

Ramin Yahyapour,
Dortmund University of Technology



SLA@SOI: Research Perspectives for Dynamic SLA Management

**Workshop on Dynamic Service Level Agreements
Barcelona, Spain, 2008**

02. June 2008

- SLA@SOI - A Quick Overview
 - Vision and main topics
 - Industrial use cases
- The SLA Management Framework
 - Features
 - Building blocks
- Research Topics
 - SLA Modeling
 - SLA Creation
 - SLA Negotiation/Interaction
 - Optimization
 - Provisioning, Enforcement, Prediction, Monitoring
- WS-Agreement in the Light of SLA@SOI
- Summary

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

Predictable Systems Engineering

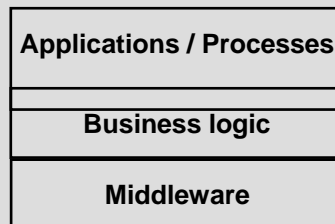
- engineering
- modelling
- analysis

Business Management (provider – consumer)

- specification & negotiation
- business & legal assessment
- arbitration & penalty management

Service-enabled Business Logic

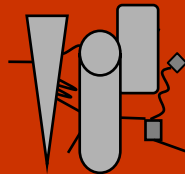
- for complex layered architectures
- for different application types



Service Management (Provider)

- landscape modelling
- discovery
- monitoring
- steering
- provisioning

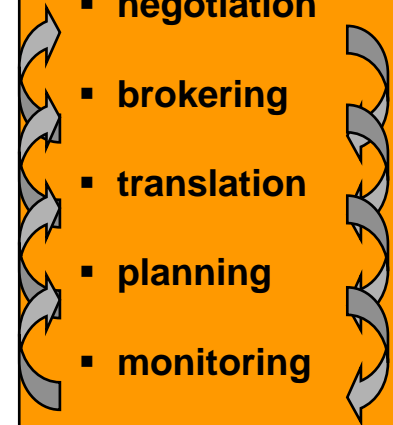
Infrastructure Management



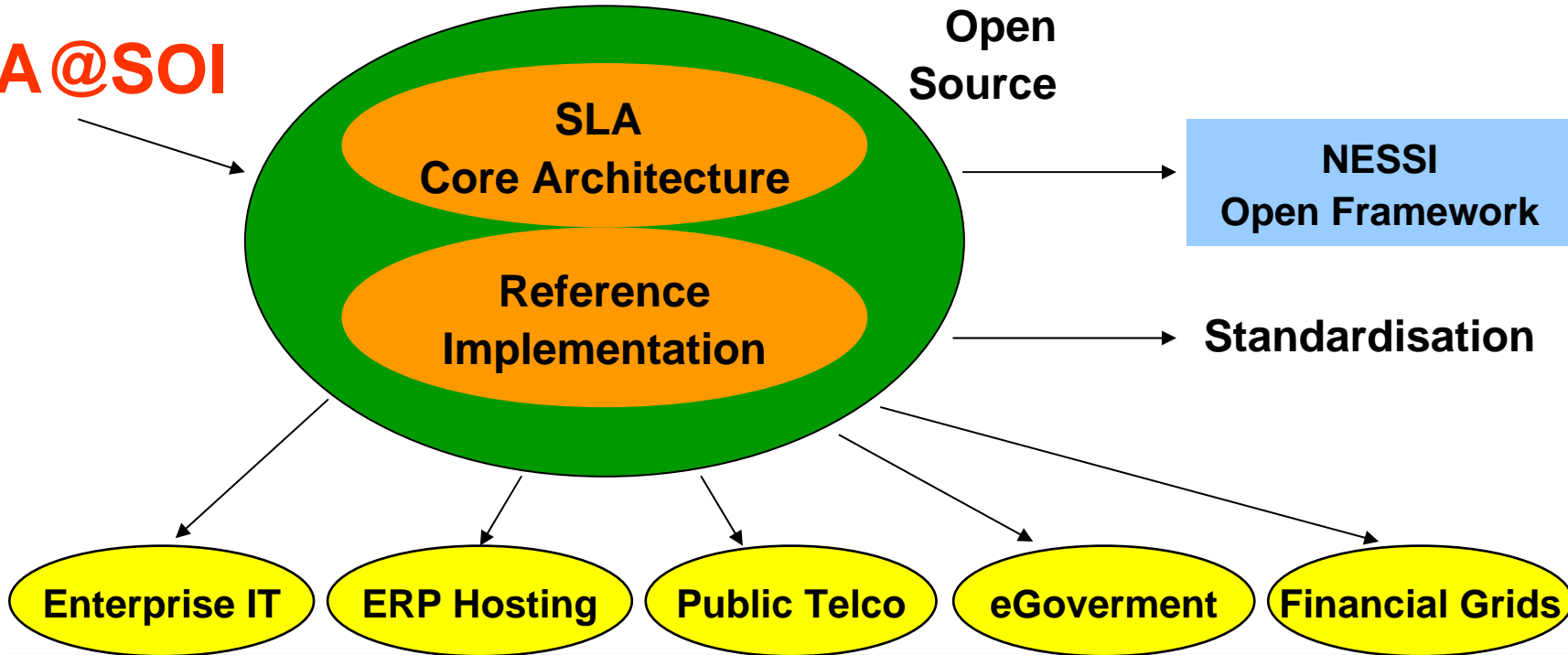
- harmonized virtualization technologies
- adaptive, SLA-aware management
- monitoring support

SLA Foundations

- negotiation
- brokering
- translation
- planning
- monitoring
- adjustment



SLA@SOI



context/
challenge

results/
impact

<ul style="list-style-type: none"> • complexity of investment focus across appl. & infrastructure + enterprise arch. 	<ul style="list-style-type: none"> • complex inter-related services • corporate customers 	<ul style="list-style-type: none"> • heterogeneous, networked env. • large scale public customers 	<ul style="list-style-type: none"> • heterogeneous stakeholders (citizens, government, ...) 	<ul style="list-style-type: none"> • regulatory compliance rules • availability vs. security conflicts
<ul style="list-style-type: none"> ➢ dynamic comprehension of service stack provisioning and business value 	<ul style="list-style-type: none"> ➢ ERP as a service ➢ business value chains 	<ul style="list-style-type: none"> ➢ user segmentation and predictive analysis ➢ public SLAs 	<ul style="list-style-type: none"> ➢ agreements driven by social aspects (not market logics) 	<ul style="list-style-type: none"> ➢ innovative financial products ➢ spatial-aware SLAs

Challenges

- SLA management is a technical & business topic
- possibly affects whole organisations and their interaction
- significantly different requirements from different sectors

Nature of industrial use cases

- differs significantly from use cases in other projects (e.g. XtremOS, RESERVOIR)
- integration of SLA framework required at all levels of IT stack
- use case implementation includes business and organisational aspects
- use cases will give comprehensive evaluation of integrated SLA management at technical & business level

Industrial use cases serve for

- steering scientific/technical work (requirements specification)
- evaluation of scientific/technical work
- demonstrating comprehensive SLA management solutions (including business and organizational aspects)
- creating impact

Partners:

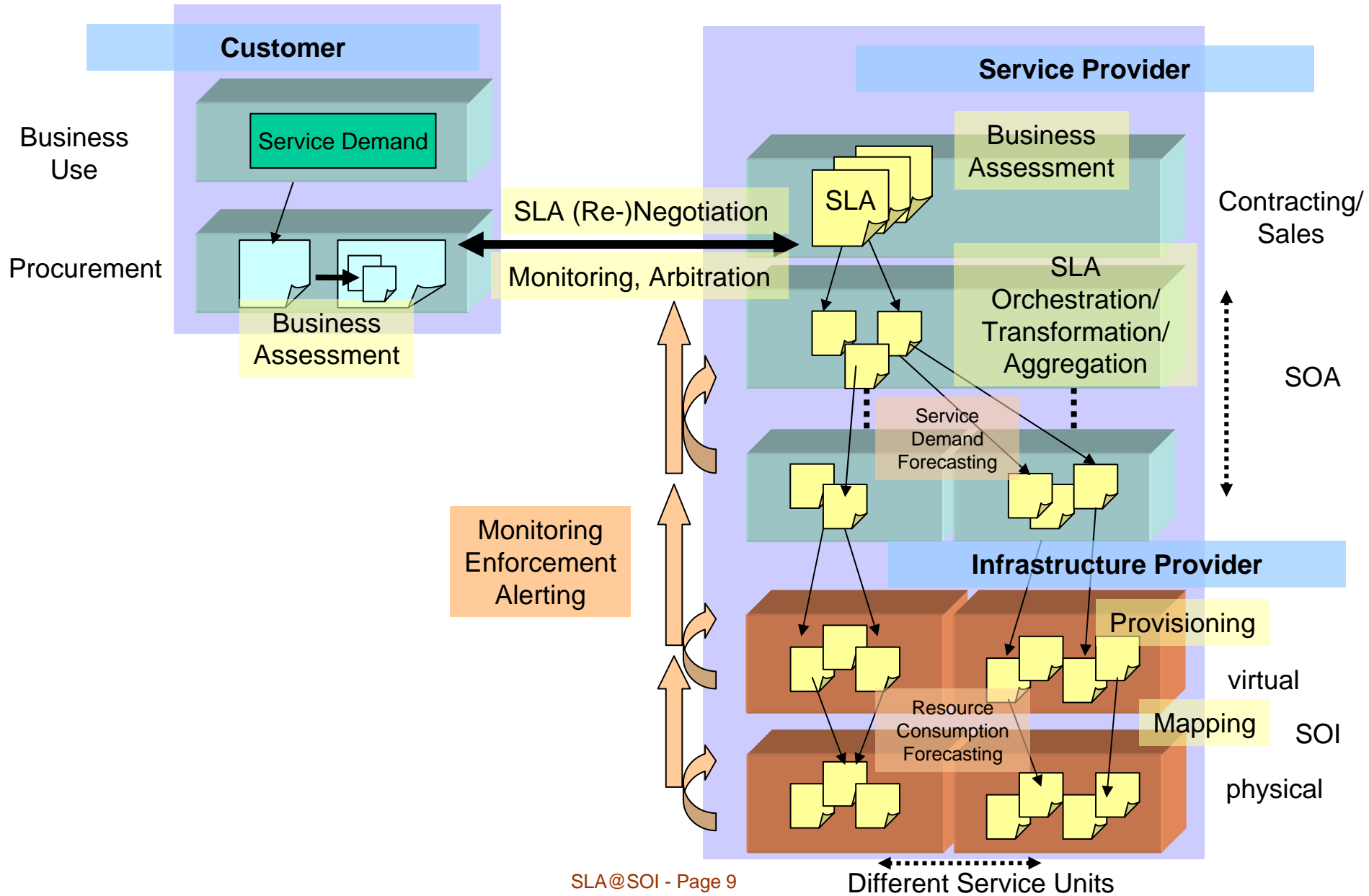
SAP AG,
Engineering Ingegneria Informatica S.p.A.
Intel
Telefónica
XLAB
GPI
eTel Austria

Technische Universität Dortmund
FZI Universität Karlsruhe
Fondazione Bruno Kessler
Politecnico di Milano
City University London
Queens University Belfast

Projekt Start: June 2008
running for 3 years

- SLA Management Framework
 - Specification including architecture, SLA foundation, business/service/infrastructure management, predictable systems engineering, etc.
 - Prototype containing 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 standardisation activities
- ➔ Designed for integration with NESSI open framework

Simplified Envisioned Interaction



- Service Level Agreements are considered in many (research) areas and many (research) projects
- A hot topic, especially for Grids
- Some projects to name here:
 - Akogrimo
 - NextGRID
 - KWf-Grid
 - AssessGrid
 - CoreGRID
 - BREIN
 - SmartLM
 - ...
- SLAs are already used for quite some time in telco environments and by infrastructure providers

- SLA Modeling
- SLA Creation
- SLA Negotiation/Interaction
- Optimization
- Provisioning, Enforcement, Prediction, Monitoring

Modeling of SLAs:

- General SLA model
- Domain specific terms (open issue)
- SLO terms (partial proposals)
- Penalty Model

SotA:

- WS-Agreement is proposed by the GRAAP Working Group in the Open Grid Forum. Accepted as standards draft. Considerable interest and uptake in several projects.
- Predecessor WSLA (by IBM) seems to be deprecated.
- WS-Agreement provides a framework for creating an SLA and the general SLA model.

Creation of SLAs:

- Two main approaches proposed in literature:
 - Super-market model/”Take it or leave it”
 - Negotiation protocols

SotA:

- Many projects focused on the super-market model.
- WS-Agreement facilitates a one-shot protocol in which an agreement is accepted or rejected.
- Research showed several use cases in which the super-market model does not suffice:
 - Orchestration of SLAs, planning etc.
- Negotiation supports the iterative modification of SLA terms between SLA consumer and provider to navigate towards a suitable solution. SLA can still be based on a fixed template in which certain terms are marked as settable.

Interaction Protocol/Negotiation Models:

- How to model negotiations between SLA providers and consumers?
- What kind of negotiation algorithms to use?

SotA

- WS-Agreement is a base but not sufficient for negotiations; Current work on negotiation extensions.
- Many consider agent-based systems and market-oriented approaches:
 - An agent acts selfish for a particular task
 - Agent roles can be consumer or provider. Intermediate brokers fulfill both roles.
 - A request/offer protocol allows negotiation between provider services without exposing individual policy
 - Suitable negotiation algorithms are necessary for different policy models.

Combination of SLAs:

- Merging, linking, aggregating SLAs are essential for orchestration and workflow planning.

SotA:

- No common accepted solution available. Several projects work on this.
- The combination of SLAs requires also the consideration of suitable monitoring mechanisms.
- New definitions have to be developed here.

Optimization of SLA planning:

- SLOs typically considered are cost or time; however other objectives can be imagined (KPI).
- There is existing work in the area of multi-criteria optimization and the use of generic objective definition.

- Suitable algorithms for optimization need to be developed.
 - Due to the complexity of the problem space, there is no general solution available.
 - Typically considered solutions are: heuristics, tabu search, GA, MIP/LP programming etc.
 - The optimisation model is typically problem space specific and needs background information for algorithms solution.

Purpose: domain-independent & standard way to establish and monitor SLAs

Provides

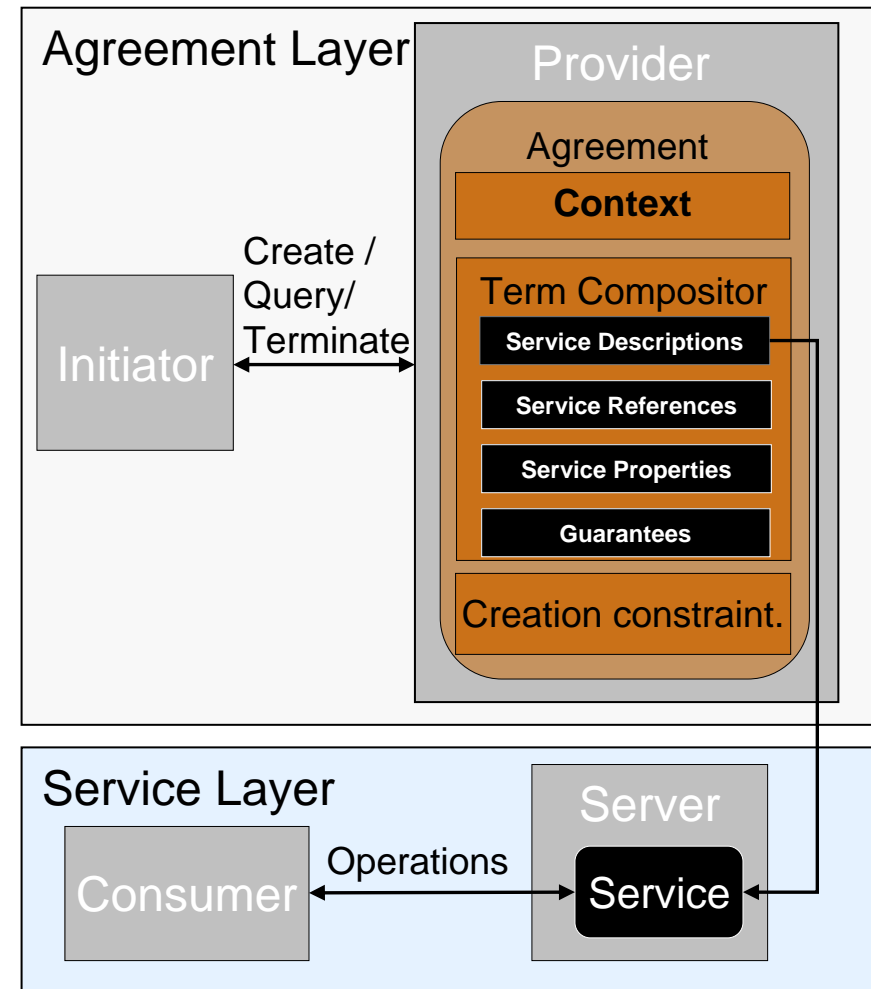
- format for agreement **templates** and **agreements**
- protocol for establishing agreements
- interface specification to monitor agreements

Status: OGF Proposed Recommendation (comparable to IETF Proposed Standard) since May 2007

Driven by the Grid Resource Allocation Agreement Working Group (GRAAP-WG)

WS-Agreement characteristics

- Protocol for dynamic agreement management
- Terms can relate to:
 - functional description
 - non-functional properties
- WS-Agreement is domain-agnostic
- Agreement can involve 4 parties:
 - agreement initiator and provider
 - service consumer and provider
- State can be published and monitored via agreement properties
- Can be chained or nested to represent complex relationships





Systems using WS-Agreement

- VIOLA MetaScheduling Service (VIOLA project)
- AssessGrid Broker (AssessGrid project)
- ASKALON (Uni. of Innsbruck)
- Community Scheduler Framework (Platform; Jilin Uni.)
- AgentScape (Vrije Uni. Amsterdam)
- CATNETS (CATNETS project)
- Job Submission Service (Umeå University)

Systems planning to use WS-Agreement

- Grid Resource Management System (PSNC)
- GridWay (Uni. of Madrid)

Systems planning to use different SLA formats

- eNanos (BSC)
- Grid superscalar (BSC)

SLA description format

- Seems to fulfill most of the use cases' requirements
- Standardization of domain-specific attributes would be beneficial (interoperability)
- Obviously missing:

SLA negotiation protocol

- Too simple for many scenarios (re-negotiation, bidding, ...)
- Many efforts and different approaches
- Task for GRAAP-WG: Co-ordinate negotiation discussion

Potential approach for WS-Agreement > V1.0

- Separation of SLA description and protocol?



- SLA format is pretty clear (WS-Agreement)
- Need to define domain-specific incarnations for use cases.

- Extension to negotiation model will probably be necessary for some of our scenarios
- Suitable algorithms for creating agreements are necessary.
 - Linked to planning/scheduling/brokering
 - Usually two roles: consumer/provider view; brokers in a SLA chain fulfill both roles.
- Link to backend resource and policy management necessary.
- Optimization framework and initial implementations are necessary.
- Runtime Management is quite unclear.
OGF provides OGSA as a standard interface for service management, but this not yet widely adopted.
- Need for defining a WS-* subset and security profile for framework building.