual monitoring is performed in lower layers below the business level but there are some types of events that have a direct relationship with the eContracting module and are needed for the proper working of the module in real time.

For that, this module receives the events of violations, and decides what component is in charge of manages these events.

The datatype used by this module, is named BusinessViolationEvent and it is received from adjustment module.

For example, eContracting can receive an event related with the break of the guarantee term X (service S).

The package is org.slasoi.eContracting.eventsMonitoring.

**Penalties Engine**

This module is in charge of evaluating the received SLA violations and calculates and applies the actions to take (such as notifying the Billing module of it or indicating the Lifecycle management module that the service has to be interrupted for instance). The evaluation could be based on different factors, such as the significance of the Guarantee Term that was violated, the duration of the violation, and the time occurrence of that violation.

The package is org.slasoi.eContracting.penaltiesEngine.

**Business web tools Architecture Diagram**

Also we have other separate component that uses some parts of eContracting module. This component is in charge of manages eContracting module. The business tools are the web module prepared to be the graphical user interface for managing eContracting
Grayed packages are not used in Business Web Tools component.

The main goal of this component is to be the business view of eContracting module. It is in charge of creates businesses data. Also, all these information is query able with the web tool.
In the first year we don’t deliver any code about this module, but in year 2 we split it in a free part for the project and other private for Telefónica.

The mainly functionality included is:
- Product creation (service selection)
- Offers and prices definition
- Discounts and rewards
- Business SLA templates definition
- Policies definition
- ...

**4.4.4 eContracting requirements/features and components matrix**

In the bellow table, it is depicted the relationship among the requirements, the features and the component implemented.
<table>
<thead>
<tr>
<th></th>
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4.4.5 Data Model

4.4.5.1 Business Data Model

In this section it is introduced the business SLA model developed by A2 Work package. Because of the extension, it has been divided in three parts in a coherence manner to a better explanation. In the next page figure it is presented how the Business parameters introduced in section 4.4.3 are included in the Business Model. From the Business point of view, there are two important entities: the Product Offering that represents what it is offered to customers (in terms of all the characteristic of the services offered, from the level of services to the conditions in which the services will be offered), and the Service Level Agreement (SLA) that represents the final agreement between customer and service providers on the delivery of services. The relationship between a Product Offering and SLA is that a Product Offering could be negotiated several times in order to achieve several different SLA. The attributes of a product offering are:

- **Id**: Used to identify uniquely a product offering.
- **Name**: A proper name for the offer.
- **Description**: Brief description of the offer.
- **ValidFor**: The period of time during which the offer is valid.

The attributes of a service level agreement (SLA) are:

- **agreementDocumentNumber**: Identifies a unique SLA.
- **agreementPeriod**: The period of time during which the SLA is valid.

Business parameters are a very important part of the entities mentioned above, because they could represent several important conditions in the services offered and, in the end, an important point in the negotiation process. In the bellow diagram it is shown how these terms are introduced as a part of the product offering as a product offering terms. The relationship between them is that a product offering term is related to one Business Parameter. The attributes of a product offering term are:

- **Id**: Used to identify uniquely a term.
- **Name**: A proper name for the term.
- **Description**: Brief description of the term.
- **ValidFor**: The period of time during which the term is valid.

These terms are introduced as a part of an SLA as agreement terms or conditions. As in the same case of product offering and SLA, the relationship among product offering terms and agreements terms or conditions is that these last terms are the result of the contract between customer and service providers. So an Agreement terms or conditions are the result of a negotiated product offering term. A product offering term could be related to several agreement terms or conditions because of a product term or conditions could be negotiated several times in order to reach several different agreements. The attributes of a product offering term are:

- **agreementTermConditionNumber**: Used to identify uniquely an agreement term.
- **Name**: A proper name for the parameter.
- **Description**: Brief description of the term.
- **ValidFor**: The period of time during which the term is valid.
Figure 10: Business Data Model. Business Parameters relationship
In the below figure, it is depicted which are the different parts of a product offering and the relationship between them and the Service Level Agreement (SLA). A SLA and a product offering are composed of two main parts. Firstly, it is the one commented above related to specific terms or conditions, which will be taken into account during the delivery of services, and the other related to the quality level of services that have to be fulfilled. Here it is shown how a product offerings and SLAs are related to the second part.

Every product offering has its own product specification where it is included all the service specifications included in the product offering. In this way, commercial offers can be composed of one or several products and, in the end, of one or several product specifications. The attributes of a product specification are:

- **productNumber**: Used to identify uniquely a product specification.
- **Name**: A proper name for the product specification.
- **Description**: Brief description of the product.
- **Brand**: The commercial name of the product
- **lifecycleStatus**: Describes, for example, whether a product description is available or not.
- **ValidFor**: The period of time during which the product specification is valid.

As is mentioned above a product specification could be composed of several services and each service has its own service specification. The attributes of a service specification are:

- **id**: Used to identify uniquely a service specification.
- **Name**: A proper name for the service specification.
- **Description**: Brief description of the service specification.
- **status**: Describes, for example, whether a service description is available or not.
- **ValidFor**: The period of time during which the product specification is valid.

In this case a service specification is related to a service level specification because it specifies the different quality levels to be taken into account. In this way a service level specification is composed of one or several service level objectives (SLO) that are specific parameter (ServiceLevelSpecParameter) values that services must fulfil. The attributes of a Service Level Specification are:

- **Id**: Used to identify uniquely a service level specification.
- **Name**: A proper name for the specification.
- **ValidFor**: The period of time during which the specification is valid.

The attributes of a Service Level Objective are:

- **conformanceTarget**: The level of the parameter to fulfil
- **conformanceCondition**: The condition related to the level of the parameter to fulfil (less than, upper than)
- **conformancePeriod**: The period of time when the parameter will be check.
- **ValidFor**: The period of time during which the SLO is valid.

ServiceLevelSpecParameter specifies the parameters to be taking into account, because a parameter could be used in several SLAs. The attributes of a ServiceLevelSpecParameter are:

- **Id**: Used to identify uniquely a parameter.
- **Name**: A proper name for the parameter.
- **Description**: Brief description of the parameter.
- **ValidFor**: The period of time during which the parameter is valid.

There are other important entities related to SLO. Service level spec consequences specify what the consequences (one or several) are when an SLO is not fulfilled over a period of time (that could be a penalty or a specific action). Another entity is Violation that is the expression of a service level objective not fulfilled for a specific SLA over a period of time. In the delivery of a SLA could
occur none several Violations. Related to a Violation there is a Penalty, that is, a violation has an associated penalty. The attributes of a Penalty are:

- **Id**: Used to identify uniquely a penalty.
- **unit**: the unit used in the penalty (for example, Euro).
- **valueExpr**: Express the quantity of the penalty.

**Figure 11: Business Data Model. Agreement relationships**

Finally, next page figure presents the data related to the parties implied in the negotiation process. As commented above there are two main entities in the diagram that are product offerings (what is offered) and service level agreement (the contract). Here it can be seen that it is another main entity, Party that
contains the basic information of the entities related to the Business SLA Model, with two different roles. These roles are: the Service provider, who offers services and creates product offerings, and the customer, who is interested in negotiating and purchasing what a product offering offers. So, a service provider is related to a product offering. This means that he could create one or several product offering. Service provider extends from partyRole entity which principal attributes are:

- partyRoleId: Used to identify uniquely a role.
- name: A proper name for the role.
- description: Brief description of the role.
- Status: Describes, for example, if a role is active or not.
- validFor: The period of time during which the role is valid.

Service provider adds the attribute sProvider, in order to identify in a unique way a service provider.

Customer has a relationship with one or several SLA, because of they are able to contract several SLA. Like Service Provider, customer extends from partyRole entity, but this one adds the following attributes:

- customerId: Used to identify uniquely a customer.
- Status: Describes, for example, if a role is active or not.
- customerRank: Specifies a possible customer classification.

The purpose of the negotiation process of a product offering is to achieve a service level agreement (SLA). As mentioned above, there is a negotiation process between a product offering and the achievement of an SLA. In this process there could be an evaluation of certain product offering characteristics of such as the service level of certain service parameters. Related to those characteristics, there could be some policies, in order to express some business rules that could be applied in the process to asses the final price of an SLA. The principal attributes of a policy are:

- id: Used to identify uniquely a policy.
- policyType: There could be different types of policies attending on which aspects are related to.

As commented above, related to policyType attribute, there are different types of policies attending to different characteristics. Bellow is also depicted the different types of policies attending to terms of dates (promotion period), service (the quantity and what services are contracted) or the quality of service.
Figure 12: Business Data Model. Parties relationships
4.4.5.2 Agreements Data Model

All the templates of SLAs and the proper SLAs are based on WSAG wrapper library from Work Package 5. Also, this wrapper is based on WS-Agreement standard. More detail in the documents provide by Work Package A5.

4.4.5.3 Violations Data Model

The information stored is relative to the business SLA violation, and all the information about the event that provokes this violation at business level.

Details of monitoring events include other structures used by other components in SLASOI, but if you want more detail about that it is necessary we refer to these work packages: WP A5 (negotiation, provision, adjustment), WP A4 (infrastructure management) and WP A6 (prediction).

A simple example of such a business violation event is shown:

```xml
<wsag:GuaranteeTerm wsag:Name="CompletionTime_BookSale_GTerm" wsag:Obligated="ServiceProvider">
  <wsag:ServiceScope wsag:ServiceName="IntermediateService"/>
  <!-- Qualifying Condition : peak customer load < 5 request per seconds -->
    <Expression>
      <Predicate xsi:type="coremodel:LessEqual">
        <OperandA xsi:type="terms:ArrivalRate" description="Non-Functional" context="InventoryService_getProductDetails_ServiceProperty_arrivalRate_Variable" qualifier="">
          <arrivalRate />
        </OperandA>
        <OperandB xsi:type="coremodel:Constant">
          <type xsi:type="coremodel:Frequency" uniqueID="" value="5.56"/>
        </OperandB>
      </Predicate>
    </Expression>
  </coremodel:Expression>
</wsag:QualifyingCondition>

<wsag:ServiceLevelObjective>
  <wsag:KPITarget>
    <!-- Completion Time < -->
    <wsag:KPIName>InventoryService_BookSale_Gterm_KPI_CompletionTime</wsag:KPIName>
    <!-- 120ms for 90% -->
    <wsag:CustomServiceLevel>
      <coremodel:Expression xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"/>
    </wsag:CustomServiceLevel>
  </wsag:KPITarget>
</wsag:ServiceLevelObjective>
```
The process to evaluate if a guarantee term is fulfilled or not is the following:

- The variables to be evaluated are: arrival rate and completion time.
- It is necessary to guarantee an arrival rate less than 5.56, then is needed to be checked the expression “completion time < 95 %”.
- Then, it is necessary to monitor the parameter arrival rate and completion time.
- The penalty is produced when the evaluation don’t achieve the expressed values commented before.
- The penalty associated to breach the guarantee term is translated in 1 euro and
- this penalty is checked in periods of 24 hours.

The monitoring event structure is the following:
Figure 13: Monitoring Event
4.5  Business SLA interfaces

4.5.1  Provided interfaces

These interfaces are consumed for other modules that consume them. eContracting is the server that offers the operations. In the final demo release of SLA@SOI we don’t use web services but the operations are defined as here appears. In year 1 release we use spring integration in order to do this effort in an easy way.

QueryCatalogue interface

This interface is provided for eContracting to Adhoc Demonstrator in order to interact for finding products, templates, and services. This interface uses EContractingSchema-1.0.xsd. eContracting is the server that offers the operations.

queryProductCatalogue operation

This operation is in charge of recover the product information from eContracting products Catalogue. It will be implemented in Year 2.

queryCatalog operation

This operation is in charge of retrieves available SLATs for the product identification given.

ProposeAgreement interface

This interface is provided for eContracting to Adhoc Demonstrator in order to interact for create an agreement with a customer. This interface allows operate with business agreements (establish, revoke, query,…). This interface uses EContractingSchema-1.0.xsd. eContracting is the server that offers the operations.
**proposeAgreement operation**

The customer proposes an SLA offer to be compute in the framework. As a result, the customer will receive the complete SLA. This operation initiates all the agreement processing with the SLA offer of the customer. Concrete SLA is returned to the customer when the framework negotiates and provisions the required resources.

**QuerySLAStatus interface**

This interface is provided for eContracting to Adhoc Demonstrator in order to interact for get information about an SLA. This interface contains all the operations that give the detailed status of an SLA to a customer. eContracting is the server that offers the operations.

**QuerySLAStatus operation**

In year 1, this operation only retrieves the violations stored of a business SLA. This operation will be enriched in year 2, with information relative to the status of the SLAs included in the business SLA and other useful information.

**EContractingSchema_1-0.xsd**

This schema defines all the data types used by propose agreement and query catalogue interfaces. It is based on WS Agreement Standard Schemas.
**BusinesViolationEvent interface**

This interface is provided for eContracting to Adjustment module in order to receive the violations event from adjustment.

The data send from adjustment is defined by the section of the document 0

### 4.5.2 Consumed interfaces

These interfaces are provided by other modules, and they are consumed for eContracting. In this case, eContracting is the client that access to the external operations. More detail of these interfaces can be found in the corresponding modules documentation: Work package A5 (Negotiation) and B2 (ADHOC).

**CreateAgreement interface & operation**

This interface is provided by Negotiation module, and it is consumed by eContracting. The operation allows establishing an agreement with the software and infrastructure levels.

**GetTemplates interface & operation**

This interface and operation are provided by Negotiation module, and it is consumed by eContracting. The operation allows retrieve concrete business, software and infrastructure SLA templates that are stored in the Templates Registry. This interface is not implemented in Year 1.

**StoreTemplates interface & operation**
This interface and operation are provided by Negotiation module, and it is consumed by eContracting. The operation allows store business, software and infrastructure SLA templates in the Templates Registry.

**GetSLAS & operation**
This interface and operation are provided by Provisioning module, and it is consumed by eContracting. The operation allows retrieve concrete business, software and infrastructure SLAs that are stored in the SLA Registry.

**StoreSLAS & operation**
This interface and operation are provided by Provisioning module, and it is consumed by eContracting. The operation allows store business, software and infrastructure SLA in the SLA Registry.

**NotifyDeliveryStatus interface**
This interface and operation are provided by ADHOC demonstrator to eContracting in order to send the violations of the SLAs of the framework. This interface is in charge of delivery to the customers also other kind of information. eContracting is the client that connects to the server allocated in ADHOC demonstrator, and eContracting send the violations in case that they appears in the framework.

**NotifyDeliveryStatus operation**
This operation allows eContracting to send violations to the customers.

---

### 4.6 Business SLA implementation

#### 4.6.1 Business SLA Templates

The business SLA templates are based in WS-Agreement standard. The business templates defined, use the business schema defined and coremodel expressions.

In WS-Agreement we can find the following sections in SLA template:
- Context
- Service Description Terms
- Guarantee terms
Creation Constraints

The business items necessary to add to the templates are:

- Business terms
- Product Information
- Offering and prices information

**Service Description Term section**

All the business items are defined in the section Service Description Term using as a base the business schema.

We can see the following example business terms section:

```xml
<wsag:ServiceDescriptionTerm wsag:Name="ContactPoint" wsag:ServiceName="IntermediateService">
    <ContactPoint>
      <Name>Contact Point Name</Name>
      <Email>Contact Point Email</Email>
      <PhoneNumber>+34606352187</PhoneNumber>
      <Fax>+34606352187</Fax>
      <Address>Contact Point Adress</Address>
    </ContactPoint>
  </BusinessSchema:BusinessSchema>
</wsag:ServiceDescriptionTerm>

Other example relative to product and offering section:

```xml
<wsag:ServiceDescriptionTerm wsag:Name="IntermediateService_OfferPrice" wsag:ServiceName="IntermediateService">
    <ProductOfferingPrices>
      <ProductOfferingPrice>
        <Name>Gold</Name>
        <Description>Maximum quality</Description>
        <BillingFrequency>Per month</BillingFrequency>
        <ValidFrom>01/01/2009</ValidFrom>
        <ValidTo>31/12/2009</ValidTo>
        <ComponentProdOfferingPrice>
          <PriceType>One Time Charge</PriceType>
            <Unit>EURO</Unit>
            <Value>20</Value>
          </Price>
        </ComponentProdOfferingPrice>
      </ProductOfferingPrice>
    </ProductOfferingPrices>
  </business:BusinessTerm>
</wsag:ServiceDescriptionTerm>
```
Creation Constraints section

Also, we can define some bounds about the prices in Creation Constraints section.

4.6.2 Business SLAs

The business SLAs are based in WS-Agreement standard. The business templates defined, uses the business schema and coremodel expressions like the templates.

In WS-Agreement we can find the following sections in a SLA:

- Context
- Service Description Terms
- Service Properties
- Guarantee terms

The business items necessary to add to the SLAs are the same as a template:

- Business terms
- Product Information
- Offering and prices information

The information related to business SLAs is the same that the last section 4.6.1 but without Creation Constraints section. This section doesn’t exist in the SLAs, then it has no sense to include it.

All the information related to business items are the same of the last section.
5 Business Web Tool

In order to build a proper framework, it is needed some business information that in the end, allow to achieve an agreement between the customer and the service providers for the offered services. The principal data created in this tool are:

- **Products**: This is the initial commercial offer that the framework offers to customers. It contains some basic information about the services that will be delivered inside the offer, and the prices related to the whole commercial offer. This is the first step in the negotiation process. If there is not an active commercial offer (Product) it will not be possible to sell the available services and in the end, the negotiation process would finish.
- **Business SLA Templates**: These are the base to achieve the final SLA. They contain all the characteristics related to the services such as its KPIs or all the business parameters offered to the customer in order to guarantee the proper work and quality of the services.
- **Policies**: These are specific Business rules used in the negotiation process to assess the final price of an SLA. These will be applied to apply a discount or reward in the evaluation of the SLA offer given by the customer against the initial SLA Template that the framework offered him.

Business Web Tool will be used to create this information in a graphical and automatic way and based on the Business Data Model.

Business Web Tool and Framework are fully integrated, because the information generated by the tool is needed for the proper performance of the framework. In this way the information is created and managed by the tool but fully accessible to the framework (tool and framework share the same information).

Following, it is shown some screenshots of this tool and explains the basic operation of it. The tool has a main menu at the left of the screen. These options are divided in three aspects: Product, Business SLAT, and Policies.

5.1 Product

5.1.1 Publish

This option allows the user to create and publish a product. It is necessary to introduce the fields required about the product. We can divide this information in different parts:

- General information about the identification and features of the product
- Commercial information like offer dates and other features like the price
- Services selection
In year 1, the selection of the services is limited to Payment & Inventory services.

5.1.2 Find
The user can find products filling some fields of the filter on the screen or without filling any filter (and recover all).

If the user clicks on the magnifying glass of a product, he can recover all the information stored of it like you can see in the following screen.
5.1.3 Customers

We have the possibility to find the customers that use a product.

1. The first step is to select the product which we want to know its customers. At the following screen you can see the list of the products with summarized information of each.
   And we can see a list with a radio button in the left of each register. The user has to select one radio button of one product.

2. Using the scrollbar we can see in the bottom of the screen the customers that are associated with this product and their business SLA and other information.
5.2  Business SLAT

5.2.1  Publish

This option allows the user to create and publish a Business SLA template. It is necessary select the product related to this template and to introduce the fields required about the business terms. We can find all the A2 defined terms and their fields. Also we can introduce the concrete data about the guarantee terms and other information of the template. In the screen we can find the following options:
The icon 📌 allows to extend the fields required to be filled, and with the icon 📌, you can retract the section.

1. Selection of the product
   The first step is to select the product in order to create a business SLAT. In this screen the user recover the full list of the existent products, and select one of it.

2. Business Terms creation in the business SLA template.
   The first information that the user has to fulfil is the data associated to the template like identification id, name, service provider and expiration date.
At this section, the user can fill the business term he wants. In this screen you can find how the contact information has to be filled.

In this screen you can find how the support business term has to be filled.
3. Guarantee Terms
In this section, the user has to fill all the information about each guarantee term. With the icon and , the user can add or delete more guarantee terms.
Each guarantee term used is named with a number in order to identify it.
In each guarantee term, it is necessary fulfil the information associated like name, KPI, Qualify Conditions, and Penalties (with more additional fields).
4. Creation Constraints
The last section is the creation constraint section of the template. Here also, the user can use the following icons: + for adding or – for deleting each constraint defined.
5.2.2 Find

The user can find business templates filling some fields of the filter on the screen or without filling any filter (and recover all).
If the user wants to show the complete XML file of the template, he can click in the icon below the text “View XML”. The appearance of the XML showed for this option is like the following screen:

![XML Example](image)

### 5.3 Policies

#### 5.3.1 Publish

This option allows the user to create and publish a policy. It is necessary select some items like the product, the offer, the service, the service level specification and introduce the parameter and price variation. Both parameters have to be filled like a percentage. The first step is the selection of the product, the screen shows the list of available products. The user mark the checkbox control on the left side of the register and selects the product.
Also, the information required to fulfil is the kind of modification of the price and thinks like that.
5.3.2 Find

The user can find policies stored, filling some fields of the filter on the screen or without filling any filter (and recover all).

When the user recover the policies filtered, can review the information about the product that applies, clicking in the magnifying glass of the register. The screen that shows the information of the product is the same of the section 5.1 (product details).
Once we have identified the Business SLA Model components, we can establish the relationship with information frameworks. For this, we are going to use the TMForum initiatives, mainly SID (Shared Information Data Model) initiative, which is included within the NGOSS (New Generation Operations Systems and Software) initiative. NGOSS is an architectural framework for organising, integrating and implementing ICT systems.

Taking into account the NGOSS sequence, first it is necessary to establish a business analysis, and then, it is defined the data analysis. In the NGOSS initiative eTOM supports the business analysis and SID initiative supports the data analysis. This is illustrated in the following Figure.

It is important to emphasize, the SID framework (in consequence: NGOSS, SID and eTOM) supports widely the ICT industry, including the most relevant players, such as: Service Provider, Infrastructure Provider, Supplier (Software, Hardware), etc; in consequence, companies such as: Ericsson, NTT, Oracle, Telefónica, Telecom Italia, Vodafone, Motorola, Agilent, etc.

![Figure 14: NGOSS Components](image-url)
Of course, the core of this section is defining the class descriptions using SID, but taking into account the NGOSS sequence, briefly it will be explained the most relevant eTOM characteristics and the relationships with SID in the next subsection.

eTOM is the ongoing TMForum initiative to deliver a business process model or framework for use by ICT industry (not only Telco industry). Therefore, and at same case that SID; eTOM framework supports widely the ICT industry, including the most relevant players, such as: Service Provider, Infrastructure Provider, Supplier (Software, Hardware), etc.

The eTOM describes all the enterprise processes required analyzes them to different levels of detail according to their significance and priority for the business.

The processes structure in eTOM uses hierarchical decomposition, so that the business processes of the enterprise are successively decomposed in a series of levels. Process descriptions, inputs and outputs, as well as other key elements are defined.

In the following sections it will be established the Classes Description using the SID initiative:

- Section 6.1: The relationship between Business SLA Model and SID. This is the section most relevant.
- Section 6.2: This section presents a summary of aspects included in the business SLA model that are not presented in SID.

### 6.1 Relationship between Business SLA Model and SID

In this section, we will establish the relationship between SID and Business SLA Model. In the following figure, it is presented the domains and the level 1 of ABES of the SID Business Model.
Figure 15: SID Domains

With the eTOM, the SID model provides enterprises with not only a process view of their business but also an entity view. That is to say, the SID provides the definition of the ‘things’ that are to be affected by the business processes defined in the eTOM. The SID and eTOM in combination offer a way to explain ‘how’ things are intended to fit together to meet a given business need.

In the following Figure, it is defined the high level alignment between eTOM Process Framework and SID Model.
The SID model also defines attributes for Business entities and relationships between them and is represented using an UML model that provides an architecturally oriented business view of business entities, their attributes, and relationships to other business entities.

In the following Figure, it is defined the overall relationship between SID Model and Business SLA Model, for this, it has been identified the next SID Classes:

- Agreement
- Service Level Specification
- Billing
- Specification
- Performance

(Each SID Class identified, it will be explained in the next paragraphs).
Figure 17: SID and Business SLA Model mapping

SID model has a common entity specific for agreements called Agreement. An agreement is a contract or arrangement, either written or verbal and sometimes enforceable by law, which involves a number of other business entities, such as Services, and/or Resources.

SLA is a type of agreement represented in the SID model by the ServiceLevelAgreement entity. Both entities – Agreement and ServiceLevelAgreement – consist of items which make the link between the SLA and the Product/Service/Resource it applies to.

For this purpose, SID ServiceLevelAgreementItem entity establishes relations with entities in different domains.

The following sections describe the SID classes directly or indirectly related with Agreement entity and the Business SLA Model. Each section finishes with the point, named Relationship with Business SLA model, where the mapping between SID and SLA business model is presented.
6.1.1 Agreement SID Class Descriptions

The following figure shows the main SID entities and relationships involved in agreement definition:

![Figure 18: Agreement SID classes](image)

**Agreement**

It is a type of commitment that represents a contract or arrangement, either written or verbal and sometimes enforceable by law.

**AgreementItem**

The purpose for an Agreement expressed in terms of a Product, Service, Resource, and/or their respective specifications.

**AgreementApproval**
AgreementApproval represents the acceptance of the agreement by the owners of the Agreement. During the negotiation of the Agreement, there could be several iterations of approvals.

**AgreementTermOrCondition**
Aspects of the Agreement not formally specified elsewhere in the Agreement and that cannot be captured elsewhere in a formal notation or automatically monitored, but require a more human level of management.

**ServiceLevelAgreement**
A ServiceLevelAgreement (SLA) is a type of Agreement that represents a formal negotiated agreement between two parties designed to create a common understanding about Products, Services, priorities, responsibilities, and so forth, in order to achieve and maintain specified Quality of Service.

**ServiceLevelAgreementItem**
The purpose for a ServiceLevelAgreement expressed in terms of a Product, Service, Resource, and/or their respective specifications, and in terms of ServiceLevelSpecification(s).

**ServiceLevelSpecification**
This is a pre-defined or negotiated set of Service Level Objectives, and consequences that occur, if the objectives are not met.

Quality of services/Products is measured by service level specifications, then this entity provides the link between Agreement and Quality of Service.

**ProductOfferingPrice**
An amount, usually of money, that is asked for when a ProductOffering is bought, rented, or leased. The price is valid for a defined period of time and may not represent the actual price paid by a customer.

A ProductOfferingPrice entity can aggregate several ProductPrice entities. The structure of ProductPrice subclasses resembles the structure of ProductOfferingPrice subclasses and in most of the cases the relationships established for one group are also valid for the other.

Price is one of the bases for billing, and ProductOfferingPrice/ProductPrice provides the link between Agreement and Billing.

**Product Specification**
A detailed description of a tangible or intangible object made available externally in the form of a ProductOffering to Customers or other parties.

This entity provides the link between Agreement and description of Product/Services/Resources.
Relationship with Business SLA Model

An attribute of the Agreement entity is the time period during which the agreement is valid. This attribute is inherited by ServiceLevelAgreement and corresponds to "Availability dates” SLA Business parameter.

In addition, the following parameters from the business model can be included in the AgreementTermOrCondition entity:

- Change Procedures
- Update Procedures
- Backup & Recovery Mechanisms.
- Changes in reports
- Priorities.
- Support Information: The contact points and resources assigned.
- Termination clauses.

6.1.2 Service Level Specification SID Class Descriptions

Service Level Agreements are expressed in terms of Service Level Specifications. Service Level Specification represents a predefined or negotiated set of Service Level Objectives. In addition, certain consequences are associated with not meeting the Service Level Objectives.

Regarding negotiation process there can be consider two types of Service Level Specification, the Template during the process and the Negotiated when the process is finished.

The following figure shows the most relevant SID entities associated with ServiceLevelSpecification entity.
**ServiceLevelObjective**

Quality goal for a ServiceLevelSpecification defined in terms of parameters and metrics, thresholds, and tolerances associated with the parameters.

**ServiceLevelSpecParameter**

A parameter whose value is used to determine compliance with a ServiceLevelObjective.

SID model considers two types of parameters:

- **Key Performance Indicator**: A measure of a specific aspect of the performance of a ServiceResource or a group of ServiceResources of the same type.
• Key Quality Indicator: A measure of a specific aspect of the performance of a product or a service. A KQI draws its data from a number of sources, including KPIs.

**ServiceLevelConsequence**
An action that takes place in the event that a ServiceLevelObjective is not met.

**ServiceLevelApplicability**
The time of day or days during which a ServiceLevelSpecification, ServiceLevelObjective, or ServiceLevelSpecConsequence is relevant or not.

**Relationship with Business SLA Model**
ServiceLevelObjective and associated ServiceLevelSpecParameter entities cover the Level and Quality of service parameters included in Business SLA.
ServiceLevelConsequence includes the concept of Penalty as “prescribedAction” attribute, but in case this penalty implies any type of alteration in the bill it will be considered in billing entities.

### 6.1.3 Billing SID Class Description
This paragraph describes the most relevant business entities and ABE utilized by rating and billing processes in particular the Applied Customer Billing Rate ABE and the Customer Bill ABE.

Products are rated at different prices depending on ProductOfferingPrices and additional terms & conditions that are determined by the CustomerAccount.

Rating process takes ProductUsages on input and applies rates to them. The Billing process applies additional charges (for example, one time charges, recurring charges), allowances, discounts and taxes, to Products, then aggregates applied rates into bills and sends them to customers.

The following figure shows the most relevant SID entities associated with Billing.
Figure 20: Billing SID classes

CustomerAccount
An arrangement that a Customer has with an enterprise that provides Products to the Customer.

CustomerBill

A total amount due to a Provider by a CustomerAccount for all products during the billing period.

Other entities associated with this are:

- CustomerBillFormat. A detailed description of the way in which a customer’s bill is presented.
- CustomerBillPresentationMedia. A means of communicating a CustomerBill, supported by the associated bill format. For example, post mail, email, web page.

**AppliedCustomerBillingRate**

A charge or a credit assigned to the customer's account in the course or for the purpose of the billing process. Each applied billing rate can be atomic or composed.

There are different types of billing rates (charges, discount, taxes...) represented in the figure by a group of AppliedCustomerBilling… entities (AppliedCustomerBillingProductCharge, AppliedCustomerBillingDiscount…).

**Relationship with Business SLA Model**

CustomerAccount entity inherits form Customer ABE the customer data necessary for the bill in Business SLA model.

CustomerBill and the group of entities for bill specification cover the billing parameters in the Business SLA model: Description of the bill, billing frequency and billing mechanism.

AppliedCustomerBillingRate entity and its subclasses link de bill with prices and monetary penalties.

**6.1.4 Specification SID Class Description**

In the SID Model the specification is spread across Product, Service and Resource domains.

Business entities in the Product domain have a close relationship with business entities in the Service and Resource domains. While Product business entities represent what the market sees of a provider’s offerings, Service and Resource business entities represent the realization of the offerings from a provider’s perspective.

The following figure shows the most relevant SID entities associated with specification.
**ProductSpecification**

A detailed description of a tangible or intangible object made available externally in the form of a ProductOffering to Customer. A ProductSpecification may consist of other ProductSpecifications supplied together as a collection.

**ServiceSpecification**

A ServiceSpecification defines the invariant characteristics of a Service. It can be conceptually thought of as a template that different Service instances can be instantiated from. Each of these Service instances will have the same invariant characteristics. However, the other characteristics of the instantiated Service will be specific to each instance.

This entity has two subentities:

- **CustomerFacingServiceSpec.** An abstraction that defines the invariant characteristics and behaviour of a particular service as seen by the Customer.

- **ResourceFacingServiceSpec.** An abstraction that defines the invariant characteristics and behaviour of a particular service that is not directly seen or purchased by the Customer.

**ResourceSpecification**

A ResourceSpecification defines common attributes and relationships of a set of related Resources, while Resource defines a specific instance that is based on a particular ResourceSpecification.
**Relationship with Business SLA Model**

ProductSpecification entity covers Design Information at business level with its “description” attribute and gives access to a more detailed description through Service and Resource Specification entities.

Entities for Service and Resource specification does not have any attribute defined so it is necessary to include the equipment on customer premises as a parameter.

### 6.1.5 Performance SID Class Description

SID Model has developed a common ABE call Performance that comprises two entities: PerformanceSpecification and Performance.

PerformanceSpecification and its related specification entities provide the definition of the performance attributes, such as KPIs, dimensions, and performance objectives. The Performance entity and its related entities provide the values associated with the manner in which a service or resource is performing or has performed.

These entities have been specialised for Service and Resource domains and should be extended to Product domain which can be considered nearer to business level.

The following figure shows the most relevant common SID performance entities related with monitoring.

![Figure 22: Performance SID classes](image)

**PerformanceSpecification**

The invariant characteristics of a measure of the manner in which a Service and/or Resource is functioning. Each related Performance instance will have the same invariant characteristics. However, the values associated with other
characteristics of the instantiated Performance entity are specific to each instance.

**Performance**

A measure of the manner in which a Service and/or Resource is functioning. It is an instance of PerformanceSpecification.

**CharacteristicSpecification**

A quality or distinctive feature that defines an entity. The characteristic can be take on a discrete value, can take on a range of values, or can be derived from a formula which description is included in the attributes of the entity.

**PerformanceCharacteristicValue**

A value of a CharacteristicSpecification provided for Performance that further defines what the Performance is.

**CharacteristicSpecValue**

A number or text that can be assigned to a CharacteristicSpecification.

**PerformanceIndicatorSpecification**

A measure of a specific aspect of the performance of an entity that may trigger the creation of a PerformanceConsequence. This entity includes as attributes a textual description of the indicator and how to calculate it.

**PerformanceIndicator**

A numerical value or text determined for a PerformanceIndicatorSpecification.

**Relationship with Business SLA Model**

Performance entities provide the description of parameters to be collected and measures to be made, algorithms and methods used to calculate, measurement intervals, and aggregation intervals. However, they do not include anything about the specification of the content of performance reports, their format, the frequency of report production and delivery, the delivery mechanism and associated distribution list.

**6.2 Business SLA Model aspects not included in SID model**

SID Model does not include some aspects considered in Business SLA Model.

**Payment**
Billing entities omits the payment concept, nothing about methods used by customers to pay is included and this is information that should be in the SLA.

**Support**

SID Model does not include any information about the support process, for example, response and resolution times, mechanisms to assign severity levels to incidences or notify problem resolution state to customer.
7 Conclusions

7.1 Summary

In this document we have studied many aspects at business level, from the first year of the European research project SLA@SOI. This includes: business process, business data models, and business terms definitions inside WS-Agreement. Also we have defined eContracting module, which is fitted inside overall framework architecture, oriented to make automatically agreements between customers and providers.

The design of the business framework has been based on the models defined in TMForum. Those are well known and used by Telco operators and IT industries (eTOM/SID). The work done has permitted feed the actual standard models with innovative SLA@SOI requirements.

The basic business framework is consistent and well defined, and was successful implemented in eContracting module. This is the first step with a basic business model, prepared to enrich it with features scheduled in next project years.

As we commented before, the business framework is fed by some requirements defined by line A and B. Then the idea is to have a module that provides business layer support for the rest of architecture in SLA@SOI.

7.2 Next steps

The main objectives for the next steps in the business framework will be to study in depth some aspects relatives to business layer like:

- commercial creation process,
  - threshold and ranges definition for made possible some kind of negotiation
- negotiation,
  - extend the actual negotiation process, in a two steps roundtrip
  - extend the actual negotiation model with stop and extend operations
- assessment,
  - personalization interface definition, in order to retrieve segmentation information of the customers
  - customer personalization based in specific conditions and customer segmentation
- Post sale management.
  - Arbitration & penalty management mechanism
  - Definition of links between penalties and service providers and communication in order to establish a procedure to advice and substitution

We have to automate all the business processes that we can, in order to have an added value system. It is necessary to study in depth the business rules associated to some aspects that have to be covered in SLA@SOI framework and also define the rules associate to the more pure business layer interaction.
8 References

[1] Deliverable D.B5a Scientific Evaluation Report. SLA@SOI.


Appendix A: Business SLA Parameters

In this section we present the collection of the Business SLA Parameters that have been identified as relevant for the Work package A2 of SLA@SOI (Columns 1-3).

Column 3 explains how the business parameters fit into the model introduced in section
## Business SLA Model of this document.

<table>
<thead>
<tr>
<th>Types</th>
<th>Description</th>
<th>Mapping into SLA@SOI Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability dates</td>
<td>Ready for service date and contract duration.</td>
<td>Attribute of SLA class</td>
</tr>
<tr>
<td>Design Information</td>
<td>Necessary when the Customer is also a SP who needs technical details in order to assess if the service offered is valid to build his own service. Information about redundancy level, routing alternatives, transport restrictions and others, can be included. In any case, if the Customer can modify some technical details, SLA shall include what type of changes he can make and under what conditions, as well as the procedure to access to the technical information he needs.</td>
<td>Attribute of ServiceOfferDescription class.</td>
</tr>
<tr>
<td>Change Procedures</td>
<td>Changes are required by one party and must be agreed by both parties. A change can affect the service provided to a customer, a group of costumers or all of them. Changes can be distributed within an upgrade or separately. SLA shall content the method to specify changes in service’s requirements and the procedure to carry out them.</td>
<td>Included in SLA</td>
</tr>
<tr>
<td>Update Procedures</td>
<td>Specification of the upgrade expectations (once a year, 6 months...), the distribution media (e-mail, CD...), the procedures for releasing and installing patches, and what to do if upgrade fails.</td>
<td>Included in SLA</td>
</tr>
<tr>
<td>Backup &amp; Recovery Mechanisms</td>
<td>It may be advisable to include in the SLA a specification of the mechanisms the SP will use to insure service continuity during and following the occurrence of a disaster and the Customer support required to assist with disaster recovery. This kind of information could be more interesting for customers who are intermediate SPs and want to ensure a good availability level of the service to their end customers.</td>
<td>Included in SLA</td>
</tr>
<tr>
<td>Priorities</td>
<td>Sometimes, it is needed to specify the priorities of tasks or priorities in the execution of functionality of the service. In the other hand, when a problem happens, may be It's needed to explain how the support is applied, under which priorities or criterions.</td>
<td>Included in BusinessValue</td>
</tr>
</tbody>
</table>

### Support
<table>
<thead>
<tr>
<th>Types</th>
<th>Description</th>
<th>Mapping into SLA@SOI Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Points</td>
<td>It is useful to specify a single point of contact for technical aspects and a different one for administrative issues. Points of contact should be specified for both parties and include a complete description: names, phone and facsimile numbers, postal and email addresses, etc.</td>
<td>Included in SLA class</td>
</tr>
<tr>
<td>Equipment</td>
<td>If necessary, SLA must include a description of the Service Provider equipment to be located on customer premises and its requirements of space, power and environment. As well as how SP staff can access it.</td>
<td>Included in SLA class</td>
</tr>
<tr>
<td>Resources assigned</td>
<td>Description of the support capabilities including the scope of services offered, the periods when supporting service is accessible, the means of contact, etc.</td>
<td>Included in SLA class</td>
</tr>
<tr>
<td>Support process</td>
<td>Information about the support process should also be included.</td>
<td>Included in SLA class</td>
</tr>
<tr>
<td>Monitoring and Reporting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>Description of parameters to be collected and measures to be made, data collection and measurement intervals, and aggregation intervals.</td>
<td>Monitoring Policy class.</td>
</tr>
<tr>
<td>Reporting</td>
<td>Specification of the content of performance reports, their format, the frequency of report production and delivery, the delivery mechanism and associated distribution list. Specification of ad hoc reporting support should be included.</td>
<td>Monitoring Report Policy</td>
</tr>
<tr>
<td>Changes in Reports</td>
<td>SLA shall include how the customer can perform changes in the report content, format, frequency, means of delivery, etc, if proceed. A description of the notification procedures for changes made by SP should also be included.</td>
<td>Monitoring Report Policy</td>
</tr>
<tr>
<td>Tariffs and Billing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of the Bill</td>
<td>Description of the content of the bill: Customer data: name, address. Method used for payment Service data: all the details needed to identify uniquely the service. Date and period Amount to be paid and details: how many unities and unit cost, discounts or promotions applied.</td>
<td>BillDescription, BillFormat and CustomerData classes</td>
</tr>
<tr>
<td>Billing frequency</td>
<td></td>
<td>BillDescription attribute</td>
</tr>
<tr>
<td>Types</td>
<td>Description</td>
<td>Mapping into SLA@SOI Model</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Billing mechanisms</td>
<td>Specifies how the billing is done. At this point it can be specified for instance time criterion like minutes or seconds or events subject to billing.</td>
<td>Included in BillDescription</td>
</tr>
<tr>
<td>Price</td>
<td></td>
<td>Included in SLA</td>
</tr>
<tr>
<td>Penalties</td>
<td>Description of the penalties in case the service doesn’t reach the level agreed: discounts, bonuses, ... Description of claiming procedures.</td>
<td>Included in BusinessValue</td>
</tr>
<tr>
<td>Termination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payments</td>
<td>In the event of termination of an Agreement for any cause, it is possible to specify any fees or expenses due for services delivered up to the effective date of termination.</td>
<td>Included in SLA</td>
</tr>
<tr>
<td>Termination for convenience clauses</td>
<td>Including reasons, notification method, periods, data transfer.</td>
<td>Included in SLA</td>
</tr>
<tr>
<td>Process for unilateral termination</td>
<td>Including notification method, periods, data transfer.</td>
<td>Included in SLA</td>
</tr>
</tbody>
</table>

**Table 1: Business SLA Parameters**
Appendix B: Business SLA Ontology

In this section, an ontology model that defines the business SLA will be introduced. Ontology definition is a very fuzzy concept in the artificial intelligence field because of the fact that experts have not found a universal one. A widely quoted definition of an ontology is Gruber’s [14] “A specification of a conceptualization”.

In the context of computer and information sciences, an ontology defines a set of representational primitives with which to model a domain of knowledge or discourse. The representational primitives are typically classes (or sets), attributes (or properties), and relationships (or relations among class members). The definitions of the representational primitives include information about their meaning and constraints on their logically consistent application. In the context of database systems, ontology can be viewed as a level of abstraction of data models, analogous to hierarchical and relational models, but intended for modeling knowledge about individuals, their attributes, and their relationships to other individuals.

Ontologies are typically specified in languages that allow abstraction away from data structures and implementation strategies; in practice, the languages of ontologies are closer in expressive power to first-order logic than languages used to model databases. For this reason, ontologies are said to be at the "semantic" level, whereas database schema are models of data at the "logical" or "physical" level. Due to their independence from lower level data models, ontologies are used for integrating heterogeneous databases, enabling interoperability among disparate systems, and specifying interfaces to independent, knowledge-based services.

It could be said that an ontology is composed by a set of concepts, its taxonomy, interrelation and the rules that govern such concepts.

The ontology definition language will be OWL (Ontology Web Language) [15] which is defined by the Semantic web. This language includes all the necessary blocks to semantically describe the business SLA definitions, classes and properties using hierarchies. SWRL (Semantic Web Rule Language) [16] extends the set of OWL axioms to include conditional rules (Horn clauses) as “if .. then”.

The use of an ontology description to define the business SLA has several advantages:

- Ontologies can facilitate the interoperability between domains by providing the shared understanding of a problem domain. In that way, problems caused by the structural and semantic heterogeneity of the models can be avoided. Structural heterogeneity means that different correlation engines store their data in different schemes. Ontologies make easier to reason about the intended meaning of the information interchanged between two different domains. Hence, interoperability is a key application of ontologies, and many ontology-based approaches to information integration have been developed.

- Ontologies provide a formalization of a shared understanding which makes them machine processable. Machine processibility will enable autonomic agents to reason about business issues, and carry out more intelligent tasks on behalf of the user.
• It is important to note that ontologies do not only define information, but also add expressiveness and reasoning capabilities. Ontology rules provide a way to define behavior related to a model.

This ontology has been designed based on UML business SLA model developed in the section 3.
Business SLA Model.

In order to clarify and facilitate its reusability and extensibility, the ontology model has been divided in several parts: Offered and provisioning service description

- SLA description
- Monitoring description

In the following sections presents each ontology part showing the main concepts and the relationships between them.

**Offered and provisioning service description**

This section shows the relationships between the entities that take part in the service offering and provisioning.

The next figure shows the ontology schema associated with ServiceOffer and ProvisioningServiceOffer.

![Figure 23: Schematic representation of provisioning service ontology](image)

A ServiceOffer (Product) has a description in business terms and is provided by a service provider.

Each ServiceOffer has its SLAT (SLA Template). An SLA template is a document used by the agreement responder to advertise the types of offers it is willing to accept.

When the negotiation of a ServiceOffer between a provider and a customer finishes it is necessary to generate a SLA, based on the SLAT, customized for the customer in order to initiate the ServiceOffer provisioning.

**SLA description**

This section shows the SLA description since its generation by the provider in the provisioning service offer. Due to the fact that the creation process must be dynamic, a semantic description is necessary in order to compose and monitor the SLA.
The next figure shows the ontology schema:

**Figure 24: Schematic representation of SLA ontology**

Once the service has been provisioning the SLA is associated with it. SLA is defined by the SLAT composed by a set of KPI (Key Performance Indicators). KPIs are defined in the service offer description. On the other hand each SLA has a guarantee terms composed by SLO (Service Level Objectives). SLOs have associated a value and a threshold. Each threshold has associated its KPI and with that the loop is closed.

**Monitoring description**

Business SLA has a runtime state that can be monitored. The objective of the monitoring is to observe agreement compliance at runtime.

The next figure shows the ontology schema:
SLO is monitored by an actor which could be customer, provider or third party, in the role of MeasurementPartner.

MeasurementPartner uses the MonitoringPolicy (set of rules) in order to determinate the set of KPI that will be monitor (monitoredKPI)

Metric concepts from the ontology are associate with metric class from the model

A compound service will have KPIs derived from the KPIs of the atomic services, but it may also have new parameters. These parameters could be compose from ComplexMetric resulted to apply different Operation.

Billing description

Billing is the process of sending accounts to customers for goods or services. The process calculates additional charges (for example, one time charges, recurring charges), allowances, discounts and taxes, then aggregates applied rates into bills and sends them to customers

The next figure shows the ontology schema

**Figure 26: Schematic representation of SLA billing ontology**
Each SLA has associated a BillDescription, which includes information like the initial data to initiate the billing, frequency or format of the bill.

The actual Billing values could change when a violation of the parameters specified in the GuaranteeManagementInfo is detected. Then a BillAlteration is generated. This alteration could be a reward (a reduction in the bill when the Provider doesn’t fulfil its Obligations) or a penalty (an increase in the price) applied to the Customer.

In addition, each BillDescription has associated a PaymentMethod for each customer, i.e. bank transfer or credit card.

**Future use of the Ontology**

The process of modeling the business model as ontology helped to identify and understand the relevant elements in the domain and the relationships between them. Furthermore, an ontology can come to include the definition of rules governing the domain, so that the definitions of behaviour that are usually included implicitly in the management information can become expressed in an integrated manner with the definitions of management information and their own language.

The possibility of applying reasoning engines on the ontology, could be interesting to be used in the automatic negotiation and post-sale management processes. Despite the advantages show in the introduction of this chapter, the requirements coming from the line B use cases do not show the necessity of implementing such an advanced methodology like ontology model as part of the business management suite. Therefore, the business SLA model to be implemented will be based on the XML model introduced in previous sections (see 3
Business SLA Model).
Appendix C: Glossary

The following list shows the most important entries of the SLA@SOI glossary.

Abstract Service  Any service not yet instantiated (→ service instance) is called an abstract service.

Active Data Source*  A data source that is emitting events in an autonomic manner.

Agreement Initiator  An agreement initiator is a party to a → service level agreement. The initiator creates and manages an agreement on the availability of a service on behalf of either the service customer or service provider, depending on the domain-specific signalling requirements.

Agreement Offer  An offer is the description of the agreement relationship that is sent from → agreement initiator to → agreement responder during agreement creation, indicating the relationship which the initiator would like to form.

Agreement Responder  The agreement responder is a party to a → service level agreement. The responder implements and exposes an agreement on behalf of either the service provider or service customer, depending on the domain-specific signalling requirements.

Agreement Template  An agreement template is an XML document used by the → agreement responder to advertise the types of offers it is willing to accept.

Agreement Term  Agreement terms define the content of a → service level agreement.

Business Service  A business service is exposed/invoked via at least some non IT elements.

External Service  External services are exposed across the boundaries of an organization, i.e. across at least two administrative domains.

Guarantee Term  Guarantee terms define the assurance on service quality associated with the service described by the service definition terms. They refer to the service description that is the subject of the agreement and define service level objectives, qualifying conditions and business value expressing the importance of the service level objectives.

Infrastructure Provider  A specific kind of service provider who focuses on the provisioning of → infrastructure services.

Infrastructure Service  An infrastructure service is a specific → IT service which exposes resource/hardware-centric capabilities.

Internal Service  Internal services are exposed within the boundaries of an organization, i.e. within one administrative domain.

IT Service  An IT service is exposed/invoked by means of information technology. Specific classes of IT services may be software services, infrastructure services or media services.

Offered Service  An abstract service which is offered by a specific → Service Provider to its → Service Customers. Product is the synonym in this deliverable.
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Data Source*</td>
<td>A data source which is passive in the sense that all data elements have to be explicitly written or read to the source.</td>
</tr>
</tbody>
</table>
| Service                                  | A means of delivering value to Customers by facilitating Outcomes Customers want to achieve without the ownership of specific Costs and Risks. 
See also → service interface type, → service stage, → service exposure |
| Service Stage                            | The stage a service reaches over time from fully abstract to actually instantiated. 
See also → abstract service, → offered service, → service instance |
| Service Consumer                         | Person(s) who actually consume/use the provided services. Typically they belong to the → service customer.                                                                                                  |
| Service Customer                         | Someone (person or group) who orders/buys services and defines and agrees the service level targets.                                                                                                       |
| Service Description Term                 | Service Description Terms describe the functionality that will be delivered under the → service level agreement. The agreement description may include also other non-functional items referring to the service description terms. |
| Service Exposure                         | Services can be exposed either internally (within the same administrative domain) or externally. 
See also → internal service, → external service |
| Service Instance                         | A concrete implementation of an → offered service which is ready for consumption by service users.                                                                                                          |
| Service Interface Type                   | Describes the nature of an actually exposed service, i.e. about the nature of his invocation interface. 
See also → business service, → IT service, → composed service |
| Service Level Consequence                 | An action that takes place in the event that a → service level objective is not met.                                                                                                                     |
| Service Level Agreement                   | An agreement defines a dynamically-established and dynamically managed relationship between parties. The object of this relationship is the delivery of a service by one of the parties within the context of the agreement. The management of this delivery is achieved by agreeing on the respective roles, rights and obligations of the parties. The agreement may specify not only functional properties for identification or creation of the service, but also non-functional properties of the service such as performance or availability. Entities can dynamically establish and manage agreements via Web service interfaces. |
| Service Level Objective                   | Service Level Objective represents the quality of service aspect of the → agreement. Syntactically, it is an assertion over the → agreement terms of the agreement as well as such qualities as date and time. |
| Service Provider                         | An organization supplying services to one or more internal customers or external customers.                                                                                                                  |
| Software Provider                        | An organization producing → software components which might be used by a → service provider to assemble actual → services.                                                                                      |
| Software Service                         | A software service is a specific → IT service which is exposed/invoked by means of software entities such as...
Web services, user interfaces, or software-based business processes.

Software Component  
Software components are the entities produced at design-time by a software provider.

T-shirt sizes* A term to denote predefined system templates for different capacity requirements along well known t-shirt sizes such as S, M, L, XL.
### Appendix D: Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABE</td>
<td>Aggregated Business Entities</td>
</tr>
<tr>
<td>BSS</td>
<td>Business Support System</td>
</tr>
<tr>
<td>eTOM</td>
<td>Enhanced Telecom Operations Map</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>KQI</td>
<td>Key Quality Indicator</td>
</tr>
<tr>
<td>NfP</td>
<td>Non-functional property</td>
</tr>
<tr>
<td>NGOSS</td>
<td>New Generation Operations Systems and Software program</td>
</tr>
<tr>
<td>ORC</td>
<td>Open Reference Case</td>
</tr>
<tr>
<td>OSS</td>
<td>Operational Support System</td>
</tr>
<tr>
<td>OWL</td>
<td>Ontology Web Language</td>
</tr>
<tr>
<td>QI</td>
<td>Quality Indicator</td>
</tr>
<tr>
<td>QoS</td>
<td>Quality of Service</td>
</tr>
<tr>
<td>SAP</td>
<td>Service Access Points</td>
</tr>
<tr>
<td>SID</td>
<td>Shared Information and Data Model</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
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<tr>
<td>SLAT</td>
<td>SLA Template</td>
</tr>
<tr>
<td>SLO</td>
<td>Service Level Objective</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>SOA</td>
<td>Service Oriented Architecture</td>
</tr>
<tr>
<td>SP</td>
<td>Service Provider</td>
</tr>
<tr>
<td>SWRL</td>
<td>Semantic Web Rule Language</td>
</tr>
<tr>
<td>TMF</td>
<td>Tele Management Forum</td>
</tr>
<tr>
<td>TNA</td>
<td>Technology Neutral Architecture</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modelling Language</td>
</tr>
<tr>
<td>URL</td>
<td>Unified Resource Locator</td>
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<tr>
<td>WP</td>
<td>Work Package</td>
</tr>
<tr>
<td>WS</td>
<td>Web Services</td>
</tr>
<tr>
<td>WSLA</td>
<td>Web Service Level Agreement</td>
</tr>
<tr>
<td>XML</td>
<td>eXtensible Mark-up Language</td>
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</tbody>
</table>