SLA@SOI – An Overview

Empowering the Service Economy with SLA-aware Infrastructures

September 2008
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SAP
Agenda

• Motivation & Goals
  • Expected Results
  • Project Data
  • (Industrial) Use Cases
  • Collaboration Spaces
  • Problem Perspectives & First Steps
• **Vision**
  – A business-ready service-oriented infrastructure empowering the service economy in a flexible and dependable way.

• **Business-readiness requires**
  – predictability & dependability → prerequisite for acceptance & uptake of (new) services
  – holistic SLA management → transparent IT management
  – automated negotiation → dynamic, scalable service consumption

• **Impact on the knowledge economy**
  – decreased time to market for new services
  – increased productivity and competitiveness
  – lower entry barriers, especially for SMEs
Technical Motivation

Service Consumer
- dynamic demand for complex business solutions at low costs

Service Provider
- service economy requires dependable services

Software Provider
- SOAs provide unprecedented flexibility

Infrastructure Provider
- virtualization technologies allow for adaptive SOIs

Flexible usage Business Services

Engineering of predictable services

Automated SLA negotiation and management

SLA enforcement via adaptive infrastructures

Vision of SLA@SOI
A business-ready service-oriented infrastructure empowering the service economy in a flexible and dependable way
Envisioned Interaction

Service Provider

Business Use

Procurement

Service Demand

Customer

Software Provider

Infrastructure Provider

SOA

virtual

SOI

physical
Envisioned Interaction

- Contracting / Sales
- SOA

Customer
- Business Use
- Procurement
- Service Demand
- Business Assessment

Software Provider

Service Provider
- SLA (Re-Negotiation)
- Monitoring, Arbitration
- Service Demand Forecasting
- SLA Orchestration/Transformation/Aggregation
- Business Assessment

Infrastructure Provider
- Provisioning
- Mapping
- Resource Consumption Forecasting
- physical SOI

- Monitoring, Adjustment Alerting
- SLA
Main innovations

- **SLA management framework**
  - harmonizing perspectives of relevant stakeholders (software/service/infrastructure provider and customer)
  - standards for SLA specification and negotiation & systematic multi-layer SLA management (planning, optimization, and provisioning), monitoring and accounting
  - guaranteed QoS in a dynamic and end-to-end fashion via consistent SLA handling across IT stack

- **adaptive SLA-aware infrastructures**
  - standardized interfaces for adaptive infrastructures with harmonized access to different virtualization technologies.
  - advanced technologies for SLA enforcement on infrastructure level
  - efficient resource usage w/ reliable SLA enforcement at infrastructure level

- **engineering methods for predictable service-oriented systems**
  - modelling techniques and prediction tools for SOA and SOI components

- **business management suite for e-contracting**
  - covers complete business lifecycle of a service provisioning/delivery
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Major Project Results

- Open Source
- SLA Core Architecture
- Reference Implementation

NESSI Open Framework

Standardization

Reference Demonstrator

- ERP Hosting
- Enterprise IT
- Serv. Aggreg.
- eGoverment
- Financial Grids

- ERP as a service
- business value chains
- dynamic comprehension of service stack provisioning and business value
- user segmentation and predictive analysis
- public SLAs
- agreements driven by social aspects (not market logics)
- innovative financial products
- spatial-aware SLAs

Industrial Evaluation Report: “How to run an SLA-driven business”
Expected Results

• **Scientific results (from action line A)**
  
  - at least 95% of research results are public
  - SLA management framework (report + prototype)

  • including all results from action line A (architecture, SLA foundation, business/service/infrastructure mgmt., predictable systems engineering)
  • contains architecture, methodologies, meta-models, tools, services, protocols, interfaces, integrated technical framework

  ➢ allows scientific community to precisely see scientific approach, developed solutions and technical evaluation results
  ➢ allows industrial community (software/service/infrastructure providers and service customers) to leverage prototype components
  ➢ basis for standardization activities
  ➢ designed for integration with NESSI open framework
Expected Results

- **Impact-related results (from action line B)**
  - **Reference demonstrator (report, prototype)**
    - demo scenario available as open source
    - allows scientific community to compare results and to do subsequent research (replay and modification of SLA-experiments)
    - allows industrial stakeholders to get hands-on experience
  - **Industrial use cases**
    - will be made largely public
    - allows industrial stakeholders to get detailed insight
  - **Scientific/Technical Evaluation Report**
    - precise description and assessment of scientific/technical results
    - community (IT managers & researchers) is able to understand the technical conditions under which the SLA framework can be used and receive guidance for implementing SLA projects
  - **Industrial Evaluation Report**
    - precise description and assessment on the applicability of project results to different industrial setups (based on use cases and external requirements)
    - includes description & evaluation results from industrial use cases
    - CIOs can assess applicability of results for their organization
**Expected Results**

- **Major contributions to NEXOF, i.e.**
  - the **NESSI reference model** and the **NESSI architecture**
  - a complete SLA management infrastructure for service-oriented utility infrastructure. This includes in particular:
    - an **e-contracting platform** between service consumers and providers
    - a **framework for mapping, planning and coordination** within multiple levels in an organizational/IT structure
    - **access and provisioning layer** for SLA-aware infrastructure

<table>
<thead>
<tr>
<th>Service Consumers</th>
<th>The project will provide standardized models, protocols and methods for SLA contracting procedures between service providers and consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPM view</td>
<td>Methods and tooling for analysis of business processes and service user behavior (independently from the functional service aspects)</td>
</tr>
<tr>
<td>Composition</td>
<td>Standardized models, methodologies and frameworks for holistic SLA management</td>
</tr>
<tr>
<td>Services</td>
<td>Standardized models, methodologies and frameworks for holistic SLA management</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Standardized interfaces for a service-oriented infrastructure including implementations of selected components</td>
</tr>
</tbody>
</table>
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The Consortium

[Logos of various organizations including Engineering, FZI, SAP, Intel, Queen's University, TU Dortmund, etel, TELEKOM AUSTRIA, City University London, Politecnico di Milano, and others]
Fact sheet

- **Duration**
  - June 2008 – May 2011

- **13 Partners**
  - 6 industrial, 1 SME, 4 academic, 2 research centres
  - 7 countries: Austria, Germany, Ireland, Italy, Slovenia, Spain, United Kingdom

- **Budget**
  - 15.2 M€

- **Info**
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A use-case driven project

Open Source

SLA Core Architecture

Reference Implementation

NESSI Open Framework

Standardization

Open reference case

ERP Hosting
- ERP as a service
- business value chains

Enterprise IT
- dynamic comprehension of service stack provisioning and business value

Serv. Aggreg.
- user segmentation and predictive analysis
- public SLAs

eGoverment
- agreements driven by social aspects (not market logics)

Financial Grids
- innovative financial products
- spatial-aware SLAs

Industrial Evaluation Report: “How to run an SLA-driven business”
Open Reference Case

• **Idea**
  - a reference demo application (as open source)
  - a reference SLA management demo scenario (as open source)
   allows scientific community to compare results and to do subsequent research (replay and modification of SLA-experiments)
   allows industrial stakeholders to get hands-on experience

• **Features of the ORC**
  - an existing Java-based application
  - precise specification & modelling available
  - addresses management of retail chains (w/ core enterprise and several stores)
  - different service selection and deployment options
Open Reference Case - Scenario

Store 1

Business Process

Service Orchestration

Web Service

inventory WS

SaaS

provides SaaS

provides SaaS

provides SaaS

Headquater „Retail Chain“

Business Process

Service Orchestration

Web Service

SaaS

provides SaaS

Software Provider

provides SaaS

Infrastructure Provider

provides

SLA

External Supplier (bank, CRM, ...)

provides

SLA

SLA

SLA

SLA

Service Provider

provides
Open Reference Case - Scenario

**Business Process**

- **91.6%**
- ... 99.5% scan goods
- 99.0% handle payment
- 95.0% book sale

**Service Orchestration**

- (customer specific)
- Product Information
- Payment
- Booking

**Web Service**

- inventory WS
- storeInformation WS
- cardValidation WS
- paymentDebit WS
- accounting WS

**CoCoMe component (Legacy)**

- <<CoCoMe>> component
- <<CoCoMe>> component
- <<CoCoMe>> component

**IT Infrastructure**

- CPU
- Memory
- HDD
- 99.5% 95.5% 93.5%
- Server
- Switch
- Router
- Internet
- 99.9% 99.9%
- 99.9%
- 99.9%
- 99.9%

**SLA Availability**

- 99.5% 95.5% 99.5%
Industrial Use Case: ERP Hosting

• **Partner & roles**
  – SAP: software & service provider
  – Intel: infrastructure provider

• **Business context**
  – business applications (ERP, SCM, CRM, ...)
  – hosted in a Software-as-a-Service model

• **Technical service/SLA features**
  – Service types: A2A/B2B Web Services, UI services, business processes
  – SLAs on performance, availability & security

• **Challenges**
  – complexity in terms of number of services, components, configurations & usage variants
  – process flow partly implemented in a constraint model (no explicit flow information)
  – underspecified environment: various parameters unknown at design time
Industrial Use Case: Enterprise IT

- **Partner & roles**
  - Intel: lead, use cases and infrastructure provider
  - XLAB: specification, design & implementation contributions
  - SAP: ERP process knowledge, monitoring capabilities
  - UDO: design & implementation contributions

- **Business context**
  - SLA-aware dynamic provisioning of Enterprise IT Suite
  - Supporting continuously evolving role and priorities of Enterprise IT
  - CMF, ECF, Scalability + TCO

- **Technical service/SLA features**
  - Demonstrate tuned adaptation to provision competing demands appropriately
  - SLAs potentially describing relative priority, response times & temporal variation
  - Realistic infrastructure, services & workload simulation

- **Challenges**
  - Efficiently reconciling and dynamically provisioning a technology capability or investment relative to a specified process with business level metrics
Industrial Use Case: Service Aggregator

- **Partner & roles**
  - eTel (lead)
  - TID, FBK, Intel (contributors)

- **Logistical Fulfillment**
  - For a product’s technical fulfillment various SLAs have to be fulfilled in aggregate across the heterogeneous technical landscape

- **Tripleplay (or Quadplay) services (implemented)**
  - (quadplay exists but not sold as such)
    - Television
    - Phone
    - IP
    - Add on services
  - SLA for services
    - multiple instances
      - DSL (8Mbits for 1 setup box)

- **Carrier routing**
  - VOIP/trunking arbitrage of minutes between carriers
    - spot markets created for
Industrial Use Case: E-Government

- **Partner & roles**
  - ENG: WP Lead., Design & Implementation Lead.
  - CITY, INTEL: requirement specification

- **Business context**
  - Social and Health assistance to elderly people: home meal delivering
  - Government (Governance, Social Care Body), Citizens, Health Care Structures
  - Integrated management of Citizen needs, Structures activities, Governance of costs, quality and performances.

- **Technical service/SLA features**
  - G2G: SLAs on key performance indexes, norms, regulations, accounting
  - G2C: SLAs on quality, privacy issues
  - G2B: quality, security, accounting
  - SOA platform provided by GPI in compliance to SPCoop (Italian standard for G2G).

- **Challenges**
  - Human Based Services (e.g. meal delivery) and integration with automatic services and monitoring.
  - No one big centralized workflow, but related/synchronized processes.
  - Relationships between G2G, G2C and G2B SLAs (related to different processes) and automatic derivation.
  - Probably each SLA will contain both business and technical constraints.
  - The Service Provider selection is possibly operated by a Request for BID (the consumer provides a SLA Template that the provider must instantiate and agree to).
Industrial Use Case: Financial Grid

- **Partner & roles**
  - BeSC: Grid and Computational Finance provider
  - XLAB: Implementation
  - Intel: infrastructure provider

- **Business context**
  - Financial applications (Risk Management, Implied Volatility, Back testing)
  - Competitive and volatile sector with demand for Risk analysis on ever larger data sets increasing by order of magnitude
  - Solutions to be deployed as a highly available and scalable online services

- **Technical service/SLA features**
  - Service types: B2B Web Services, UI services, Infrastructure Services
  - Online services – dynamic composition and deployment of spatially aware services
  - SLAs on availability, location, compliance, system architecture, networking capability
  - Vendor and architecture neutral services

- **Challenges**
  - Complexity in terms of dynamic service composition, auto deployment and un-deployment
  - Service Discovery and selection based on
    - location, networking bandwidth and non-functional metadata e.g. legal and jurisdiction issues
  - Service Assurance in such a complex and dynamic environment
  - Highly regulated and compliance aware sector (MiFID - EU FSA, CRD, SarbOx, Basel2)
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Collaboration Spaces

- **NEXOF-RA**
  - early input delivered to RFP roadmap

- **SSAI Concertation WG on “SLAs and QoS”**
  - co-lead by SLA@SOI (Tariq Ellahi)

- **SSAI Concertation WG on “Standardization”**
  - co-lead by SLA@SOI (Philip Wieder)

- **SSAI Concertation WG on “Virtualization”**
  - active participation (Joe Butler)

- **Future Internet**
  - participation in “Management & Governance”
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Topic Areas

Business Management (provider – consumer)
- specification & negotiation
- business & legal assessment
- arbitration & penalty management

Service-enabled Business Logic
- for complex layered architectures
- for different application types

Service/SW management (provider)
- landscape modelling
- discovery
- monitoring
- steering
- provisioning

Infrastructure Management
- harmonized virtualization technologies
- adaptive, SLA-aware management
- monitoring support

SLA foundations
- negotiation
- brokering
- translation
- planning
- monitoring
- adjustment
**Topic Areas & Interactions**

**Predictable systems engineering**
- engineering
- modelling
- analysis

**Business Management (provider – consumer)**
- specification & negotiation
- business & legal assessment
- arbitration & penalty management

**Service-enabled Business Logic**
- for complex, layered architectures
- for different application types

**Applications / Processes**
- Business logic
- Middleware
  - landscape modelling
  - discovery
  - monitoring
  - steering
  - provisioning

**Infrastructure Management**
- harmonized virtualization technologies
- adaptive, SLA-aware management
- monitoring support

**SLA foundations**
- negotiation
- brokering
- translation
- planning
- monitoring
- adjustment

**Provide business context**
- provide business context
- evaluation of methodologies

**Provide requirements**
- provide requirements
- requirements on SLA management

**Evaluate SLA framework**
- evaluate SLA framework
- provide system models & monitoring handles

**Provide requirements on application management**
- provide requirements on application management
- infrastructure testbed

**Interface for infrastructure steering**
- interface for infrastructure steering
- requirements on SLA specification

**Interface for SLA specification**
- requirements on SLA specification
- negotiation interface

**Provide methodologies**
- provide methodologies
- requirements on SLA specification

**Evaluation of methodologies**
- evaluation of methodologies
### System lifecycle

#### Conceptual system lifecycle

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineering</strong></td>
<td>- Engineering of system’s building blocks (software &amp; hardware)</td>
</tr>
<tr>
<td></td>
<td>- Modelling of system structure and (non-functional) behaviour</td>
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<tr>
<td></td>
<td>- Clean room experiments / measurements</td>
</tr>
<tr>
<td><strong>Negotiation &amp; Planning</strong></td>
<td>- Translation of business SLA to technical level</td>
</tr>
<tr>
<td></td>
<td>- concrete workload characterisation &amp; non-functional requirements</td>
</tr>
<tr>
<td></td>
<td>- Translation &amp; prediction &amp; planning across whole business/IT stack</td>
</tr>
<tr>
<td></td>
<td>- based on templates &amp; historical traces &amp; models</td>
</tr>
<tr>
<td><strong>Provisioning</strong></td>
<td>- Actual resource allocation</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td>- Actual workloads</td>
</tr>
<tr>
<td></td>
<td>- SLA Monitoring &amp; enforcement/adjustment</td>
</tr>
<tr>
<td></td>
<td>- Collection of historical data for improved model calibration / prediction</td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td>- Detailed analysis of trace data</td>
</tr>
<tr>
<td></td>
<td>- to update performance KPIs</td>
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<td>- to identify the necessity for manual efforts</td>
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</table>
Conceptual Architecture – Provisioning view

- **Service Registry**
  - Portfolio, Catalogs
  - Composite services/products

- **Business Rules Repository**
  - Business values
  - CRM

- **SLA Template Registry**
  - Terms
  - Templates

- **Prediction Services**

- **Design-Time Repository**
  - Design-time artifacts
  - NFP Annotations
  - Profiles

- **Software Landscape**
  - Middleware
  - Apps, packaging
  - Configuration, exec.

- **Infrastructure Lands.**
  - Physical resources
  - Virtualization
  - Allocation
  - Sensors and Actors

- **Service Registry**
  - Composition
  - Instances + SLA

- **SLA (Re-) Negotiation**

- **SLA Translation**

- **SLA Planning & Optimization**

- **Service Landscape**
  - IT Operation rules

- **Policy Repository**

- **Legend**
  - Data Store (passive):
  - Data Source (active):
  - Control Flow:
  - Data Flow:
  - Function Module:
Conceptual Architecture – Run-time view

- **Design-Time Prediction**
  - Policy Repository: IT Operation rules
  - SLA Planning & Optimization
  - SLA Provisioning
  - SLA Monitoring
  - Event correlation
  - Predictive Monitoring
  - Standard Steering Capabilities (for adjusting QoS)
  - Standard Monitoring Capabilities
  - Autonomic management

- **Business Rules Rep.**
  - Business values
  - CRM

- **Monitoring**
  - Software
  - Infrastructure

- **Penalty handling**

- **Policy Repository**
  - IT Operation rules

- **Service Landscape**
  - Composition
  - Instances + SLA

- **Historical Info Rep.**
  - Post-processed monitoring data
  - Usage profile

- **Penalty handling**

- **Legend**
  - Data Store (passive): 
  - Data Source (active):
  - Control Flow: 
  - Data Flow: 
  - Function Module:
Thank you!