A K-Based Specification of Web Services

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Outline

- Problematic
- Objectives
- Overviews
- Contributions
- Conclusion and Perspectives
SOA Conceptual Model

Standards:

- Service discovery- UDDI
  Universal Description Discovery Integration

- Service Description- WSDL
  Web Service Description Language

- Service Invocation- SOAP
  Simple Object Access Protocol

What about its semantics?

Did the protocol describe the results of invocation?
**Problematic**

Intervene at each phase of the Web service development process to solve problems

- Infer an operational semantic to service contracts written in WSDL
- Formalize the Interactions between services
- Optimize the Web services selection algorithm
- Test the compatibility between services and try to adapt them to the context-aware
- Verify and check the service properties
WSDL Web Service Description Language

```xml
<definitions name="AktienKurs"
    targetNamespace="http://local..."
    xmlns:xsd="http://schemas.xmlsoap.org/..."
    xmlns="http://schemas.xmlsoap.org/wsdl"
>
    <service name="AktienKurs">
        <port name="AktienSoapPort" binding="soap:address location="http://local...">
            <message name="Aktie.HoehWert">
                <part name="body" element="xsd:..."
                    ...
            </message>
        </port>
    </service>
</definitions>
```
The K-Tool

K module \equiv Maude module (meta-data, K semantic)

K- syntax = syntax of the language in K

K- semantic = (import) Ksyntax + Ksemantic (Evaluation strategies, Configuration, Rules)
The K-Tool

\[ K-\text{semantic} = K\text{syntax} + K\text{semantic} \quad (\text{Evaluation strategies, Configuration, Rules}) \]

- **Evaluation strategies**:
  Link between the syntax and the semantic.
  Gives the order in which the arguments of a construction must be evaluated.

- **Configuration**:
  Represents the current state of execution.

- **Rules**:
  Describe how a configuration evolve during the execution and which is susceptible to change states of the system.
The K-Tool
A sound modeling methodology, to integrate WSDL into rewriting logic.

A high level specification of Web service without any encoding or translation process is given.
The K-Tool

Advantages

The main objective of K is to prove that a formal specification language can be at the same time:

- Simple,
- Comprehensive,
- Analyzable,
- Executable.

- Extend the syntax of an existing language by the possibility of enriching it by adding new concepts and elements in answer to susceptible appearing needs.

- Make a specification executable and consequently, allow the concrete exploitation of the model.

- Offer a high level of abstraction by the definition of a meta-model including all the language concepts.

- Analyze and verify systems properties in a formal way by the use of the various mechanisms of analysis and check offered by the Maude language (K is implemented on the top of Maude).
Full proposed grammar of WSDL in K:

KWSDL DESCRIPTION

KWSDL SYNTAX

KWSDL SEMANTIC
The K-WSDL-SYNTAX Module

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```
Module KWSDL-SYNTAX
Syntax K-WSDL ::= "KWSDL" "ServiceName" ServiceId "::=
{" DescriptionPart "}"
syntax DescriptionPart ::= "messages" "::=" [Message]
    | "types" "::=" {"Type"}"
    | "ports" "::=" {"Port"}"
    | "bindings" "::=" {"Binding"}"
    | "service" "::=" {"Service"}"
  >DescriptionPart DescriptionPart [left]
syntax Message ::= MsgId TypeMsg "::=" Msg
syntax TypeMsg ::= "request" | "response"
syntax Msg ::= String
syntax Type ::= TypeId "::=" DataType
syntax Port ::= PortId "::=" PortType TypeMsg "::=" Msg
syntax PortType ::= "Input" | "Output"
syntax Binding ::= BindingId PortId ProtocolStyle "::=" Body
syntax Service ::= ServiceId BindingId PortId Location
syntax Protocol ::= "SOAP" | "SMPT"
```
The K-WSDL Configuration

```xml
<configuration>
  <state color="yellow">
    <k color="green">SPGM:WSDL</k>
    <definitions color="cyan">
      <message color="orange">Map</message>
      <portType color="red" multiplicity="*">
        <PortName>"port"</PortName>
      </portType>
    </definitions>
    <binding color="Orchid" multiplicity="*">
      <bindingName>"binding"</bindingName>
      <bindingPortName>bindingPortName</bindingPortName>
      <protocol>"protocol"</protocol>
      <style>"style"</style>
    </binding>
    <inputOperations>Map</inputOperations>
    <outputOperations>Map</outputOperations>
  </state>
</configuration>
```
The K-Rules

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The K-Rules

Module KWSDL
imports Module KWSDL-SYNTAX
rule <k>...port X = {O} => X -> O ...<k>
(., =><portType>
<PortName> X </PortName>
<operation>. </operation>
</portType>)

rule <k>... X -> TP:Type T:TypeMsg : MS:Msg =>
X -> . ...<k>
<portType>
<PortName> X </PortName>
<operation>Rho:Map (. , => TP | => MS
</operation>
</portType>
rule <k>... service S -> U:Loc : AS:AdresseService => S
-> . ...<k>

<service> ...<serviceName> S </serviceName>
<bindingName>B</bindingName>
<bindingPortName>BP</bindingPortName>
<location>Rho:Map( . => U | => AS )</location>
<service>

Operational Semantics

rule <services>...
<serviceName>X</serviceName>
<PortName>P</PortName>
<Operations>...Out P:PortId | >(RequestMsg :String=>,)
...</Operations>
<bringing>..
<BindingName>Y</BindingName>
<bringing>... In B:BindingPort |>
(Request:String=>Resquest+ResquestMsg)...</Binding>
<exchange>Rho:Map </exchange>

When ShasMapping(Rho,X,P)
andBool(Y.B==K.Rho:Map(X,P))
andBool Request==String ""

...
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Problematic

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Service discovery

User Request

Service description

K-Tool

K-WSDL

WSDL

Add semantics
Problematic

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Conclusion & Perspectives

Service selection

K-WSDL

Similarity algorithm
If.... else...

K-WSDL

Measure syntax and semantic similarities

Service invocation

K-WSDL

K-Tool

SOAP

Messages

Messages
Example: Student registration
The K-WSDL description of the student service and its execution in K

WSDL Service Name Student:

{definitions Service Name = Student:

{TargeNameSpace Tns = "http://www.UC2.dz/kwsdl/Student.kwsdl"

DefaultNameSpace Dns = "http://schemas.xmlsoap.org/kwsdl"

message NumCardSearch request : "NumCardStudentRequest"

message NumCardFound response : "NumCardStudentresponse"

port StudentPort = Input request : "NumCardStudentRequest"

port StudentPort = Output response : "NumCardStudentresponse"

binding StudBinding StudentPort SOAP rpc =

   EncodingStyle = "http://schemas.xmlsoap.org/soap/encoding/"

   Tns = "http://www.UC2.dz/kwsdl/wiki.kwsdl"

   use = encoded

   service Student

   StudBinding

   StudentPort

   ServiceLocation : "http://www.UC2.dz/"

exchange UC2 . Studentport to StudBinding . SendnumCardStudentRequest

exchange Student . receiveNumCardStudentResponse to StudBinding . Studentport

}
Service composition process

Service composition

User Request

Select service

WS1, WS2, WS3 ... WSn

Check-compatibility

Compose services

TRUE

FALSE

Resolve mismatch

Service composition process
Contributions:

- Defining a generic syntax for Web service
- Integrating WSDL in Maude using K technique.
- Defining a complete formal execution framework for Web service
- K represents the overall SOA architecture in a formal semantic framework
**Future Work:**

- Enrich the K-WSDL specification based on various related work
- Exploiting the result model for executing more complex systems
- Describe formally the web service behavior (rewrite rules..)
- Check the compatibility and similarities between services to compose them
- Verifying the correctness of some properties: QoS, dynamic reconfiguration …etc.
- Extending the proposed syntax of K-WSDL to deal with some others aspects (composition..)
- Exploiting the K2-tool (last release of K).
Thank you for your attention!