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Service Aggregator Use Case Specification

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Executive Summary

The SLA-aware aggregation of telecommunications services enabled by SLA@SOI presents a business opportunity for the agile and efficient creation of new service offerings. In this document we present the specification of a use case centred on the service-enabling of core telco services and their aggregation with services from third parties. We identify the need for the creation of both a SLA-aware Telecommunications as a Service (TaaS) platform to enable this aggregation and a Business to Business environment in which a telco operator acting as a service aggregator can collaborate with the necessary third parties. This new business environment we envision treats SLA as the foundation to the business of fulfilling service consumption. The TaaS will execute on a virtualized hosting platform providing telco web service endpoints governed by vertical SLAs implemented vertically down through their supporting telco infrastructure. We identify the business areas and values associated with this proposal which we will use for the construction and evaluation of the service aggregator prototype. The necessary architecture that this document specifies includes the business layer, the software services layer, and the supporting telco infrastructure layer. We outline five scenarios which we will use to exercise and evaluate the architecture, namely 1) the publishing of SLAs for services available for aggregation; 2) the ordering of an aggregate service; 3) the steps relevant to SLAs involved in the operation of an aggregate service; 4) the ability of the customer to retrieve usage information; and 5) the termination of the service by the customer with necessary de-provisioning through the architecture. We conclude with notes on the necessary next steps to realize our ambitions.

Changes from M12 Version

As instructed by the project reviewers following the first year review, we have completely reworked our approach to the service aggregator use case. Everything from the business benefits afforded by multi-party telecommunications service aggregation to the nature of the planned prototype has been newly fashioned in a short working time. Although the influence of our thinking and work as of M12 in the SLA@SOI project can be identified, no content from the original document has been retained. Additionally, we write this document from the perspective of the end of M17 from where considerable progress on the understanding of the nature of the research results from the scientific A-line workpackages has been more precisely delineated, which we take advantage of where we can instead of strictly conforming to the perspective that this revised document was written with what was known in M12. Since we have reworked the scenario from scratch, the requirements have been revised and redrafted as well. This work has been done under the requirements process performed in B1, and the updated results will be included as part of the consolidation process. Since we have completely rethought our approach, some details as presented in this document — most notably in our depiction of the planned architecture — are not yet completely at the level of detail expected of a M17 perspective. We can only note that the participating partners are quite convinced of the essential soundness of our newly reforged approach, finding that we are solving problems and objections to the current proposal at a much more rapid clip than previously, as all details seem to be finding their proper place within our more clearly focused core vision of SLA-enabled telco service aggregation.
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1 Introduction

1.1 Context within the SLA@SOI Project

The FP7 project SLA@SOI seeks to research a comprehensive Service Level Agreement (SLA) framework that manages a complete SLA lifecycle as it unfolds upon a Service Oriented Infrastructure (SOI). Service Oriented Infrastructures support the implementation of a Service Oriented Architecture (SOA) by providing the functionality necessary for the managing of allocations of the resources which maintain the desired operational level of a service. For SLA@SOI, these desired operational levels are expressed in terms of SLAs. The paradigmatic example of such a SOI is the virtualisation of compute resources—such as processor, memory, and persistence—into an abstraction that supports the adjustment of the availability of such resources for the continuous execution of software services.

One of the unique benefits of service orientation lies in its agile and efficient aggregation of existing services into new, composite\(^1\) services. These new services may then be offered by a party acting as a service aggregator to a customer who may be blissfully unaware of the complex interdependencies that support the service which he consumes. With sufficient sophistication of aggregation methods, one might then imagine that aggregated services themselves would be aggregated into further service offerings. With enough participants aggregating and consuming services across both administrative and company boundaries, one entertains the possibility that network effects would begin to arise, promoting the emergence of a more efficient service-based economy.

But this vision would come to naught if the interdependencies involved in the aggregated services were to result in problems leading to service quality and/or unavailability. Such services would be quickly abandoned in favour of their less sophisticated yet more reliable predecessors. In order to succeed, such an ambitious type of service aggregation would clearly need some form of SLAs to gain enough acceptances to reach the hypothesized network effects. As such, we argue that the notion of an SLA should be foundational in any service aggregation proposed for serious consideration in a business application.

We will develop these necessary foundations by contributing to the understanding of what is necessary from a technical basis for the multi-level (infrastructure, software and business), multi-provider SLAs needed for service aggregation. Upon these foundations we will provide scenarios that demonstrate machine-assisted negotiation of multi-provider SLAs, business management tracking and control, detection of multi-provider SLA violations, predictions for aggregate resource utilisation, and the ability of such an infrastructure to adjust resources to correct (or possibly prevent) multi-level SLA violations.

1.2 The Service Aggregator Use Case

For the Service Aggregator use case, we will demonstrate the application of the generic SLA@SOI framework to the specific needs of providing SLA-aware aggregation of telecommunication and third party services. In order to make

\(^1\) We identify the notions expressed by “service aggregation” as being identical to “service composition” which is the more commonly used term in the literature. We therefore use the terms “aggregation” and “composition” interchangeably in this document.
telecom services more amendable to commonly used composition techniques, we expose a selected set of telecommunications services (VoIP, SMS, and VAS) through a standardized web service interface which we denote as Telecommunications as a Service (TaaS). The use of these TaaS web services will be governed by a vertically composed multi-level SLAs for which the controlling portion of the TaaS implementation will be executed upon a suitable hardware and software virtualisation container that will allow computation-based resources to be dynamically adjusted. Where possible, the same ability for resource adjustment will be extended to the enabling telco infrastructure. Furthermore, the entire aggregation process will be controlled by the business guidelines defined for the selling process of the products and services.

From this common technical basis in the SLA-enabled TaaS, Telekom Austria and Telefónica will pursue scenarios investigating their differing business opportunities. For both partners the ability of offer of the TaaS platform to other parties to create new services that will be offered to customers directly is very important. The use of the virtualised container will be offered to service providers as a so-called “cloud” environment similar to what is available via Amazon Elastic Computing Cloud or Google's App Engine. These service providers will create service aggregations utilizing TaaS services, and whose resulting service will be covered by a multi-party SLA. An example of such a service creations would be a web browser based “mash-ups” that displays the social network of a Facebook user for a given incoming VoIP call. An equally important opportunity lies in the advanced business management possibilities that lie in the SLA-aware aggregation of third party services under the telco name. By utilizing the SLA@SOI TaaS container, we will prototype services which aggregate customer profiles with aspects of the SLA lifecycle for which it would be useful to achieve more differentiated and customized product offerings. An example of such a scenario would be the use of a customer profile during negotiation of an SLA agreement to automatically derive the base parameters for the offer.
2 Background

Telekom Austria and Telefónica both contribute different perspectives to the challenge of service aggregation in large telecommunications companies. We now present each business context separately in the sequel, ending each with the identification of the business areas and associated values that we seek to exploit through involvement in SLA@SOI. We then present general topics of interest that impact the specification of a telco service aggregation, namely the problem of composition for telecommunication companies, the trends towards virtualization, the nature of SLAs in telecommunications companies, and the current state of attempts in markets towards multi-provider, multi-domain aggregation. We conclude with the expected contributions that the work in this use case will provide the rest of the project.

2.1 Telekom Austria

The research group participating in SLA@SOI is part of the fixed line (wireline) which is a wholly owned subsidiary of the Telekom Austria Group. In 1996, the TA Group split its main business into the wireline and wireless companies, Telekom Austria and Mobilkom Austria. The first decade of the twenty first century has been an era of disruptive change for the wireline business, as we have seen our fixed line customer base steadily erode as customers turn to smaller, more nimble competitors offering telephony over VoIP or to completely wireless solutions.

2.1.1 Business Context

The erosion of the traditional fixed line business shows that the traditional telco market is both mature and saturated. Consequently, TA faces a strategic need to develop new services that maximize the utilization of its existing resources and capabilities.

New service offerings are both expensive and risky to develop, as they are seldom a guaranteed success. Traditionally, telcos have been most successful when they provide the infrastructure for other parties to develop services targeted to their market specifics. The possibility to be the infrastructure provider for services has been hampered by the lack of standard service models that may be composed between companies.

One of Telekom Austria’s continuing strong markets is providing telco capabilities on a wholesale basis, such as the ability to transit internationally trunked VoIP traffic through the fixed-line assets we maintain throughout Austria and Eastern Europe. But such wholesale offerings tend to be very specialized involving rather specific scenarios and technologies. The agility necessary for the introduction of new services does not exist here, as changing business processes in the telco wholesale market takes times on the order of years.

The ICT outsourcing trends present in the contemporary business market increases the need for hosting solutions. Telekom Austria has abundant network and physical plant location for warehousing compute resources. Already TA provides various forms of hosting from specific applications like Microsoft Exchange for email/calendaring to more general server co-location offerings where we host hardware provided by the customer. The TA also provides virtualized disk storage which we lease to customers in these hosted data centres. Currently, the TA has no systematic manner to maintain SLAs across such offerings. Examples
such as Amazon’s Elastic Compute Cloud and Google’s AppEngine demonstrate that there is value in providing compute infrastructure as a service. Service outages such as those repeatedly experienced by Gmail users that have left paying business users questioning their continuing commitment have highlighted the need for SLAs to be enforced in such offerings.

2.1.2 Basis of Business Scenarios

From this business context, TA envisions a business opportunity in the creation of an SLA-enabled telephony platform which would then be used by other companies to create new services targeted to their specific market niches. The ability to provide multi-level SLAs on such resulting aggregations would be a key differentiating factor in being to offer such a Telecommunications as a Service (TaaS) platform from competing offers.

In the business scenarios of specific interest to the TA, the use of the virtualised container will be offered to service providers as a so-called “cloud” environment similar to what is available via Amazon Elastic Computing Cloud or Google’s App Engine. These service providers will create service aggregations utilizing TaaS services, and whose resulting service will be covered by a multi-party SLA. An example of such a service creations would be a web browser based “mash-ups” that displays the social network of a Facebook user for a given incoming VoIP call. The SLA offered over the composed service in this example would be between the company hosting the telco services, the service aggregator, and whatever guarantees are made by Facebook. In this scenario we would expect that the telco would have full access to SLA@SOI abstractions, the service aggregator less so, and no knowledge by Facebook, so we need to ensure that the prototyped technical basis of the service aggregator takes the full spectrum of SLA@SOI awareness into account for each stakeholder.

For the exploitation of this business context, Telekom Austria will prototype a Telecommunications as a Service (TaaS) platform which encapsulates existing telco capabilities in the form of SLA-aware web service wrappers. These wrappers will be executed on a virtualised computing container. The wrappers will be extended vertically down through the telco infrastructure layer to support the SLA@SOI abstractions of provisioning, monitoring, prediction and adjustment where possible. Each of these vertical extensions will be necessarily be customized to the specific telco infrastructure deployed, but we will attempt to reuse developed techniques to the extent it proves possible. External business parties will then use the telco service wrappers to create aggregated services on the virtualised computing platform. The focus of our scenarios will be the ability of such service aggregation to operationalise the composited SLA. One of our two scenarios will be on the steps necessary at service creation. The other will be on the detection and adjustment of violations during service lifetime.

2.1.3 Business Value

From the business context we summarize the business areas in which the Telekom Austria use case scenarios will be evaluated for exploitation in Table 1 on page 11. For each business area we list the specific business value that will form the basis for the subsequent evaluation of the applicability of the business objective.
The business area of service infrastructure concerns the creation of the SLA-aware virtualization of telco services in the TaaS. This has been identified as a market opportunity for Telekom Austria which would increase the utilization of its existing services by making them amendable for aggregation in the emerging web service based economy. The efficiency and scalability of such a virtualization platform would allow the consolidation of the resources necessary for compute-based tasks, decreasing costs. With such a consolidation afforded by this platform we would be able to more easily model and evaluate capacity planning in a systematic manner again with the most relevant impact on cost. And the clear linkage from the enacted SLAs to the specifics of the virtualized resources coupled with such a comprehensive planning model will allow the dynamic adjustment of such arrangements in order to increase the quality of the hosted services.

With the implementation of the service infrastructure suitable for service creation via aggregation, TA will create a market opportunity by allowing other companies to increase the utilization of our telco services within their branded services. Such an opportunity will be successful based on the agility with which service creation can be enabled. Additional business value will be evaluated upon the ability to bring industry standards for services and their composition with their attendant SLAs.

The final area where TA will evaluate the value of SLA@SOI lies in the need for service management for such aggregate services. The ability to provide information that is both accurate and timely for the monitoring of the services composed over multiple business parties and the resources which support their execution will provide a key business value. The construction and enforcement of multi-provider SLAs enabled will form the second axis on which TA will evaluate the management capabilities.

Table 1 Telekom Austria Business Value Matrix

<table>
<thead>
<tr>
<th>Business Area</th>
<th>Business Value</th>
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<td>Service Infrastructure</td>
<td>Market opportunity</td>
</tr>
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<td></td>
<td>Efficiency</td>
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<td></td>
<td>Scalability</td>
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<tr>
<td></td>
<td>Systematic planning</td>
</tr>
<tr>
<td></td>
<td>Dynamic Adjustment</td>
</tr>
<tr>
<td>Service Creation</td>
<td>Market Opportunity</td>
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<tr>
<td></td>
<td>Agility</td>
</tr>
<tr>
<td></td>
<td>Industry Standards</td>
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<td>Service Management</td>
<td>Multi-party Monitoring</td>
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<td></td>
<td>Multi-party Aggregate Reporting</td>
</tr>
<tr>
<td></td>
<td>Construction/enforcement of multi-provider SLAs</td>
</tr>
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</table>
2.2 Telefónica

The research group that is participating in SLA@SOI, is part of Telefónica I+D. Telefónica I+D is one of the companies that is doing the research and the innovations tasks in the holding. The people of this research group have extensive experience in both the mobile and fixed services for Telefónica España S.A.

Telefónica has the typical problems that arise when a company is composed by several companies in a global market. Telefónica develops its business from Spain to South America and in the latest times in United Kingdom and Germany. This is a specific problem to which we are facing.

2.2.1 Business Context

Telefónica has some initiatives in order to allow third parties to use the Telco capabilities. Telefónica has opened APIs and SDKs (Software Development Kit) to provide some Telco functionalities for developers and for third parties.

These initiatives for developers and partners are based on web services and SOA technologies (SOAP) and they are isolated. This means that each capability is sold and used standalone. The mash-up and/or aggregation of Third Parties and Telefónica services are the key points. And it is also the fact that all the services exposed are SLA based inside the product offering for the end customers.

2.2.2 The Challenge

Current mobile Telco initiatives to open the capabilities don’t support SLA management in the delivery such as those in SLA@SOI approach. The SLAs are implicit in the different capabilities and, in the future, it has to be taken into account in an automated way for creating B2B (Business To Business) environments for generating new services and new demands of the Telco capabilities.

Other market initiatives

There are other similar initiatives in the market for accessing the Operators APIs like Vodafone Betavine, BT Web21CSDK, Orange Partner among others.

All of them have in common:

- Few APIs (messaging, location, voice calls etc.)
- Poor Business Models (flat rates, free of charge...)
- They neither guarantee service levels nor offer SLAs
- At the moment, the success of these initiatives is moderated

Other initiatives have recently been shown and launched to the market from the services point of view. One of the most important is Microsoft Azure, and it is associated with SaaS. But this initiative deals with selling capabilities as specific Microsoft Software and providing an infrastructure for hosting services for third parties. It doesn’t support an open interaction with other Third Parties services in order to be sold as one.

The Telefónica I+D background is based on the collaboration in some proofs of concept:

- TM Forum (Building marketplaces through Managed Syndicated Service Delivery Framework Services),
- Telefónica España, internal projects
• Telefónica I+D, research line: new generation business environments

Our business vision

From our point of view the New Business Environments must allow Telefónica to achieve Time-To-Market reduction and revenues increase, exploring new market niches and also we will take into account the advantage of the collective intelligence (because Telefónica sell third party services). Telefónica will be more than a carrier (to be the ‘shop runner’ in the open market). And also others can re-use and sell our services because our Telco services could be published in other marketplaces.

Traditional service providers as well as the Internet, content and media service providers such as Google, Amazon, Facebook, etc. are facing many business challenges. The challenges are different for each community...

- Internet service providers have many services but often poor business models and limited differentiators (QoS, customer care etc.)
- Telecommunications service providers have all these differentiators BUT very few services.

2.2.3 Telefónica’s contribution

From the point of view of SLA@SOI, Telefónica has a big interest in building a multi-provider oriented use case, with the SLA management point of view, from business to infrastructure.

SLA@SOI will support the automatization of SLA management between service providers and Telco services, in a new generation business environment. This approach has to carry the SLAs in B2B environment to obtain new ways of doing business with Third Parties. And also SLAs and SLOs must to be the core of the customer assistance. This approach guarantees to take into account service violations and the execution of the services in a multi provider environment and translate those violations to customers and service providers to whatever penalties that may be implied. Moreover, it will be possible to manage certain kinds of negotiations between customers and service providers. This negotiation is driven by the Operator that sells the products to the end customer.

Furthermore, in future we could take into account the user profile and the service usage in order to adapt the prices and the product offers to the customers. This means that it could allow offering customized product SLAs to the customers in terms of prices and quality of services.

On other matters, in order to optimize the Telco resources that are very expensive, we are interested in managing internal software and hardware infrastructures from SOI point of view. This is the way to achieve better results, and help us to be more efficient and competitive in the global market.

Impact on Telefónica’s business

Telefónica is researching and developing new business environments (B2B) in which Third Parties are involved in the value chain. Until now these environments don’t take into account the SLAs in an automated way.

We hope that the SLA@SOI project allow us to enrich our vision of new business environments of Telefónica, and we will be able to build some Telefónica pieces of software that allow the collaboration with Third Parties based on automatic SLAs and, moreover, we can also manage our resources with the SOI approach.
### 2.2.4 Business Value

We can summarize the business areas and values in the following table:

<table>
<thead>
<tr>
<th>Business Area</th>
<th>Business Value</th>
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<tbody>
<tr>
<td>Business Management</td>
<td>Business Control (rules and policies definition)</td>
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<td></td>
<td>Fast decision making</td>
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<td></td>
<td>Time to market reduction</td>
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<td></td>
<td>Services control based on the monitoring of Telco and Third part services</td>
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<tr>
<td>Customer Satisfaction</td>
<td>Confidence in the performance of consumed services</td>
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<td></td>
<td>Perceived difference of quality (customer views)</td>
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<td></td>
<td>Delivery of products that has guarantees because we have an SLA model behind, and we cannot fail to the customer</td>
</tr>
<tr>
<td>New markets &amp; environments</td>
<td>Differentiation from competition</td>
</tr>
<tr>
<td></td>
<td>Reach new market niches and the “long tail”</td>
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<tr>
<td></td>
<td>Taking advantage of the collective intelligence because Telefónica sell third party services</td>
</tr>
<tr>
<td></td>
<td>New B2B environment to do business with Third parties</td>
</tr>
<tr>
<td>Efficiency &amp; Optimization</td>
<td>Internal resources optimization based on customer demand</td>
</tr>
<tr>
<td></td>
<td>On demand provisioning of services and infrastructure resources (energy &amp; operational)</td>
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**Table 2 Telefónica Business Value Matrix**

We have specified some business areas in which we will impact in Telefónica with this use case. One of the final objectives is to increase the usage of the current telco capabilities of Telefónica. In other hand this use case will provide a real example of the business control and tracking that it is necessary in the current competitive world.

Other important area that will be covered by the use case is the improvement of the customer satisfaction and the guarantee that offers the Telefónica brand to them. We cannot support third party services that they don't guarantee some minimum quality levels (or if they generate an excessive number penalties). With the proper SAL foundations, the service aggregator will enable a way to control and tracking these problems. In this concrete case the SLAs are the core of all the services that we will manage and the enforcement of them. The customization of the products or services required by customers provide another important
opportunity for the telco differentiation as Telefónica has a lot information about their customers.

To move ahead of our competitors we have to open new markets and to have more convergence with third party and internet services. Also we must create new business environments to do business and we foresee that automatization will play a big part in such efforts.

Finally, the new trends we are promoting in the use case are based on the scalability and efficiency of the computing resources. We are able to do a lot in order to optimize the resources and their management and the virtualization is a real choice that we have to take and to deploy. Other time, the SLAs are also the core to achieve this new way. The dynamic provision and the adjustment will allow to our systems to move computing resources from services that don’t needs them (or simply don’t generating much revenues) to services that has problems to fulfil the guarantees signed.

2.3 Trends in the Telecommunications Business

We now present short summaries of background topics that have informed this specification of the SLA@SOI service aggregation use case to illuminate the choices we have made to the challenges we have faced.

2.3.1 The Problem of Service Composition

Contemporary telco resources are insufficiently interoperable to allow the agile composition of services we identify as necessary for meeting the emerging market opportunity. While service oriented, Telco companies they do not current encapsulate their services offerings in a standardized manner that is easily amendable to service composition. Emerging standardized notions of service composition such as WS-BPEL are not directly applicable to telecommunications companies for a number of reasons as outlined in [1]. Chief among these reasons is the fact that the contemporary technical landscape of large telecommunications companies can be characterized as consisting of the multi-level aggregation of a large number of heterogeneous technical systems in an explosive number of highly customized interfaces. Thus the aggregation (composition) of these services which provides the basis for the services offered by telecommunications firms to their customers are highly application domain dependent, and not suitable for exposure for subsequent service composition. Utilizing the method of composition afforded by web service standards\(^2\) has been recently addressed by standards such as Parlay-X [2] but implementations and adoption of such offerings are just starting to come to the market. In our survey of such implementations we have not found one that offered any mechanisms for the management of SLAs we have identified as a key differentiating feature for our markets. Additionally, there is no current mature Open Source Parlay-X implementation that we could possibly use for experimentation.

\(^2\) We use the term “web service” to denote the abstraction of abstract invocation of a service over a network that may be concretely realized in such standardized forms as WS-* or REST. In SLA@SOI, we will use a WS-* based technical implementation, but do not wish to preclude the possibility to use the increasingly popular REST-based services in the future.
2.3.2 Service in Clouds

Increasingly companies seek to improve profitability by outsourcing business operations that do not fall into their core competence. An increasing number of these business operations rely on computing infrastructure whose capital depreciation cycles are extremely rapid. Almost as important to business considerations are the operational costs involved in maintaining a data centre, including the high labour costs for the specialists needed to staff the necessary operational levels. The response to these trends over the past several years has been the development of so-called cloud based environments that allow compute capacity to be leased on the basis of demand. The market for such cloud is certainly nascent with some standards in place, but certainly lacks the sort of SLAs enabled by the SLA@SOI framework.

2.3.3 Telecommunications SOI

One of the stumbling blocks we encountered in this use case specification lay in the analysing how telecommunications companies may be said to operate on a service oriented infrastructure (SOI). An infrastructure may be said to be service oriented only to the extent that that it consists of resources that possess some property of substitution for one another. The paradigmatic example of a SOI are infrastructures that are based on the utilization of compute resources. For example a single processor of a given clock frequency may be substituted by two processors of half that frequency. The general SLA@SOI framework adheres to the paradigm, so most of the research in the A-line work-packages is directly applicable to such compute infrastructure. A majority of SLAs that occur are currently offered by telcos involves network segments for which there is a single point of failure often due to equipment malfunction or the physical severing of lines by some unpredictable event such as a thunderstorm or a backhoe. The terms of the SLA involve the penalties to be assessed if service is not restored. There is no underlying infrastructure here that can be adjusted, no failure that can be predicted, no capacity that can be planned for involved in these typical SLAs. After trying hard to find a use case that applied to these types of network link SLAs, we decided that it would be more appropriate to focus on the services provided over these networks. To an increasing extent, these services are provisioned by compute infrastructure and we predict that such a trend will only increase in the future.

2.3.4 Multi-provider environment

Nowadays, Telco Operators are exploring new business models and revenue opportunities generated from the controlled service exposure of core network services and the use of services from third parties.

Accessing network services through standards-based Parlay X Web Services, third-party application developers can enhance consumer and enterprise applications with valuable service provider network capabilities and information. And in the end, consumer and business users can choose from a broader range of tailored applications that include rich communications capabilities.

2.4 Main novelties associated in SLA@SOI

The aim of the service aggregator work is to build a use case with important business values based on the telco requirements provided by TA and TID.
From our specification of a service aggregator, we have provided depth and sophistication to the requirements of interest to be researched in the A line scientific work-packages of SLA@SOI. The prime requirement we exert on the SLA@SOI project is the necessity to have a business management suite for automated e-contracting and post-sales management, as we strongly believe in the necessity of business-based foundations for SLA management. This suite will cover the whole business lifecycle of the products and the relationships with the customers who consume them.

Additionally we derive the requirement that it be possible to aggregate different services from its own infrastructure or third party in a unique product merging the different terms (business and guarantees), characteristic of the different services and also new business terms. This merging task will create a final SLA that takes into account all the services included.

One important novelty in A line is the possibility of the SLA customization. There are several main aspects:

- **Commercial aspects based on specific business rules that will allow:**
  - Define promotions or specific commercial conditions over the products in order to introduce it inside the market.
  - Define specific rules for different characteristic of the product which will be taking into account to assess the final SLA between service provider and customer.

- **The customer will be allowed to obtain a customized product that fits with his expectations.**
  - It will be possible to the customer to specify some requirements that will be take into account inside the negotiation process of an SLA.
  - It will be possible to obtain profile information of the customer by the relationship with the Business Support System (BSS). This profile will be used to assess the characteristics of an SLA to a specific customer.

- **The management of the multi-provider environment:**
  - To reach a SLA with third parties in order to create a product portfolio with services from different companies. This SLA will include service provisioning, monitoring and possible penalties in case of not fulfilment.

One of the main over-arching objectives of SLA@SOI is improving the quality perceived by the customers. To do this, it must be possible to define mechanisms for the relationship management between providers and customers after product sale. It will allow to customer and provider could exchange information like the Business SLA conditions signed or behaviour information of the Services implied. It is important to analyze in an automatic way the extraction of Business SLA violation evidences from lower level SLA monitoring information. This will allow knowing the responsibility of the events success and also the mechanisms for arbitration & penalty management to apply the consequences of these events.
3 Architecture and System Design

In this section we describe the architecture of the Telco Service Aggregator to be implemented for SLA@SOI.

We have three sections. We define the overall architecture of the use case, the different domains and the different components structured in different layers, and we have the architecture deployment to build the use case.

3.1 Architecture

We have different domains in the use case:

- Customer domain
- Telco domain
- Third Party domain

Customer is the actor that searches, contracts and consumes the products that contains several aggregated services. He doesn’t know if this product has one or several services and if it is based on different services from different providers. He only knows that he wants to consume and use a product. He registers their personal information in the system in order to contract products. Also he receives information of the consumption of their contracted products. The Telco domain is based on three layers: business, software and infrastructure. The product that it is sold to the customer is composed by these kinds of items from the three layers. These items are: business, software and infrastructure resources. For instance, the business resources that could be aggregated could be a supporting email for the assistance to the customer’s problems.
The typical Telco software offered will be SMS, VoIP. The Telco Wrappers that contains these capabilities are deployed in the Telco infrastructure under demand. Also, Telco’s has other kind of infrastructure such as Network Capabilities that are used by the Telco software wrappers.

These Telco components are sold as a whole in order to be aggregated with Third Parties services. In this case, collective intelligence of Third Parties can enrich their services using Telco capabilities exposed as web services wrappers.

Third Parties have their own infrastructure and services offered as SaaS.

Internally Telco operator needs to provision all the resources that are needed for a product consumed by a customer, and also it will call the provision of services needed by the Third Party.

Other important problem is the monitoring of the services of the Third Party, and also Telco operator has to share the penalties if they were produced.

Then, we are speaking about two kinds of SLAs:

- **External SLAs**
  - Telco will have an SLA with Third Party for the service that it is included in a product
  - Customer will have an SLA with the Telco Operator for the product consumed for him

- **Internal SLAs**
  - Software layer resources has their own SLA
Infrastructure layer resources has their own SLA

The Infrastructure SLA can be either be exposed or hidden behind the software SLA.

Figure 2 Service Aggregator Detailed Architecture

The reader can see other diagram based on building blocks used in SLA@SOI framework with Year 1 basic components.

We depicted some components and their interaction.

### 3.2 Components

#### 3.2.1 Telco Domain

We have defined the components grouped in the three typical SLA@SOI layers:

- Business
- Software/Services
- Infrastructure

➤ **Business layer**

This layer includes business resources (such as call centres or supporting services), but these resources are not provided using a specific SLA.
This section only considers the modules included in the business layer of the Telco Provider domain. These modules are associated to the work that will be developed in the A2 work package.

**Customer Management**

The customer has to be registered in the system in order to consume services. He has to provision billing details etc. This module is responsible for managing customer relationship and data.

The Telco operator has to have the possibility to manage the customers.

**Third Party Management**

The service aggregator might build products using Third-Party services/capabilities. This module is in charge of managing the business relationship between the Telco Operator, who aggregates services to build the product and the Third Party Providers.

**Product Catalogue**

The products include services in order to be consumed by the customers. Then the catalogue has the information about the available products for customers.

This module stores product information so customers are able to discover them.

**Product Management**

It must be possible to control the lifecycle of the products. So, the main task of this module is just to manage the product lifecycle.

**Business Management**

This module is in charge of managing all the business process involved in the products and services lifecycles. Therefore, it takes decision about top-level business terms, such as deciding prizes, promotions, penalties, business rules and so on.

**Business Engine**

The aim of this module is managing business rules so they can be defined and applied. Rules engine that can be business oriented to take into account a lot of kind of rules:

- Price modifications: Promotions, rewards, assessment ...
- SLA Customization based on BSS profiles.
- Billing engine rules.

**Penalties Engine**

This component is in charge of the evaluation of the business violations produced, and it also takes into account other penalties and other historical data about the consumer and the services.
**Business Adjustment**

The Business Adjustment module will ensure that routine responses to alerts from the business violations are automatically executed; therefore saving time and costs, and even ensuring problems are dealt with before they noticeably impact users.

**Third Party Monitoring**

Usually, the relationship between the telco operator as a service aggregator and the customer has a common access point to which the SP has access to monitor the service operation.

In case of the customer is using a product that includes services from third party, usually the service aggregator monitors the service in the customer access point. It could happen that the service aggregator would not be able to monitor the service in its own domain. If that occur, the SLA will include a term to articulate the way to achieve the monitoring. The aim of the third party monitoring module is to establish the way to communicate the monitoring information between service provider (aggregator) and the third party, and supervise it.

**Aggregation manager**

This module inside the business layer is responsible for managing the relationship between the services involved in a product. So, its main task is to ensure that own and third parties services are ready to be consumed as soon as the product consumption starts. But this module does not in charge of the provisioning itself. This task is done by each provision module in the different levels/domains.

**Provisioning**

It is in charge of provisioning directly the business resources needed.

**Monitoring**

This module is in charge of monitoring business resources involved in the product consumption. It informs to the business adjustment about the possible SLA violations.

**Prediction**

This module is in charge of predicting the business services usage in order to anticipate possible service malfunctioning. It also informs to the business adjustment about the predictions based on actual service performance.

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**Software/Services layer**

The services layer will be executed on a virtualized compute environment whose functional relationship in depicted in Figure 3 Virtualization of Services Environment on page 22. The vertical orientation of the diagram reflects the increasing abstraction from the bottom to the top. At the bottom level of our container we have the hardware virtualization environment provided by the Sun xVM server [3] which is an open source hypervisor based on Xen [4]. On this container we run instances of the OpenSolaris [5] operating system. The pairing of
xVM with OpenSolaris has natural affinities in the options available for instrumenting the resulting system on the basis of tools such as Dtrace [6]. OpenSolaris offers a native advanced filesystem in ZFS [7] that allows us to quickly and cheaply build storage clusters for SLA@SOI experimentation. The more constrained the applications that we host in our services container, the better able we are to offer SLA execution guarantees and software component predictability. For our use case architecture we further constrain our hosted applications to execution on a Java Virtual Machine (JVM). And within the JVM we require that the service execute in a Java Servlet container for which we will probably use a version of Apache Tomcat [8] customized with the necessary hooks for SLA management. This servlet container combined with the standard JAX-WS mechanism for managing the network mechanism will be combined to create the functional abstraction we denote by “WS Servlet”. This will be similar to the industry standard of a Java servlet, but it will offer hooks for SLA guarantees specialized to the abstractions afforded by the overall SLA@SOI framework. Included in these abstractions will be the ability to provide prediction capabilities.

At each level of the functional service composition, there exists the ability to increase and/or decrease the resources of the components in order to support the dynamic adjustment of the capabilities of the layer.

That our proposed software services architecture includes elements such as virtualization that are clearly identified within the rest of the SLA@SOI project of infrastructure requires a clarification. For the service aggregator, we distinguish between compute infrastructure and telco infrastructure. Compute infrastructure consists of the infrastructure upon which computational tasks may be performed, and fully corresponds to the SLA@SOI common model. Additionally, for the service aggregator we have the telco infrastructure on which the SLAs are vertically extended to the best of our ability to adapt the common SLA@SOI abstractions. It is this telco infrastructure that we detail in the next section.

![Figure 3 Functional Components of Service Virtualization](image)
The relationship between this TaaS virtualization services construction, the services it exposes as web services and the telco infrastructure that supports it is depicted in Figure 4 Functional Interface between TaaS and Telco Infrastructure on page 24. The WS-servlets that provide the VOIP-WS, the SMS-WS, and the VAS-WS for service aggregation are executed on the TaaS container. But these servlets are also connected in highly specialized ways to the supporting telco infrastructure. These connections to the telco infrastructure connect with the necessary management interfaces to extend SLAs vertically down through the base telco systems. Depending on the capability of the underlying systems not all abstractions offered by SLA@SOI are always possible, namely the sort of management actions involved in adjustment. Monitoring will always be possible, so violations of SLAs will always be reported. These “incapabilities” will be expressed in the appropriate abstractions of the multi-level SLAs.

![Figure 4 Functional Interface between TaaS and Telco Infrastructure](image)

**Telco Infrastructure layer**

The telco infrastructure layer is depicted in Figure 5 Telco Infrastructure Schematic on page 25. Here we have the basis for the VoIP telephony depicted in the rectangle at the top of the figure. Contained within this VoIP platform exist various services that may be controlled via SIP signalling. The services include interactive voice response would allows navigation of pre-recorded messages on the basis of DTMF (i.e. key tones) signalling, voicemail, PBX functionality allowing the routing of calls, call centre configurations that allow queues, conference bridge systems, and the possibility to transmit and receive FAXes. Since controlling each of the functionalities requires customization to enable the necessary provisioning, monitoring, adjustment, and prediction capabilities with the attendant SLA terms, we do not propose to exhaustively enable these telco services in the course of our work in SLA@SOI but merely to validate the necessary technical and business opportunities.

These services are run upon both traditional voice and IP networks as depicted in the bottom half of the diagram. The complexity of the networks in terms of heterogeneous interfaces is quite large. We have identified a way to map the monitoring needs for our use case to the SNMP traps that are present in most of the network. Provisioning of bandwidth will typically not be present in our use case
as network capacity is modified by manual processes under extensive change management rules that typically take on the order of half-year time intervals to affect.

The infrastructure that we will build on top of to handle SMS traffic is depicted in Figure 6 SMS Infrastructure Schematic on page 26. Since Telekom Austria is not a wireless carrier, we have to utilize infrastructure that is under our control to transit SMS traffic. Here, the monitoring of whether an SMS has been successfully transmitted will have to be based on information shared between business domains.

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**Figure 5 Telco Infrastructure Schematic**
3.2.2 Third party domains

This section only considers the modules included in the third party domain that have a role in the relationship between the Telco Operator as service aggregator and the third party. These modules are associated to the work that will be developed in the A3 work package.

**Business Management**

The relationship between the service aggregator and the third party service provider is only established at business level. The service aggregator can not control the software or infrastructure activities of the third party. So, the aim of this module is to manage the business relations between both entities.

The basic functionalities of this module are:

- Notifying the availability of new services to the Service Aggregator.
- Reception of the penalties notification from service aggregator when the SLA is not fulfilled.

**Service Publishing**

This aim of this module is to show the service portfolio that a third party service provider offers to the service aggregator. In this portfolio you can find both atomic services and composed services that can be included in the product catalogue of the service aggregator.

Between service publishing and product catalogue it exist an interface that includes the guarantee terms associated with each service.
Reporting
It is in charge of receiving the reports regarding the business evaluation made by the business manager inside the SLA@SOI infrastructure.

Provisioning
Once the customer chooses to use a product that includes a third party service, this third party may provision it within this domain. So the aim of this module is to receive the provision notification from the service aggregator and to order the suitable commands in order to do it.

Monitoring
Once the third party service is running and the customer is using it, usually the service aggregator monitors the service operation in the access point. It that it is not possible, the SLA include some terms that define the way of the service monitoring could be achieved.

This monitoring module is in charge of sending charged of send the service monitoring information from third party to the service aggregator.

3.3 Architecture Deployment
We now provide some orientation for the reader on where the various pieces of the architecture we have previously detailed will be deployed in the course of its development in the remainder of the SLA@SOI project. The telco service infrastructure which forms the operational basis of the TaaS is firmly situated in the existing systems present in the laboratories of the wireline group of Telekom Austria. These lab systems are mixtures of components that are both testing and production systems whose composition we will detail in the subsequent B5 deliverables as they are constructed.

Telekom Austria plans to construct and host the compute virtualization environment on which the TaaS executes as we need to be able to manage the relationship between the computation-based SLAs and the telco infrastructure in an integrated manner. As TA is neutral to the technology used in such compute virtualization, we will naturally re-use as much as is currently proto-typed in the testbed that Intel hosts for the SLA@SOI project in Ireland.

The deployment of the necessary components for the business layer elements to be constructed by Telefónica will be shared in the project testbed and in Telefónica I+D, which will host the simulators of the third parties Because we prototype the construction of a multi-provider service aggregation, we will need to be executed at other locations. We can take advantage of the already running Intel testbed. As such our architecture will demonstrate the execution of an SLA-aware composite application which is geo-graphically distributed between Ireland, Spain and Austria.
4 Scenarios

4.1 Description

This section depicts different scenarios of the Service Aggregator use case. The Telco Provider offers products that involve service and capabilities of its own infrastructure, as well as of Third Party Providers. The scenarios cover the whole product and services lifecycle, being each of them focused on a different part on the process for composing, selling and delivering properly a defined product to a customer.

The scenarios considered are:

1. Publishing (capabilities and products)
2. Product ordering
3. Product usage
4. Obtaining product usage information by customer
5. Termination

In these scenarios, it has not been considered yet the negotiation between telco operator, as service aggregator, and third parties. In this way, third parties offer their services to service aggregator with fixed terms that are not negotiated. This negotiation will be developed during year 2 and 3.

These scenarios show how a Third Party Operator can open its own capabilities to a Service Aggregator to enrich Telco operator’s portfolio in a new collaborative business environment. These capabilities (Aggregator’s and Third Party ones) can be combined in order to build attractive products.

The scenarios describe in detail the management of all the process from the Business point of view, defining business information to manage the selling process, such as rewards and promotions and also tracking the penalties of the full product and services included.

The Service Aggregator can manage its own capabilities using the SLA@SOI framework, but it does not have access to the service management nor infrastructure of the Third Parties. In this case, the provisioning, monitoring, adjustment and penalty management procedures must be modified in order to take into account the new actor(s) in the scenario.

The use case can be summarized in the next figure.
The end Customer sees the product as a combination of services/capabilities, matter the actual Service Providers delivering each one of the atomic services. However, once third parties have shared its services/capabilities in the infrastructure, the Product Manager of the Service Aggregator, who is in charge of creating products and adding business values to them, has to be aware about where the capabilities/services come from. So, the differences arise in the product management process.

The key points involved in the proposed scenarios can be summarized as follow:

- Publishing products that includes our services (Telco) and services from Third Parties
- Business policies definition
- Business negotiation among the parts involved
- Adjustment and Penalties with Third Parties services
- Service Usage information for increasing the customer experience
- Customization of SLAs based on Customer profiling
- Agreement termination

Different kinds of SLA are involved in the proposed scenarios. These SLAs comprise the relationship between the telco operator, third parties and customers. Each capability, service (telco or third party) and product consumed by customer implies a signed SLA between the Customer and the Service Aggregator. In case a Third Party service is used in the product, a SLA must be agreed between the Service Aggregator and the Third Party Provider.

Regarding Telco SLAs, it is worth noting that telco capabilities and services exposed as Web Services to Third Parties have their own SLAs. However, these services and capabilities are based on predefined Internal SLOs associated to core network element and cannot be changed.

### 4.2 Actors

Inclusive of all the use case scenarios the following roles involved.
### Actors

<table>
<thead>
<tr>
<th>Actors</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>The customer of Products and services in the end.</td>
</tr>
<tr>
<td>Telco Provider/Operator</td>
<td>This provider offers Telco services. In this case it is the one who develops products and negotiates with the customer. In our use case, the Telco Operator owns and acts as the service aggregator.</td>
</tr>
<tr>
<td>Third Party Provider</td>
<td>This provider offers any kind of services. It registers them into the catalogue to be sold by the Telco provider.</td>
</tr>
<tr>
<td>Product Manager</td>
<td>The business expert from the business department who decides on the portfolio of offered products and the business rules related to them.</td>
</tr>
<tr>
<td>Business Manager</td>
<td>The business expert from the business department who defines the business rules to follow in the product development.</td>
</tr>
<tr>
<td>Sales Manager</td>
<td>The expert from the sales department who decides on special offers and promotion, and keeps track of customer profiles. Sales Department must be the contact point for customers. It is in charge of driving customer negotiations during the sales process.</td>
</tr>
<tr>
<td>Customer Manager</td>
<td>The one in charge of the relationships with the customer once a product has been purchased.</td>
</tr>
<tr>
<td>IT Administrator</td>
<td>The administrator of a Telco infrastructure provider</td>
</tr>
</tbody>
</table>

Table 3: Actors involved in the use case

#### 4.3 Scenarios

Here is presented a diagram with the scenarios that will be explained below.
4.3.1 Publishing

The process of publishing products has some different aspects and requirements based on the actor that has been involved. But, before publish a product, it is needed to publish the capacities that will compose it. For this, this scenario has been divided in three as it can be seen in the following sections.

The common objective of these scenarios is to publish a product with the SLAT information and other details. The different actors from the different departments must to define the different values of the parameters needed. The necessary specification includes:

- Definition of rules to be followed in the negotiation process for the definition of product.
- Guarantee terms and business terms: These terms describe the conditions to fulfil by customer and service providers.
- Prices: Define the prices associated to the use of the services.
- Penalties: The consequences of breach the terms signed on the SLA.

Another additional task that is not address in the publishing scenario is the definition of Business Rules and policies.

This approach is different if we want to publish a standalone service or we want to publish a product as a mash-up or an aggregation of basic services. The problem in this last case is that we have to merge or combine different SLAT aspects such as guarantee terms, penalties, and prices.

➢ Publish Telco capabilities

Own capabilities are the value that a company can offer to the market. A way to make accessible this value is needed. This scenario will demonstrate how an
organization will be able to make accessible its own capabilities in order to obtain profitable value. It is a kind of preparation step before the product publishing.

➢ Story Line

Here it is explained in detail the steps to follow.

Steps:

1. The first step is the development of the some Telco adjustment to be done in some network resources, in order to be offered to the customers within a product.

2. Telco Product Manager accesses to publish the Telco services. Once a Telco service has been created, it must be published in the product catalogue in order to make it available to be composed and purchased. Before this, it is necessary to define some information related to it. Firstly, it will be defined the basic information such as its description or its categorization in order to allow a specific searching. Then it will be defined the SLA Template that contain all the data related to the service. This information include:
   a. Guarantee and Business Terms
   b. Prices
   c. Penalties

Here it is specified some of the characteristics that Telco services could offer:

<table>
<thead>
<tr>
<th>Service</th>
<th>Term Type</th>
<th>Offer Type</th>
<th>Parameter</th>
<th>Rule</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
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<td>Business Term</td>
<td>Bronze</td>
<td>Support</td>
<td></td>
<td>Email Address</td>
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<td>Jitter</td>
<td>&lt; 300 ms</td>
<td></td>
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<td>Packet lost</td>
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<td>Jitter</td>
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<td></td>
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<td>Guarantee Term</td>
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<td>Packet lost</td>
<td>&lt; 3%</td>
<td></td>
</tr>
<tr>
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<td>Guarantee Term</td>
<td>Silver</td>
<td>Delay</td>
<td>&lt; 300 ms</td>
<td></td>
</tr>
<tr>
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<td>Business Term</td>
<td>Gold</td>
<td>Support</td>
<td></td>
<td>Phone number All week 24h</td>
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<td>Guarantee Term</td>
<td>Gold</td>
<td>Jitter</td>
<td>&lt; 100ms</td>
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<td>Gold</td>
<td>Packet lost</td>
<td>&lt; 1%</td>
<td></td>
</tr>
<tr>
<td>Service Type</td>
<td>Guarantee Term</td>
<td>Customer Support</td>
<td>Key Performance Indicators</td>
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<td></td>
</tr>
<tr>
<td>--------------</td>
<td>----------------</td>
<td>------------------</td>
<td>----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VoIP</strong></td>
<td>Gold</td>
<td>Delay</td>
<td>&lt; 150 ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SMS</strong></td>
<td>Business Term</td>
<td>Bronze</td>
<td>Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Bronze</td>
<td>Delivery</td>
<td>&gt; 90%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Bronze</td>
<td>SMS per second</td>
<td>&lt; 100 SMS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Bronze</td>
<td>Response Time</td>
<td>&lt; 500 ms</td>
<td></td>
</tr>
<tr>
<td><strong>SMS</strong></td>
<td>Business Term</td>
<td>Silver</td>
<td>Support</td>
<td>Phone number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Silver</td>
<td>Delivery</td>
<td>&gt; 95%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Silver</td>
<td>SMS per second</td>
<td>&lt; 300 SMS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Silver</td>
<td>Response Time</td>
<td>&lt; 300 ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Business Term</td>
<td>Gold</td>
<td>Support</td>
<td>Phone number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Gold</td>
<td>Delivery</td>
<td>&gt; 99%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Gold</td>
<td>SMS per second</td>
<td>&lt; 1000 SMS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Gold</td>
<td>Response Time</td>
<td>&lt; 100 ms</td>
<td></td>
</tr>
<tr>
<td><strong>VAS</strong></td>
<td>Business Term</td>
<td>Bronze</td>
<td>Support</td>
<td>Phone Number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Bronze</td>
<td>Voicemail Storage</td>
<td>&lt; 20 min</td>
<td></td>
</tr>
<tr>
<td><strong>VAS</strong></td>
<td>Business Term</td>
<td>Silver</td>
<td>Support</td>
<td>Phone Number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guarantee Term</td>
<td>Silver</td>
<td>Voicemail Storage</td>
<td>&lt; 100 min</td>
<td></td>
</tr>
</tbody>
</table>
3. Telco Business/Sales Manager defines the negotiation margins and thresholds of the capability. That is, here it is specified the conditions business and technical conditions under with a service could be negotiated.

4. Telco Business Manager defines the business rules associated to this capability. In example, the business manager could specify how the price of the service increasing/decreasing according to the modification of the parameter described above such as the guarantee terms. Bellow it is shown an example of business rules.

<table>
<thead>
<tr>
<th>Service</th>
<th>Policy Type</th>
<th>Offer Type</th>
<th>Parameter</th>
<th>Parameter variation</th>
<th>Price variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VoIP</td>
<td>Surcharge</td>
<td>Bronze</td>
<td>Delay</td>
<td>10%</td>
<td>3%</td>
</tr>
<tr>
<td>VoIP</td>
<td>Surcharge</td>
<td>Silver</td>
<td>Delay</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>VoIP</td>
<td>Surcharge</td>
<td>Gold</td>
<td>Delay</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Table 5 Examples of telco Business Rules

5. Telco Business Manager publishes the service in the Products catalogue. Once all the data necessary for a service is ready (SLA and margin templates, business rules), the service is published in the catalogue as available. From this point the Product Manager will be able to compose the service inside a product in order to be sold.

➢ Publish Third Party capabilities

One of the challenges of this use case is just the possibility to use third parties capabilities in order to add value to the company capabilities. To make it possible, it will be demonstrated in this scenario how a third party is able to publish its capabilities in order to be used by the company.

➢ Story Line

Here it is explained in detail the steps to follow.

Steps:

1. Third Party Product Manager accesses to publish its services. It is needed to put them into the Product Catalogue in order to make it available to be composed and purchased. Before it, it is necessary to define some information related to it. Firstly, it will be defined the basic information such as its description or its categorization in order to allow a specific searching. Then it will be defined the SLA Template that contain all the data related to the service. This information include:
a. Guarantee and Business Terms
b. Prices
c. Penalties

Here it is specified some of the characteristics that Third Party services could offer:

<table>
<thead>
<tr>
<th>Term Type</th>
<th>Service</th>
<th>Offer Type</th>
<th>Parameter</th>
<th>Rule</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guarantee</td>
<td>Travel Agency</td>
<td>Gold</td>
<td>Response Time</td>
<td>&lt; 1000 ms</td>
<td>1 Euro</td>
</tr>
<tr>
<td>Guarantee</td>
<td>Travel Agency</td>
<td>Silver</td>
<td>Response Time</td>
<td>&lt; 1500 ms</td>
<td>0.75 Euro</td>
</tr>
<tr>
<td>Guarantee</td>
<td>Travel Agency</td>
<td>Bronze</td>
<td>Response Time</td>
<td>&lt; 2000 ms</td>
<td>0.5 Euro</td>
</tr>
</tbody>
</table>

Table 6 Example of terms specified for a Third Party

2. Third Party defines the negotiation margins and thresholds of the capability. That is, here it is specified the conditions business and technical conditions under with a service could be negotiated.

3. Third Party publishes the service in the Products catalogue. Once all the data necessary for a service is ready (SLA and margin templates), the service is published in the catalogue as available. From this point the Product Manager (owner of the catalogue) will be able to compose the service inside a product in order to be sold.

🚀 Publish Products

A company must be able to offer its product to the market in order to be sold and obtain as much benefits as possible. This product could be composed only by its own capabilities or mixed with third parties capabilities. It will be demonstrated in this scenario how a company is able to compose products from its own capabilities and the capabilities coming from third parties. Here, it will be also allowed to create different offers adjusting their characteristic to the characteristic of some different customer segments.

🚀 Story Line

Here it is explained in detail the steps to follow.

Steps:

1. Telco Product Manager accesses the Products Catalogue searching services. Telco Product is interested in develop new products to offer to the market, because in example has detected a business opportunity.

2. Telco Product Manager selects one or several services from Telco or from Third Parties in order to build a product. In this way, this use case can be divided in two more depending on if the product is compose of one or several own services or services from a Third Party.

3. Telco Product Manager defines the basic information such as its description or its categorization in order to allow a specific searching.
4. Telco Product Manager defines the SLA Templates that contain all the data related to the product. This information include:
   
   d. Guarantee and Business Terms
   e. Prices
   f. Penalties

6. When a product is composed of several services, Product Manager will merge and combine the information about prices, guarantee terms, penalties given by the individual services. Below it is shown an example of the characteristic that could be offered.

<table>
<thead>
<tr>
<th>Term Type</th>
<th>Service</th>
<th>Offer Type</th>
<th>Parameter</th>
<th>Rule</th>
<th>Value</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>Gold</td>
<td>Support</td>
<td>Number of telephone</td>
<td>All week Days InitTime: 00:00:00 FinishTime: 23:59:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>Gold</td>
<td>Termination clauses</td>
<td>Initiator: Service Provider Type: Customer fault NotificationPeriod: 1 day NotificationMethod: Email</td>
<td>1 Euro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guarantee</td>
<td>VoIP</td>
<td>Gold</td>
<td>Delay</td>
<td>&lt; 150 ms</td>
<td>1 Euro</td>
<td></td>
</tr>
<tr>
<td>Guarantee</td>
<td>VoIP</td>
<td>Silver</td>
<td>Delay</td>
<td>&lt; 300 ms</td>
<td>0.75 Euro</td>
<td></td>
</tr>
<tr>
<td>Guarantee</td>
<td>VoIP</td>
<td>Bronze</td>
<td>Delay</td>
<td>&lt; 500 ms</td>
<td>0.5 Euro</td>
<td></td>
</tr>
</tbody>
</table>

Table 7 Example of terms specified inside a product

7. Telco Business/Sales Manager defines the negotiation margins and thresholds of the capability. That is, here it is specified the business and technical conditions under which a service could be negotiated. Here, Sales Manager could specify different offers for the same product in order to offer different characteristics to different customer segment. Sales Manager is able to generate different promotion offers in order to introduce a new product into the market. Below it is presented an example of some rules.
<table>
<thead>
<tr>
<th>Policy type</th>
<th>Offer Type</th>
<th>Promotion</th>
<th>Time Duration</th>
<th>Price variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount</td>
<td>Gold</td>
<td>Launch of the product</td>
<td>2009/12/31</td>
<td>50%</td>
</tr>
<tr>
<td>Discount</td>
<td>Silver</td>
<td>Launch of the product</td>
<td>2009/12/31</td>
<td>35%</td>
</tr>
<tr>
<td>Discount</td>
<td>Bronze</td>
<td>Launch of the product</td>
<td>2009/12/31</td>
<td>25%</td>
</tr>
</tbody>
</table>

Table 8 Example of business rules specified by a Sales Manager

8. Third Parties online negotiation. In the case of use services from a Third Party to compose a product, it is necessary to negotiate certain aspects about the shared business between the Telco Provider and the Third Party. Inside this point it is the revenue sharing that explains how the benefits will be shared.

9. Telco Business Manager defines the business rules associated to this product. In example, the business manager could specify how the price of the product increasing/decreasing according to the modification of the parameter described above such as the guarantee terms. Below it is shown an example of business rules.

<table>
<thead>
<tr>
<th>Service</th>
<th>Policy type</th>
<th>Offer Type</th>
<th>Parameter</th>
<th>Parameter variation</th>
<th>Price variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VoIP</td>
<td>Surcharge</td>
<td>Bronze</td>
<td>Delay</td>
<td>10%</td>
<td>3%</td>
</tr>
<tr>
<td>VoIP</td>
<td>Surcharge</td>
<td>Silver</td>
<td>Delay</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>VoIP</td>
<td>Surcharge</td>
<td>Gold</td>
<td>Delay</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Table 9 Example of product business rules

10. Telco Business Manager publishes the service in the Products catalogue. Once all the data necessary for a product is ready (SLA and margin templates, business rules), the product is published in the catalogue as available. From this point the customer will be able to purchase it.

➢ Scenario Diagrams

The next figure summarizes the publishing process of the related topics discussed in this section.
Firstly, the telco capabilities are publish in the product catalogue, so the Telco Product Manager is able to discover them to build products. These capabilities are offered as TaaS to the product catalogue, so the products that will use these capabilities can access them via WS.

Next, third party services are also published in the product catalogue. Thus, the Telco Product Manager can select these services to build the product.

Finally, with all the available services, the Telco Product Manager can build a product using services coming from whether Telco or third party domain.

**4.3.2 Product Ordering**

The goal of a company is to sell its product to customer to obtain profit. It will be demonstrated in this scenario how a customer purchases products. So, here it is shown the process that must be followed by a customer and the negotiation process needed to achieve a successful agreement between the company and the customer.

**Story Line**

To be able to purchase products, a customer has to be registered into the framework. This is not necessary to search into the catalogue in order to find attractive offers. However this is necessary once the customer starts the negotiation process. A customer only has to be registered a time following a registration process in order to provide some necessary information such as personal or billing information. After that, he only has to follow an authentication process to be able to access to the framework.

Here it is explained in detail the steps to follow.

**Steps:**
1. Customer query products. Customer search for product that fulfils the characteristics he is interested on. To do this, it is possible to do a category based search.

2. Customer selects a product and queries for the associated templates in order to make an offer. The customer is interested on one product and queries for the associated templates. Then selects one of them (the one close to his expectations) and fill in all the data necessary. Customer could modify some parameter in order to adjust the characteristics of the templates to the ones he is looking forward. Finally the customer sends the offer to the provider to its evaluation.

3. Customer offer evaluation and negotiation. Once the provider receives the offer of the customer, it is checked different aspects such as the availability of the services required or the final price for the offer received. In order to assess the price, it is taken into account the following:
   - Business Support System (BSS) profile. The final prices given to the customer could be adapted to the specific characteristics of the customer who make the SLA offer. That is, the customers could be classified in different categories according to its profiles inside BSS. A service provider could be interested in given better prices or discounts to the customer of a category in particular.
   - Service Provider negotiation margins for customers. In order to agree on an SLA, after the assessment of prices, to the characteristics proposed by the customer, the final price must be inside of the negotiation margin proposed by Business/Sales Manager.

   Then it is sent the SLA with the prices adjusted to the customer.

4. Customer accept the conditions (prices and technical) offered by the provider. After the evaluation of the SLA offer, the provider will send an SLA with all the required data. This data includes the final price for the use of the services described inside the SLA. If the customer agrees with the conditions, it will send the acceptation of the conditions to the provider. If not, it is possible to return to the step 3 in order to create a new offer or to adjust the characteristics of the present offer.

5. Customer provision and activation of services (Telco & 3 Parties). Once the customer accepts the conditions of the SLA, the provider will begin the provision and activation of the services required. To do this, the following steps are followed:
   - a. From the SLA are extracted the conditions and characteristic of the services implies.
   - b. Then this conditions and characteristic are communicated to the corresponding layer implied by a specific agreement. In the same way, in the case of any of the services belong to a Third Party; the provider will contact with it, in order to provide the conditions and characteristics needed for the provisioning of the services.
   - c. Finally, the Third Party provider or the layer implied will provision and activate the services required from the conditions and characteristics given.

➢ Scenario Diagrams

The next figure summarizes the product ordering.
In order to purchase a product, the customer access to the product catalogue. If he finds a product that meets his needs, the next step he must do is to register him in the system so he can purchase products. Once he has ordered the product, the product manager starts the provisioning process through the aggregation manager. This manager will communicate with the provision modules of the layers involved in the own services that compose the product in order to provision properly the business, software and infrastructure resources needed. Moreover, it also has to order the provision of the needed services in the third party domains if the product contains third party services.

### 4.3.3 Product Usage

Once the services have been successfully provisioned and the whole product has been activated, the customer can start using the purchased product. The GuaranteeTerms embedded in the signed SLA establish the conditions of the normal functioning of the product. When the product is composed of one or more Third Party services, the SLA(s) between the Telco Operator and the Third Party Provider(s) also contain GuaranteeTerms that govern the normal operation of each of the services. The GuaranteeTerms can contain penalties to be applied in case of malfunctioning of an atomic service or the whole product.

It is worth mentioning the importance of the Penalty Management from the Service Aggregator point of view. Penalties apply not only in the relationship with the customer, but also with the Third Party providers. From a business perspective, the Telco Operator will develop policies aiming to maximize the benefits, and minimize the penalty impact. Therefore, one of the main aspects to be taken into account when implementing the business policies is the propagation
of the penalty to be paid to a Customer, to penalties to the Third Party Providers delivering the atomic services of the aggregated product.

This scenario describes the mechanisms that play an important role during the product usage: the monitoring of the service and the adjustment and penalty application.

➢ Story Line

1. Customer starts using the purchased product. The atomic services and the whole product have been previously provisioned and activated.

2. Product monitoring. Telco Operator must ensure that the product is delivered to the customer under the conditions agreed in the Guarantee Terms of SLA. Therefore, the operator monitors the quality parameters of the product being used by the end-customer. The measured parameters are then compared with the values of the Guarantee Terms of the signed SLA, in order to detect SLA violations.

The monitoring process depends on the kind of services involved:

   a. Services provided by the Telco Operator. Monitoring takes place at infrastructure, software and business layers of the Telco Provider, each of which has their own Monitoring and Adjustment modules. As soon as a SLA violation is detected, it is communicated to the upper layer, and the appropriate actions take place in order to restore the normal functioning of the system.

   b. Services provided by Third Parties. In this case, the Telco Operator does not have access to the external low level infrastructure nor to Third Parties service management environment. The Telco Operator must monitor the service in the customer’s endpoint.

      • In some cases, the SLA between the Telco Provider and the Third Party can contain a term that obliges the Third Party to share its monitoring information with the Telco Provider. In that case, the Third Part will send monitoring events to the Telco Operator using the syntax and procedures established in the SLA.

The results of the monitoring process are stored in an historical database for analysis purposes

3. In case a SLA violation is detected, an automated process of adjustment takes place in order to restore the normal functioning of the service. The adjustment process is different depending on where the problem is located:

   a. Malfunctioning of a service owned by the Telco Operator. In this case, the Adjustment modules of the involved layers (Infrastructure, Software and/or Business) automatically take the appropriate corrective actions.

   b. Malfunctioning of a Third-Party service. In this case, the Telco Operator has no mean to apply the needed adjustment in the service or infrastructure layer of the Third Party. The only possible adjustment comes from the modification of the internals of the product delivered to the Customer:

      • Telco Provider selects another Third Party (Third Party B) Provider offering a service with the same functionality, and checks that the SLA of this new service is compatible with the SLA between the Customer and the Telco Provider.
• Telco Provider triggers the provisioning of the new service to the Third Party Provider B.

• Once the provision is finished, Telco Provider modifies the aggregation: the new service is used instead the malfunctioning one.

• Telco Provider notifies the original Third Party owner of the malfunctioning service the finalization of the usage of that service.

c. In case problems arise both in services owned by the Telco Operator and Third Party-services, both a) and b) must be applied.

d. Malfunctioning of the Composition. If the atomic services are running with the correct QoS, the problem may be located in the way the composition has been done by the Telco Provider. In that case, the composition should be redefined and redeployed.

4. In case a GuaranteeTerm with an attached penalty is violated, the defined penalty must be applied. The definition of a GuaranteeTerm includes the party (Service Provide or Customer) that is obliged to fulfil the given term. Therefore, a penalty can affect the Customer, the Telco Provider or the Third Party Provider:

a. SLA between Telco Provider and a Third Party Provider. If a GuaranteeTerm of this SLA is violated, the penalty must be applied to the Third Party (if the term has ServiceProvider as the obliged party) or to the Telco Provider (if the obliged party is the Customer).

b. SLA between Telco Operator and Customer. If a GuaranteeTerm of this SLA is violated, the penalty must be applied to the Telco Provider (if the term has ServiceProvider as the obliged party) or to the end Customer (if the obliged party in the GuaranteeTerm definition is the Customer).

c. When a violation in the SLA between the Telco Provider and the Customer is associated to a violation in the SLA signed with a Third Party, both a) and b) must be applied.

5. In case a penalty is applied, the corresponding report must be automatically sent to the other party:

a. SLA between Telco Provider and Customer. The Customer Manager informs the end Customer of the GuaranteeTerm that has been violated, as well as the penalty application.

b. SLA between Telco Provider and Third Party Provider. The Telco Provider informs the Third Party of the GuaranteeTerm that has been violated, and the associated consequences (application of a penalty).

➢ Scenarios diagrams

The scenario described in the previous section involves the modules depicted in the following figure:
4.3.4 Obtaining Product Usage Details

As it can be seen, all the layers involved in the product, along with third party domain if third party services are involved, provide monitoring information. If the monitoring information states that a violation has been breached, the business adjustment module take needed actions. If this module decides that the violations mean a penalty, it informs to the penalty engine in order to communicate the penalty to third party (if the penalty is due to third party).

**Story Line**

Here it is explained in detail the steps to follow.

**Steps:**

1. Customer authentication process. Before a customer could be able to access to the platform, it must be an authentication process, because of though this functionality, the customer access to his own confidential information.

2. Customer obtains the corresponding details. The customer is interested on the behaviour of the products contracted. Customer is able to request information for one or several of the contracted products. Here it is possible to obtain different kinds of information that will help to know the real state of the products such as, violation committed, reports with monitoring information required.
Scenarios diagrams

The scenario described in the previous section involves the modules depicted in the following figure:

As it can be seen, the business layer informs to end customer about the actual performance of the product and of the involved services. The module in charge of doing this communication is the reporting module. It is in charge of gathering information from monitoring system and penalties engine so it can build proper informs that will send to both customers and third parties involved in the product delivering.

4.3.5 Termination

The conditions and processes to terminate an agreement are specified in the SLA. The SLA establishes as well the expiration date indicating the period in which the agreement is valid. When this date is reached, the normal termination procedure takes place, which is in charge of freeing all the allocated resources for that given service, and updating the corresponding registries. When Third Party services are involved, the termination procedure must trigger the finalization of the service to the Third Party Provider.

Apart from the normal termination procedure, the termination process could be launched following a bilateral or a unilateral decision. In any case, the SLA should specify the foreseen reasons to end an agreement, either by the customer or by the service provider 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.

A concrete example of a special termination procedure is a GuaranteeTerm of the SLA specifying that, in case of violation, the agreement must be automatically ended, instead of the Service Provider trying to recover the normal situation.

➢ **Story Line**

The steps that fulfill the termination process are the following:

**Steps:**

1. Notification of the end of the agreement. Two different cases may be distinguished:
   a. In case of a normal termination procedure, and previously to the expiration date, the Telco Provider notifies the Customer the end of the service delivery. This notification can include an offer to prolong or renegotiate the agreement.
   b. In case that one of the parties wishes to finalize the agreement before the expiration date, it must send a notification to the other party, in the format specified in the SLA.
   c. In case of an automatic termination procedure, the Telco Operator notifies the Customer the end of the agreement, specifying the reasons that lead to that situation.

2. The Telco Provider launches the finalization of the services that compound the final product. The concrete process depends on the kind of services involved:
   a. Own services: Telco Provider commands the service finalization to the Business Layer, which takes care of the finalization in the lower layers. The software and infrastructure resources are released, and the registries updated. Automatic monitoring and adjustment processes are instructed to not manage the terminated service.
   b. Third Party services: Telco Provider commands the service finalization to the Third Party Provider involved. The Third Party frees its resources and takes the corresponding management actions.
   c. Composite services: Telco Provider frees the aggregation, and launches steps a) or b) for each one of the atomic services. Automatic monitoring and adjustment processes are instructed to not manage the terminated aggregation.

➢ **Scenarios diagrams**

The scenario described in the previous section involves the modules depicted in the following figure:
The Customer Management is in charge of sending or receiving the notification of the agreement termination. The Aggregation Management module will free the aggregation, and launch the termination process either to the Provision module of the Third Party Provider, either to their own business, software and infrastructure layers, or both.
5 Conclusions and Future Work

5.1 Summary

We have presented the respective business contexts for Telekom Austria and Telefónica which have led us to identify multi-party telco service aggregation with comprehensive multi-level SLAs as a new market business opportunity. We have specified an architecture for a prototype which will support the execution of this use case. We have detailed the scenarios which we will then utilize the to exercise the prototype.

We have stated the importance to enrich service portfolio of telco providers with third parties services/capabilities. This means that telco providers can take advantage of third party developments and deployments, and on the other hand, third parties can access to telco customers. In this way, in order to provide properly products composed by services/capabilities coming from multi-domains, it is has been shown that it is essential to have a business top-level management to drive negotiations and manage the service delivery, so it can control that the services/capabilities performance fits with the SLA agreed.

The architecture needed for the prototype has been depicted and broken down into the modules that are needed to develop the whole product lifecycle. The prototype will cover these modules, as well as the identified relationships.

The different scenarios identified, in which the use case can brake down, state the different steps needed to deliver the product to customer. It has been presented the main scenario issues that has to be faced in order to build such a framework, Moreover, we have shown the different modules, which have been identified in the architecture, that interact in each scenario.

5.2 Outlook on Future Work

The future work of this work package will be focused on the design and implementation of the service aggregator demonstrator based on the specification described in this deliverable. Within the next deliverable, D.B5b we will describe the first iteration of the architecture implementation, which will include a functional TaaS that exposes a set of SLA-enabled telco services on which we will have a working service aggregator demonstration.

Moreover, we will provide details for other important issues regarding the service aggregation and product delivery to end customers. The features which we will focus on can be summarized as follow:

- Enhance the customer management in order to obtain useful information to be able to customize SLAs and negotiate in a better and automated way with them.
- Enhance the product discovery process by customers, so they can find our composed product.
- Development of negotiation orchestrators so automatic negotiation can be driven. This negotiation must be driven by business rules and must be evaluated by business departments.
- Extend the negotiation process to third party providers, so some third party services terms could be negotiated and customized in an automatic way, taking into account business rules defined in the business department.
• Customize SLAs with customers as well as with third parties, taking into account customer and third party conditions, requirements and limitations.

• Develop and enhance the post-sale management. In this way, it is needed to enhance the engine in charge of calculating penalties when an SLA has been broken and sharing these penalties with the third parties involved.

• It is also needed to enhance the penalty evaluation, so business rules can be taken into account to take further decisions on a business level (i.e. changing provider for a specific service).

• Another important task is to develop a billing engine responsible for managing the charging process for the use of a product among the different participants (customer, service provider, internal services ...).
6 References


Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>PBX</td>
<td>A Private Branch Exchange provides abstractions to manage telephony calls in typical business settings. Such abstractions include the ability to route a call to a different number or voice mail if unanswered after a certain number of rings.</td>
</tr>
<tr>
<td>SOI</td>
<td>A Service Oriented Infrastructure (SOI) provides the resources for the execution of services to a specified operational level. This operational level is achieved by the addition and/or removal of resources consumed by the service. Any given class of these resources must be fungible in the sense that it must have a possible substitution.</td>
</tr>
<tr>
<td>TaaS</td>
<td>The exposure of telecommunications services as a web service</td>
</tr>
<tr>
<td>VAS</td>
<td>Voice Application Services refers to any additional service provided over simple two-party calling in voice telephony. Examples of VAS include functionalities such as voicemail, conference bridges, and do not disturb.</td>
</tr>
<tr>
<td>Web Service</td>
<td>A service which provides an interface for its use through either the technical implementation of either WS-* or REST.</td>
</tr>
<tr>
<td>Wireline</td>
<td>A telecommunications service provided by a physical wire line, such as the twisted pair copper connection used in traditional analogue telephony</td>
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</table>

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Expansion</th>
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</thead>
<tbody>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>PBX</td>
<td>Private Branch Exchange (see definition above)</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
</tr>
<tr>
<td>SLAT</td>
<td>SLA Template</td>
</tr>
<tr>
<td>SOA</td>
<td>Service Oriented Architecture</td>
</tr>
<tr>
<td>SOI</td>
<td>Service Oriented Infrastructure (see definition above)</td>
</tr>
<tr>
<td>SaaS</td>
<td>Software as a Service</td>
</tr>
<tr>
<td>TaaS</td>
<td>Telecommunications as a Service (see definition above)</td>
</tr>
<tr>
<td>VoIP</td>
<td>Voice over Internet Protocol</td>
</tr>
<tr>
<td>WS</td>
<td>Web Service (see definition above)</td>
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