A coalition formation based model for Web service composition

Mme SOUILAH BENABDELHAFID Maya
LIRE Laboratory, Mentouri University, Constantine

IWAISE’2012
1. Introduction (1/3)

Context and Motivation

- Service Oriented Computing (SOC) → Development of rapid, low-cost and easy composition of distributed applications even in heterogeneous environments
- Web Service (WS) → Concretization of SOC
- Web Service Composition (WSC) → Aggregation of several WSs to answer to needs that a single WS can not provide
- New WSC process based on the combination of WSs and software agents in order to have a better interoperability [Souilah and al., 11]
I. Introduction (2/3)

Problem

The service providers don’t have enough autonomy to choose their partners during the WSC process!!

- Very close to the coalition formation in the Multi Agent Systems where software agents can allow such autonomy
Objective

- Proposition of a negotiation model where the service providers can participate in the WSC process

- Considering criteria permitting the construction of a composed WS that answers at best to the service consumer needs
Outlines

1. Introduction

2. Some research works comparison

3. Proposed model

4. Does it work?

5. Conclusions

6. References
## 2. Comparison of some research works

<table>
<thead>
<tr>
<th>Research Works</th>
<th>Objective</th>
<th>Technology used in WSC</th>
<th>Provider-Provider negotiation</th>
<th>QoS negotiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Ermolayev and al., 03]</td>
<td>Composition</td>
<td>Coalition formation</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>[Maamar and al., 05]</td>
<td>Composition</td>
<td>Agent and context</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>[Wang and al., 12]</td>
<td>Composition</td>
<td>Cooperative reasoning based agent</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>[Zarour and al., 06]</td>
<td>Cooperation</td>
<td>/</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Our work</td>
<td>Interoperability</td>
<td>Coalition formation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
3. Proposed model (1/8)

Hypotheses

- The consumer agent represents the service consumer
- The provider agent represents the service provider
- The service providers propose atomic services that will be discovered from a service registry

CFWSC (for Coalition Formation for Web Service Composition)

1. Negotiation of the service functionalities
2. Negotiation of the QoS

1 provider agent coalition member
1 needed service \( \rightarrow \) N discovered provider agents (P)
3 retained provider agents (RP)

Composed WS

November 10th, IWAISE'2012
3. Proposed model (2/8)

**PHASE 1: NEGOTIATION OF THE SERVICE FUNCTIONALITIES**

1. **Formulation and sending of the announcements by the consumer agent C**

   - **Announce(C, P)**
   - Expiry of the waiting period of responses

2. **Formulation and sending of the offers by the discovered provider agents P**

   - **Negotiate(P, C)**
   - **Negotiate-Propose(P, C)**
   - **Propose(P, C)**

3. **Evaluation of the discovered provider agents and selection of 3 retained agents R**

   - **Evaluate(R)**
   - **Retain(C, P)**
   - **Eliminate(C, P)**

4. **Negotiation and selection**

   - **Expiry of the waiting period of responses**
   - **Expiry of the reply time of P**

**Message**

- The QoS values +
- The maximum reply time value +
- (ev. the services wanting to negotiate on)

**Announce message**

- The needed services +
- The service to negotiate on +
- The current coalition members +
- The waiting period

**Message**

- The QoS values +
- The maximum reply time value +
- (ev. the services wanting to negotiate on)
What are the criteria that are used to evaluate the discovered provider agents?

- Criteria that are related to the partners [Cherni, 04]:
  - Previous relations with the partner
  - Experience in the cooperation

- The criteria will be aggregated by the coalition members in order to have a global estimation for each discovered provider agent that will be then classified [Zarour and al., 06]
3. Proposed model (4/8)

**PHASE 2: NEGOTIATION OF THE QoS**

November 10th, IWAISE'2012

- **a.** Accept one of the proposed offers, Accept (C, RP), and rejects the two remainder offers (Reject (C, RP))
- **b.** Propose three counter-offers Re-propose (C, RP)
  - **b.1** Accept the counter-offer Accept (RP, C)
  - **b.2** Reject the counter-offer Reject (RP, C)
  - **b.3** Generate a new offer then propose it Re-propose (RP, C)

---

**Algorithm: Agents negotiation**

**Inputs:** Retained agent offers $O_R$.

**Outputs:** A provider agent member of the coalition.

**Begin**

1. $t \leftarrow 0$
2. $O^t_R \leftarrow O_R$
3. Repeat
4. $t \leftarrow t+1$
5. The consumer agent offer computation at round $t(O^t_C)$
6. $O^t_R \leftarrow O^{t-1}_R$
7. Offers evaluation
8. Offers comparison
9. Generation and sending of responses
10. Until($t \geq temp$) or ($temp_1 = 0$ and $temp_2 = 0$ and $temp_3 = 0$) or ($O^t_R = \Phi$)
**End**
What are the QoS criteria that are considered in the negotiation?

- We consider the set C including the following QoS criteria:
  - Response time
  - Price
  - Availability
  - Robustness

Criteria qualified quantitatively
Criterion qualified qualitatively
3. Proposed model (6/8)

How about the offers evaluation?

<table>
<thead>
<tr>
<th>QoS Criteria</th>
<th>Response time</th>
<th>Price</th>
<th>Availability</th>
<th>Robustness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain</td>
<td>[4, 12]</td>
<td>[0, 10]</td>
<td>[0.2, 0.7]</td>
<td>{weak, little-robust, robust}</td>
</tr>
<tr>
<td>Weigh</td>
<td>0.15</td>
<td>0.55</td>
<td>0.20</td>
<td>0.10</td>
</tr>
</tbody>
</table>

**Aggregation Function**:  

\[ U^a = \sum_{c \in C} w_c \times V_c \]

Let be:  

- \( U^C : for C \)
- \( U^1, U^2, U^3 : for RP \)
3. Proposed model (7/8)

Two cases are possible:

1. Choose the offer that generates the biggest utility value
2. Regenerate a new counter-offer in which it makes a concession (reduction of its utility value by changing its QoS values)

- \( U^1 \neq U^c \) and \( U^2 < U^c \) and \( U^3 < U^c \)
- \( U^1 = U^c \) or \( U^2 = U^c \) or \( U^3 = U^c \)

1) If it finds that there is an offer that has values that are the same or better than its own, then it accepts it
2) else, it regenerate a counter-offer in which it makes a concession
When does a negotiation process end?

- When all the discovered services will be allowed to providers that are now coalition members (coalition formation)
4. Does it work? (1/2)

**Example:** A service negotiation in a project of the construction

<table>
<thead>
<tr>
<th>Needed services</th>
<th>(Discovered Web Service, Provider agent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior decoration service</td>
<td>$(WS_1, P_1), (WS_2, P_2), (WS_3, P_3), (WS_4, P_4), (WS_5, P_5)$</td>
</tr>
<tr>
<td>Exterior decoration service</td>
<td>$(WS_6, P_6), (WS_7, P_5), (WS_8, P_8), (WS_9, P_1), (WS_{10}, P_{10}), (WS_{11}, P_{11})$</td>
</tr>
</tbody>
</table>
Does it work?

Simulation in JADE:

Several platforms are supplied as software packages such as Jade and Zeus.

Our choice is the Jade plateforme in which:

- WS are implemented as tasks
- Agents are implemented as Java classes

Two classes in the package CFWSC:

- CONSUMER
- PROVIDER

Extension of the basic Agent class included in jade.core.
5. Conclusions

• We have:
  ✓ Used a negotiation as a mechanism of interoperation.
  ✓ Materialized the agent negotiation by the CFWSC
  ✓ Studied a real case of interoperability domain
  ✓ Realized its simulation in jade platform

• Now, we are :
  ❑ Working on the second phase of the CFWSC (extension by other QoS criteria like security)

• As next step, we’ll:
  ➢ Formulize the CFWSC so that it’ll verify some properties such as the lack of blocking
7. References


Thanks for your attention, Questions?