NEXOF-RA

NESSI Open Framework – Reference Architecture

IST- FP7-216446

Open Architecture Specification Process
Open Construction Cycle #1

Design time service composition
Position Paper

Contact: Dr Bill Mitchell, IT Innovation Centre

Date of publication: 7th October 2008

Action Required by October 3rd, 2008

1 DETAILS ABOUT THE CONTRIBUTORS

Main Contact / Lead

- Name: Bill Mitchell
- Affiliation: IT Innovation Centre
- Email: wm@ it-innovation.soton.ac.uk
- Phone: +44 23 8076 0834

Projects Represented

- Project: IRMOS
- Programme: ICT-2007.1.2

Glossary:

- MAPS: Modelling, Analysis, Planning and Specification
- QoS: Quality of Service
- QoE: Quality of Experience
- SLA: Service Level Agreement
- SOI: Service Oriented Infrastructure

2 TOPIC OF POSITION PAPER

2.1 Title

Modelling, Analysis, Planning and Specification (MAPS) of real-time service composition at design time

2.2 Dependencies

Several other NEXOF-RA topics will have dependencies on MAPS capabilities, namely Service Description Techniques, Service Discovery and Interoperability of Message-Based Service Interaction.

- Service Description.
  As stated in the NEXOF invitation the challenge for service description techniques is to enhance reuse and automation of the composition of services. Such reuse and automation is not possible without MAPS capabilities. Service descriptions have to incorporate concepts and properties that are relevant to QoS and such properties have to be testable and capable of analysis. QoS properties may well include non-functional real-time aspects of service performance, such as latency and responsiveness.
- Service Discovery.
  As stated in the NEXOF invitation, service discovery will rely on semi-automated search facilities, especially in the composite service development lifecycle. Such semi-automated facilities will be dependant on MAPS capabilities to determine appropriate matches for search criteria.
- Message-Based Service Interaction.
  As stated in the NEXOF invitation, in order for services to operate they must understand each others' messages completely and unambiguously. This will require verification that the content of a message received from a service is consistent with the goals of the receiving service. MAPS capabilities will support semi-automated validation of message contents against specifications.

3 SUMMARY

One of the fundamental issues for people designing business services is the difficulty of managing uncertainty. Different component services will be required at different stages of a composite service. Who will use these composite services, how long they will be required for, and what kind of performance they will expect of them are complex problems that include many uncertainties. This is particularly so where services are interactive and have complex QoS constraints such as latency or responsiveness. Small perturbations in one part of a composite service can well lead to cumulative effects that materially affect the overall QoS. Predicting where such sensitivity may occur is an important aspect of composition design. Soft real-time services are also resource

constrained, and the availability and reliability of necessary resources is another area of uncertainty. Uncertainty also occurs where composition requires the translation of high level performance values into lower level values used by some service acting at a lower level of an infrastructure stack. That is when mapping is needed between high level application parameters and low level infrastructure parameters, which could be supported by component benchmarking for example. Extrapolating parameter values from benchmarking would itself introduce another type of uncertainty. Additionally, composite services must be able to monitor component service behaviour and decide if these services need to be adapted or replaced. A reference architecture that permits service composition must enable MAPS technologies in order to address these uncertainties. The IRMOS project [1] will integrate such MAPS capabilities into the design process in order to support the management of these types of uncertainties for real-time services.

The IRMOS objectives that are relevant to this NEXOF topic are to provide software and techniques for real-time applications across administrative domains concerned with:

- Planning, analysing, modelling and specifying real-time applications on service oriented infrastructures
- Services to support discovery, workflow, SLAs, application performance monitoring and management
- Specification language and tools for generating code artefacts to aide application adaptation and integration

NEXOF-RA is intended to be of especial relevance to people involved in the design process. Stakeholders can only design composite services if they have the capability to understand what they are designing and how it will work. That is they must have the capability to understand how to correctly design service compositions and how to analyse what those compositions can do. The IRMOS project intends to provide these types of capabilities within the context of real-time interactive applications deployed over SOIs that span multiple administrative domains.

The aggregation of services within a composite service must be managed according to business goals, which will change during the services lifecycle. Such goals will be partially expressed within an SLA. Providing MAPS capabilities during service composition design is therefore essential if services are to fulfil their business goals. MAPS capabilities also provide support to people when they have to understand how available composition choices will impact on their business goals. In other words how to understand cost/benefit trade offs that will occur as a result of choices made in composing services with respect to different SLA criteria. Such MAPS capabilities for real-time service composition will be enabled by the technologies developed within the IRMOS project.

In this document, a service composition design does not solely mean a description in the sense of constructing a UML model. It also incorporates a behavioural description that is sufficiently complete so that ‘what if’ questions

can be explored through automated reasoning techniques. Such techniques may include formal, analytical, statistical or quantitative techniques. This type of design could be described as a 'testable' design. Hence, the design must capture sufficient domain knowledge to describe how the composition of services will meet the requirements for the service as a whole. Thus a design will include a composite specification that defines a testable model of service interfaces and interaction behaviours.

The proposed contributions to the service composition reference architecture are

- define specification languages for design patterns of soft real-time service composition
- construct methodologies and techniques for managing and analysing uncertainties against QoS, SLA and QoE criteria and with respect to orchestration and choreography
- capture best practice across soft real-time multimedia composite services
- provide the above as UML profiles that extend and integrate with current standards relevant to this area ([2][3][4][5]) and the other NEXOF-RA UML models and profiles

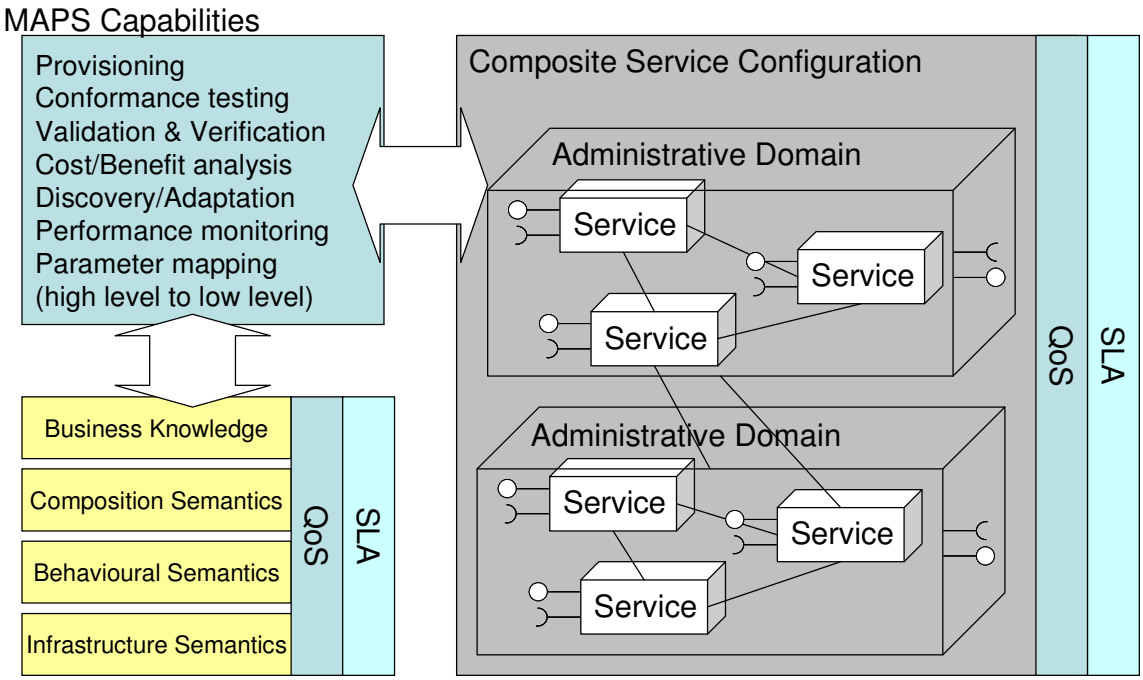

Figure 1: MAPS Architecture

Figure 1 gives a high level illustration of the capabilities of the proposed MAPS architecture. MAPS capabilities provide a vehicle for relating service composition configurations to business goals and QoS, SLA and QoE concerns. Such concerns are related to provisioning of resources between service

components, ensuring conformance to the correct standards (ITU standards for example), deciding on the correct trade off between costs and benefits within the different components, determining suitable strategies for compensating when one component fails, ensuring there is sufficient adaptation within the configuration for exceptional events, and of course validating that the services collectively deliver the appropriate performance. MAP capabilities also provide support for ensuring that local properties demonstrated by individual service components aggregate into the correct global properties of the composite service. A service composition may span multiple administration domains, which may have an impact on orchestration of services. That will raise interesting challenges in demonstrating composite services perform as designed. The IRMOS project has produced a preliminary version of the IRMOS platform architecture that discusses the pertinent issues for soft real-time services deployed on an IRMOS platform [6].

3.1 Background

The IRMOS project will design, develop and validate a Service Orientated Infrastructure which will allow the adoption of interactive real-time applications, and especially multimedia applications, enabling their rich set of attributes (from time-constrained operation to dynamic service control and adaptation) and their efficient integration into the infrastructure. This FP7 project is an IP involving thirteen partners running for 36 months. See reference [1] for more details.

The IRMOS partners are Xyratex (UK), Institute of Communication & Computer Systems – National Technical University of Athens (GR), Universität Stuttgart (DE), Alcatel-Lucent Deutschland AG (DE), STIFTELSEN SINTEF (NO), IT Innovation (UK), Scuola Superiore Sant'Anna (IT), Telefonica I+D (ES), Giunti Labs (IT), Grass Valley Germany GmbH (DE), Deutsche Thomson OHG (DE). IT Innovation is an autonomous science-park-based research centre, undertaking applied research and development with and for industry and commerce.

REFERENCES

[1] IRMOS, http://www.irmosproject.eu/

[2] UML Testing Profile, http://www.omg.org/technology/documents/profile_catalog.htm#UML_for_Testing

[3] UML Profile for Schedulability, Performance and Time, http://www.omg.org/technology/documents/profile_catalog.htm#UML_for_SPT

[4] UML Profile for QoS and Fault Tolerance, http://www.omg.org/technology/documents/profile_catalog.htm#UML_for_QoS_and_FT

[5] OMG Systems Modeling Language, http://www.omg.org/technology/documents/domain_spec_catalog.htm#OMGSysML

[6] IRMOS WP3_D3_1_1_v1_0 "Prelimenary IRMOS overall archietecture" http://www.irmosproject.eu/Deliverables/Download.aspx?ID=24