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
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An Online
Peer Assessment
System for HE



Task 20

The SOA Approach

Author: Nicola Wilkinson

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Project lead by:
engCETL, Loughborough University

Project partners:
The University of Hull
Higher Education Academy, Engineering Subject Centre
Higher Education Academy, Physical Sciences Subject Centre

Executive Summary

Within this document the SOA will be examined and explained in the context of the WebPA project. The first definition will be what SOA represents. From this discussion of the basic principles will be covered with regard to the guiding principles surrounding SOA to the specific architecture principles. From this point the available SOA technologies are identified and examined. The overall advantages and disadvantages of the system can be found in Appendix 2 – A Comparison of Web Service Technologies.

One of the most important aspect of SOA to the WebPA project are the existing frameworks and specifications that can be utilised. This encompasses the relevancy of some of the ELF projects to WebPA.

This document also covers the other considerations that must be taken into account with regard to SOA. Finally the document is concluded and the recommendations for the project are made.

Through out the document a high number of acronyms and abbreviations are used. In most instances within the body of the document where an acronym is used it is explained at that point. However, to ensure that the reader can understand all acronyms a glossary is included in Appendix 1 – Glossary.

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Introduction

SOA is the acronym for Service Oriented Architecture. The SOA approach is independent of the technology being used. It is possible to implement a SOA in a wide range of technologies, including REST, RPC, DCOM or generically Web Services. The whole concept is to utilise an independent service with defined interfaces, allowing tasks to be performed when called.

Often the SOA is referenced with regards to interoperable services. The interface definition is used to hide the implementation of the language specific service. There is no specific methodology or framework for documenting the capabilities or services of the SOA.

Defining SOA

As with a lot of the terms in software development there is no one definition and this is true for SOA. There are two formal definitions that have been create as well as a whole host of others mainly from the technology vendors. The definitions from the technology vendors tend to be orientated towards the technology, or the services that are being provided. These definitions will therefore be discounted and instead one of the formal definitions will be used within the context of the WebPA project. The formal definition that will be used, has been defined by OASIS (Organisation for the Advancement of Structural Information Standards) and is shown in Figure 1.

<p>A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provided a uniform means to offer, discover, interact with and use capabilities to produce desired effects consisting with measurable preconditions and expectations.</p>
<p>OASIS</p>

Figure 1 - OASIS SOA Definition

Basic Principles of SOA

For SOA there are basic guiding principles as well as specific architectural principles. It is beyond the scope of this document to fully define the SOA principles so an overview is offered to allow for reader understanding.

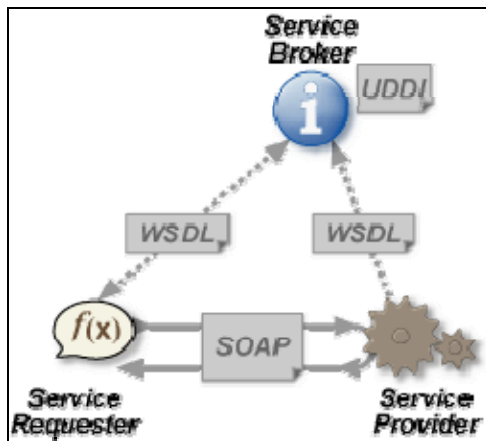


Figure 2 - Web Services (Source: Wikipedia)

Guiding Principles

The guiding principles allow for the definition of ground rules for the development, maintenance and usage of SOA. The basics are to allow for; reuse, granularity, modularity, composition, componentization and interoperability. There is also a requirement for the SOA to comply with both common and industry specific standards. Also all services must accommodate;

- service identification and categorisation,
- provisioning and delivery,
- monitoring and tracking.

Specific Architecture Principles

The specific architecture principles are related to the design and service definitions for specific themes that influence the behaviour and style of design for the system. These principles include service:

- Encapsulation,
- Loose coupling
- Contract
- Abstraction
- Reusability
- Composability
- Autonomy
- Statelessness
- Discoverability

In addition other factors should also be considered, such as the SOA Reference Architecture, Life cycle management, efficient use of the systems resources, service maturity, service performance, and enterprise application integration (EAI).

SOA Technologies

These SOA technologies fall under the functional area of the SOA. The technology is classed as the invocation and indicate the invocation means of the service, including the URL, interfaces etc. It is possible to have multiple paths for invocation for a single service. Each of the SOA technologies are seen as distinct protocols, often built on one another.

REST

Representational State Transfer (REST) is a style of software architecture as defined by Roy Fielding (Figure 3). The main principles of REST are:

- application state and functionality are divided into resources,
- Every resource can be addressed using universal syntax
- all resources share a uniform interface between the client and the resource,
- a protocol that is Client/server, stateless, cacheable and layered.

Representational State Transfer is intended to evoke an image of how a well-designed Web application behaves: a network of web pages (a virtual state-machine), where the user progresses through an application by selecting links (state transitions), resulting in the next page (representing the next state of the application) being transferred to the user and rendered for their use.

Dr. Roy Fielding, Architectural Styles and the Design of Network-based Software Architectures

Figure 3 - Definition of REST

SOAP

SOAP (Simple Object Access Protocol) is for exchanging XML based messages via HTTP. SOAP is often referred to as the foundation of Web Services Stack. There are a number of messaging patterns, RCP being the most common.

XML is the standard messaging format due to its wide spread use by both major corporations and the open source community. This use of XML is often seen as weakness of SOAP. Other perceived weaknesses are The reliance on HTTP as the transfer protocol and the WSDL.

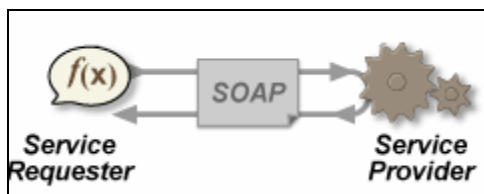


Figure 4 - Architectural elements involved in the XML-RCP (Source: Wikipedia)

RPC

Remote procedure call (RPC) is a way in which a application can cause a subroutine or procedure in another address space to execute, without the programmer coding the details for the remote interaction. Where object orientated principles are used the RPC is often called remote invocation or remote method invocation.

A number of different technologies have been developed to accomplish RCP that are not compatible with each other. The different flavours of RPC include ONC RCP, DEC/RCP, MSRPC and COBRA.

RCP Web Services are based around the WSDL operations and are often criticised for not being loosely coupled.

DCOM

Distributed Component Object Model (DCOM) is a Microsoft proprietary technology and is based on MSRPC. Due to DCOM being a proprietary technology it will not be considered in the WebPA project.

Web Service Description Language

Web Services Description Language (WSDL) is an XML based language for modelling web services. The services provided are defined as a collection of network end points. WSDL is often used in conjunction with SOAP and an XML schema.

SOA Frameworks and Specifications with Relevance to WebPA

FREMA

FREMA (Framework Reference Model for Assessment) is a reference model for the JISC e-Learning Framework (ELF). This framework is used for describing how the web services can be plugged together to create e-learning applications.

The FREMA although useful is not relevant for the project, at this point, as it has been specified that WebPA will use both the IMS specifications. There is a possibility in the future that the uses of FREMA by the project will need to be revisited as the system is adapted to be used at other institutions and can be used as a guide to how the system will fit together.

IMS Enterprise Services Specification

The IMS Enterprise Service Specification (IMS ESS) is the definition of how systems manage the exchange of information that describes people, group and membership in the context of learning. The service specification has been orientated around the WSDL web service, with the use of SOAP as the main service protocol.

This IMS ESS is the most crucial at this time for the WebPA project, as it describes both people and groups. IMS ESS will aid in the communication between the Institution Enterprise systems that contain the student and academic data and the WebPA system. Within ELF there have been a number of projects that have used Tool Kits based on this specification and it is therefore worth investigation how this has been accomplished. One particular project is MINTED.

XCRI

XCRI (eXchanging Course-Related Information) is a JISC funded project which is defining a vocabulary and the appropriate bindings for describe course-related information for a number of purposes including course quality assurance and reporting requirements.

XCRI at present offers little in the web services arena for the WebPA project to use as it targets a different area of the e-learning framework. The information that is communicated relates to specific course information such as; course title, modules, duration of the course and entry requirements.

IMS Question and Test Interoperability Specification

The IMS Question and Test Interoperability Specification (IMS QTI) describes the model for the representation of the question and test data, and for the corresponding results reports.

This may be beyond the scope of the WebPA project at present. However all development should bare this interoperable specification in mind as it is possible that it could be integrated in the future.

Other SOA Consideration

- Security Constraints
This defines who can execute the service in terms of roles, individuals, partners etc. Also which mechanisms that can be invoked.
- Quality of service
Determines the allowable failure rate
- Service level agreement
Determines the amount of latency that the service can have to perform all its actions.
- Semantics
Dictates the meaning of the terms used in the description and interfaces of the service.
- Process
Describes the process of the contracted service

Conclusion and Recommendations

For the WebPA project SOA is very important and will need to be documented fully. One of the main issues that will face the project is the integration via SOA for all of the pilot institutions and subsequently when the system is released as an open source system.

In the first instance WebPA will need to ensure that the IMS ESS can be met. Although the specification states the user of WSDL and SOAP, for Person information it is possible to use LDAP and this is a more appropriate method of communication in this case. However, shibboleth will not be supported for Person information at this stage.

Within the original proposal it is stated that REST will be used and this will be accommodated when it is feasible to do so.

In order to document appropriately the SOA a roadmap will be drawn up. This Roadmap will be supplementary to this document, and will go into greater depth regarding the marrying of the technology with the requirements.

However it must be recommended that the service must start of small and can be grown across the life time of the project.

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RFC 1831 - Specifies version 2 of ONC RPC, [Online] Available at: <http://tools.ietf.org/html/rfc1831>

Remote Procedure Calls (RPC) A tutorial on ONC RPC by Dr Dave Marshall of Cardiff University, [Online] Available at: <http://www.cs.cf.ac.uk/Dave/C/node33.html>

Web Sites

Site name	URL
OASIS	http://www.oasis-open.org/home/index.php

The Open Group, SOA Definition	http://opengroup.org/projects/soa/doc.tpl?gdid=10632
WSDL 1.1 Specification	http://www.w3.org/TR/wsdl
FREMA	http://frema.ecs.soton.ac.uk/wiki/index.php?title=Main_Page
MINTED	http://www.sussex.ac.uk/its/minted/
ELF	http://www.elframework.org/common_services/

Appendices

Appendix 1 – Glossary

DCOM	Distributed Component Object Model
EAI	enterprise application integration
ELF	JISC e-Learning Frame Work
FREMA	Framework Reference Model for Assessment
HTTP	Hyper Text Transfer Protocol
IMS ESS	IMS Enterprise Service Specification
IMS QTI	IMS Question and Test Interoperability Specification
LDAP	Lightweight Directory Access Protocol
OASIS	Organisation for the Advancement of Structural Information Standards
RPC	Remote procedure
REST	Representational State Transfer
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
URL	Uniform Resource Locator
WSDL	Web Services Description Language
XCRI	eXchanging Course-Related Information
XML	Extensible Markup Language

Appendix 2 – A Comparison of Web Service Technologies

Technology	Advantages	Disadvantages
SOAP	<ul style="list-style-type: none"> • Debugging is possible • Complex operations are easily hidden • API wrapping is straight forward • Increased privacy 	<ul style="list-style-type: none"> • Client needs to know operations and their semantics beforehand • Client needs to decided ports for different types of notifications • Process instances are created implicitly • Uses JSON(JavaScript Object Notation)
JSON-RCP	<ul style="list-style-type: none"> • Allows bi-directional communication • Allows multiple calls sent to a peer to be answered out of order • Can use HTTP or TCP/IP 	
XINS (XML Interface for Network Services)	<ul style="list-style-type: none"> • Open source • Uses 'plain old XML' • Simple Http based RCP • Compatible with plain web browsers 	<ul style="list-style-type: none"> • Very Java orientated
Burlap		<ul style="list-style-type: none"> • For JavaBeans only
GXA	<ul style="list-style-type: none"> • Extension to SOAP 	<ul style="list-style-type: none"> • Microsoft Driven
Hessian Web Service Protocol	<ul style="list-style-type: none"> • Does not require a large framework to be usable • It is a binary protocol 	<ul style="list-style-type: none"> • Mainly developed for Java and Python although other third party implementations are available
REST	<ul style="list-style-type: none"> • Improved response times and server loading due to caching • Server scalability 	<ul style="list-style-type: none"> • A large number of objects are required • Managing the URI can become difficult

- Less client side software is needed
- Less dependant on vendor software for messaging frameworks for HTTP
- Does not require a separate resource discovery mechanism
- Provides better long term compatibility

XML-RCP (XML Remote Procedure Call)

- Commonalty used Web Service protocol

- Defines only a limited number of data types and commands
- Has evolved into SOAP

BEEP (Blocks Extensible Exchange Protocol)

- Bi-Directional
- Facilities for encryption
- Facilities for authentication
- Highly extensible

- Runs on top of TCP
- Not well known