

The Role of XML in Service Level Agreements Management

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Abstract- At present, Internet services environment will be administered and managed according to dynamically negotiated Service Level Agreements(SLA) between service providers and customers. With the development of application of XML and the publication of XML schema recommendation by W3C, XML+XML schema-based SLA is becoming a good solution to the e-Business administration. The design and implementation of SLA message structure based on XML schema is the most important work. In this paper, we present the design and implementation of SLA message structures based on XML schema and illustrate it with examples.

Keywords: e-Business; XML; XML schema; SLA

I. INTRODUCTION

The widespread use of the Internet within the business community is leading to a fundamental change in the way that services are being delivered by service providers and consumed by service customers. One of the very important elements of e-Business is an electronic contract that describes the role of the various parties involved in a e-Business environment and the service level agreements (SLA) that are negotiated between them. Considerable research has been ongoing on the content and structure of electronic contracts [4,5]. However, existing work often focuses on a special internet service. Or some work makes people confusing because of absent semantics. The emergence of XML (eXtensible Markup Language) resolves those problems. Now XML is the first choice in the field of defining SLA for e-Business. In May 2001 W3C published a recommendation of XML Schema[1,2]. XML schema can be used to describe the structure of XML document and define the semantics of element. Thus we can use XML+XML schema-based SLA as the solution to e-Business administration.

This paper is organized as follows: In section 2, we describe what SLA is and how it is used in e-Business. In section 3, we present how to specify SLA message structure with XML schema. The section 4 we discuss related work and conclude our work.

II. OVERVIEW OF SLA

SLAs were originally used by Information Technology (IT) organizations and adopted by telecommunications providers to manage the quality of service(QoS) expectations and the perception of their contributions to the company's productivity and bottom-line success. Early goals set for service level management(SLM) initiatives were based on the IT department's need to validate its existence as an independent entity, justify the budgets being spent, manage

user expectations, prove delivery of services to users, provide a vehicle for ensuring that the scarce IT resources were distributed relatively equally, and provide defensible QoS metrics. The relative success of SLM in the IT industry has brought about widespread acceptance and adoption of its concepts and methodology, most notably within the telecommunications industry.

The TeleManagement Forum defines an SLA as "a formal negotiated agreement between two parties, sometimes called a service level guarantee. It is a contract (or part of one) that exists between the service provider and the customer, designed to create a common understanding about services, priorities, responsibilities, etc."

Quality of service is defined by the International Telecommunications Union(ITU-T) as "the collective effect of service performances, which determine the degree of satisfaction of a user of the service. The quality of service is characterized by the combined aspects of service support performance, service operability performance, service integrity and other factors specific to each service."

The SLA life cycle consists of the following phases. SLA life cycle is shown in Fig.1.

1. SLA development: Develop templates and entitlements.
2. Negotiation and Sales: Negotiate and execute contracts
3. Implementation: Generate and provision service orders and SLA monitoring
4. Execution: Operate and Maintain, monitor SLA performance
5. Assessment: Assess performance and reassess templates.

Increasingly, services such as E-commerce, Web hosting, application hosting, etc., are being deployed over Internet. For examples, the service provider can provide email, web services, etc., for the customer. Service providers are increasing using SLAs to define agreements for offering service quality guarantees to customers. The general structure of all the different SLAs remains the same: Every SLA contains

- the involved parties
- the SLA parameters
- the metrics used as input to compute the SLA parameters
- the algorithms for computing the SLA parameters.
- The service level objectives and the appropriate actions to be taken if a violation of these SLOs

has been detected

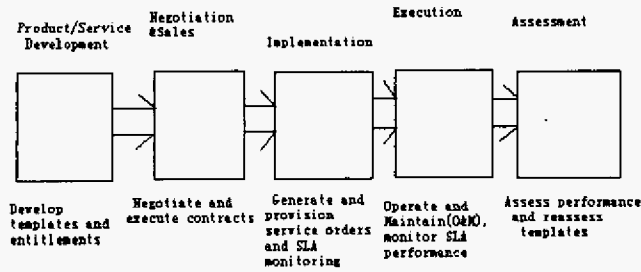


Figure 1. The TeleManagement Forum's service level agreement life cycle

III. DESIGNING SLA WITH XML SCHEMA

SLA message structure is based on XML. It is defined as an XML schema. It consists of three parts: a description of the parties and their roles(provider, customer, third parties), a detailed specification of the service level metrics, and a representation of the parties' obligations.

A. XML representation of parties

XML representation of parties describe information about the service provider, the customer and third parties. The third parties ,named as SupportingParties, are involved in measuring the service's parameters, supervising the given guarantees and managing the corrective procedures in case of failure.

XML schema definition of parties is as follows.

```

<xsd:complexType name="PartiesType">
  <xsd:sequence>
    <xsd:element name="ServiceProvider"
type="sla:PartyType"/>
    <xsd:element name="ServiceConsumer"
type="sla:PartyType"/>
    <xsd:element name="SupportingParty"
type="sla:PartyType" minOccurs="0"
maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>
  
```

The party description describe the properties of a party that are common to all participating organization. Its XML schema definition is as follows.

```

<xsd:complexType name="PartyType">
  <xsd:sequence>
    <xsd:element name="Contact"
type="sla:ContactInformationType"/>
  </xsd:sequence>
  <xsd:attribute name="name" type="xsd:string"/>
</xsd:complexType>
  
```

B. XML representation of service description

The service description includes three issues: To which

service do SLA parameters relate? What are the SLA parameters? How are the SLA parameters measured or computed?

The XML schema of service definition is defined as follows:

```

<xsd:complexType name="Servicetype">
  <xsd:complexContent>
    <xsd:sequence>
      <xsd:element name="ServType" type="xsd:string"
maxOccurs="1"/>
      <xsd:element name="ServiceLevel" type="xsd:string"
maxOccurs="1"/>
    <xsd:element name="ServiceMetric"
type="sla:MetricType" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexContent>
</xsd:complexType>
  
```

Multiple SLA level (platinum, gold, silver, bronze, and so forth) for the same service gives the customer the opportunity to weigh competing priorities within his or her own company. These SLA levels help the customer to spend money appropriately. We have divided every SLA metrics into several grades. In a real world application we can get the value of service level from the grade of SLA metrics. The details of its algorithm are shown in [7].

The XML schema of service metric type is defined as follows:

```

<xsd:complexType name="ServiceMetric">
  <xsd:complexContent>
    <xsd:sequence>
      <xsd:element name="Expression"
type="sla:LogicExpressType"
maxOccurs="unbounded"/>
      <xsd:element name="MetricGrade"
type="xsd:integer" MaxOccurs="unbounded"/>
    </xsd:complexContent>
  </xsd:sequence>
</xsd:complexType>
  
```

We give a sample service description as follows.

```

<ServiceDefinition
  name="Downloadservice">
  <ServiceDescription name="Download">
    <ServType> Download</ServType>
    <ServiceLevel> bronze </ServiceLevel>
  </ServiceDescription>
  <ServiceMetric>
    <Expression>
      <Predicate xsi:type="sla:less">
        <SLAParameter>AverageResponseTime
      </SLAParameter>
      <Value>5</Value>
    </Predicate>
    </Expression>
    <MetricGrade> 4 </MetricGrade>
  </ServiceMetric>
</ServiceMetric>
  
```

```

.....
</ServiceMetric>
</ServiceDefinition>

```

C. XML representation of Obligations

Obligations describe the guarantees and constraints that every parties promise to commit. These include two issues: When is SLA parameter guaranteed? Corrective actions are carried out when detecting violation.

The XML schema of obligations is defined as follows.

```

<xsd:complexType
name="ServiceLevelObjectiveType">
  <xsd:sequence>
    <xsd:element name="Obligated" type="xsd:string"/>
    <xsd:element name="validity"
type="sla:periodType" maxOccurs="unbounded"/>
    <xsd:element name="action"
type="sla:actionType"/>
  </xsd:sequence>
</xsd:complexType>

```

The validity period is specified; it indicates the time intervals for which a given SLA parameters is valid. Examples of validity periods are business days, regular working hours. Actions are carried out whenever a violation of a service level objective has occurred. Actions are sending a event to one or more signatory and supporting parties, opening a trouble ticket or problem report, payment of penalty.

The XML schema of action is defined as follows.

```

<xsd:complexType name="actionType">
  <xsd:sequence>
    <xsd:element name="Expression"
type="sla:LogicExpressionType"/>
    <xsd:element ref="sla:QualifiedAction"
maxOccurs="unbounded"/>
  </xsd:sequence>
  <xsd:attribute name="name" type="xsd:string"/>
</xsd:complexType>

```

An Expression of the LogicExpressionType defines the precondition of the action. The QualifiedAction contains a definition of the action to be performed at a particular party.

IV. CONCLUSION

XML+XML schema-based SLA is a good solution to the Dynamic e-Business management. The XML document includes the message information while the XML schema can be used to define message structure and datatypes of elements according to SLA. So we can use the XML schema to validate the XML documents and make them conform to the specification of the XML schema-based SLA.

There have been some papers discussing the SLA message structure. P.Bhoj,etc[4] uses a declarative language with syntax similar to the C language to describe contracts. Even though Alexander Keller, etc[5] uses XML+XML schema to describe SLA, The service they describe is specific, not general. It is based on web services. In this paper we give a general message structure of SLA for different internet services. What we do next is to refine the datatypes of SLA message structure until all SLA message structures are specified with XML schema.

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REFERENCES:

- [1] XML Schema Part 0: Primer, <http://www.w3.org/TR/2001/REC-xmlschema-0-20010502/> W3C Recommendation, 2 May 2001
- [2] XML Schema Part 1: Structures, <http://www.w3.org/TR/2001/REC-xmlschema-0-20010502/> W3C Recommendation, 2 May 2001
- [3] John J. Lee, Ron Ben-Natan, "Integrating service Level Agreements with OSS", Wiley Publishing, Inc, 2002
- [4] P.Bhoj, S.Singhal,S.Chutani, "SLA management in federated environments" Computer Networks 35(2001) 5-24
- [5] Alexander Keller and Heiko Ludwig, "Defining and Monitoring Service Level Agreements for Dynamic e-Business" 2002 LISA XVI Sixteenth Systems Administration Conference, November 3-8, 2002
- [6] Alexander Keller, Gautam Kar, Heiko Ludwig, Asit Dan, Joseph L. Hellerstein, " Managing Dynamic Services: A Contract Based Approach to a Conceptual Architecture", Proceedings of the 8th IEEE/IFIP Network Operations and Management Symposium, Italy, April 2002
- [7] "General design of 863 software incubator environment", Technical Report for Beijing Jiaotong University