Empowering the Service Economy with SLA-aware Infrastructures in the project SLA@SOI


Ramin Yahyapour
Technische Universität Dortmund.
Business Motivation

Vision
• A business-ready service-oriented infrastructure empowering the service economy in a flexible and dependable way.

Business-readiness requires
• predictability & dependability $\Rightarrow$ prerequisite for acceptance & uptake of (new) services
• holistic SLA management $\Rightarrow$ transparent IT management
• automated negotiation $\Rightarrow$ 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

**Software Provider**
- SOAs provide unprecedented flexibility

**Service Provider**
- service economy requires dependable services

**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.
SLA@SOI Project

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
- http://www.sla-at-soi.eu
Envisioned Interaction

Business Use

Procurement

Software Provider

Customer

Service Provider

Service Demand

Contracting/Sales

SOA

virtual

SOI

physical

Infrastructure Provider
Envisioned Interaction

**Customer**
- Service Demand
- Business Assessment

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

**Infrastructure Provider**
- Provisioning
- Mapping
- Resource Consumption Forecasting

**Software Provider**

**Procurement**
- Business Use

**Contracting/Sales**
- SOA

**SOI**
- virtual
- physical
Envisioned Interaction

Customer
- Service Demand
- Business Assessment

Service Provider
- SLA (Re-)Negotiation
- Monitoring, Arbitration
- SLA Orchestration/Transformation/Aggregation
- Service Demand Forecasting
- Resource Consumption Forecasting
- Provisioning
- Mapping

Software Provider

Infrastructure Provider
- Business Assessment
- SLA
- Service Demand Forecasting
- Monitoring Adjustment Alerting

Business Use
Procurement

Contracting/Sales
SOA

Procurement

Business Assessment

Service Demand
SAMI Architecture

Negotiation Messages

- Syntax Converter
- Template Registry
- Protocol Engine

Negotiator

Provisioning / Optimization

Planning / Optimization

Business Tracking / Control

Adjustment

Monitoring Manager (SLAM4M)

- Control actions
- Monitoring events

RM

Monitors

Template advertisements

Predictions (?)

(?)

BM

Resource dependencies (?)
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
Example real world use-case ...

**Multiple service types hosted**
- Communications,
- Social networking, media, entertainment,
- Enterprise.

**On a heterogeneous infrastructure:**
- Data centres, grid,
- Wired, wireless.

**With associated diversity of:**
- Margin and profitability,
- Customer expectations and satisfaction requirements,
- SLA ‘levels’ – platinum ... bronze ... etc,
- Workload patterns and scheduling / provisioning requirements.
Additionally ..

**Constraints**

- **Internal governance**
  - Logging for billing,
  - Auditability,
  - Licensed product management.

- **Internal efficiency**
  - Managed resource consumption,
  - Utility cost minimisation,
  - Operational cost minimisation,
  - And third party resources and services.

- **External events**
  - ‘Slashdot effect’,
  - Resource failure,
  - SLA adjustments.
Service Level Agreements

Constraints expressed in Service Level Objectives
- ‘Make composite resource available between 09:00 and 11:30.’
- ‘Complete processing of a daily data transformation by 14:00.’
- ‘Sustain average throughout of 3000 transactions/hour.’
- ‘Peak throughput of 150 transactions/minute for up to 10 minutes.’

Statistical constraints
- ‘deliver 99.98% availability’
- ‘ensure <1% transaction timeouts’
- ‘ensure 90% transactions complete within 1sec.’

Complex provisioning challenge
SLA Lifecycle view

**Normal lifecycle**
- Negotiation → planning/optimisation → provisioning → execution
- Monitoring provides a feedback loop for adjustment at run time.
Implications from service level objectives –

- Selection and configuration of individual resources based on performance and cost.
- Statistical likelihood of SLA compliance with end customer.
- Calculation and expression of SLOs, negotiation of SLAs with third party providers.
- Final orchestration and provision of service to end customer.
Run time phase

Proactive adjustment

- Predictive analysis of monitoring data.
- Adjustment –
  - Dynamic resource allocation to any part of the service chain.
  - Full re-provisioning of any part of the service chain followed by re-orchestration.

Reactive adjustment

- Recovery from failure.
- Adjustment –
  - Full re-provisioning of any part of the service chain followed by re-orchestration.
In summary

**Complexities**
- Management of SLO parameter variation
- Mapping of provided vs. consumed resources SLAs.
- Workload patterns and variations,
- Internal policy objectives and constraints.

**Responses**
- Prediction, reasoning and optimisation
- SLA encapsulated elasticity rules
- Run time SLA adjustment
- Automated SLA (re)negotiation

**Tangible Results**
- Providing a complete SLA management model ad framework
- Adapted and verified by several industrial use cases
- Supporting NEXOF
Thank you!

http://www.sla-at-soi.eu