A preliminary study on BPEL process testability

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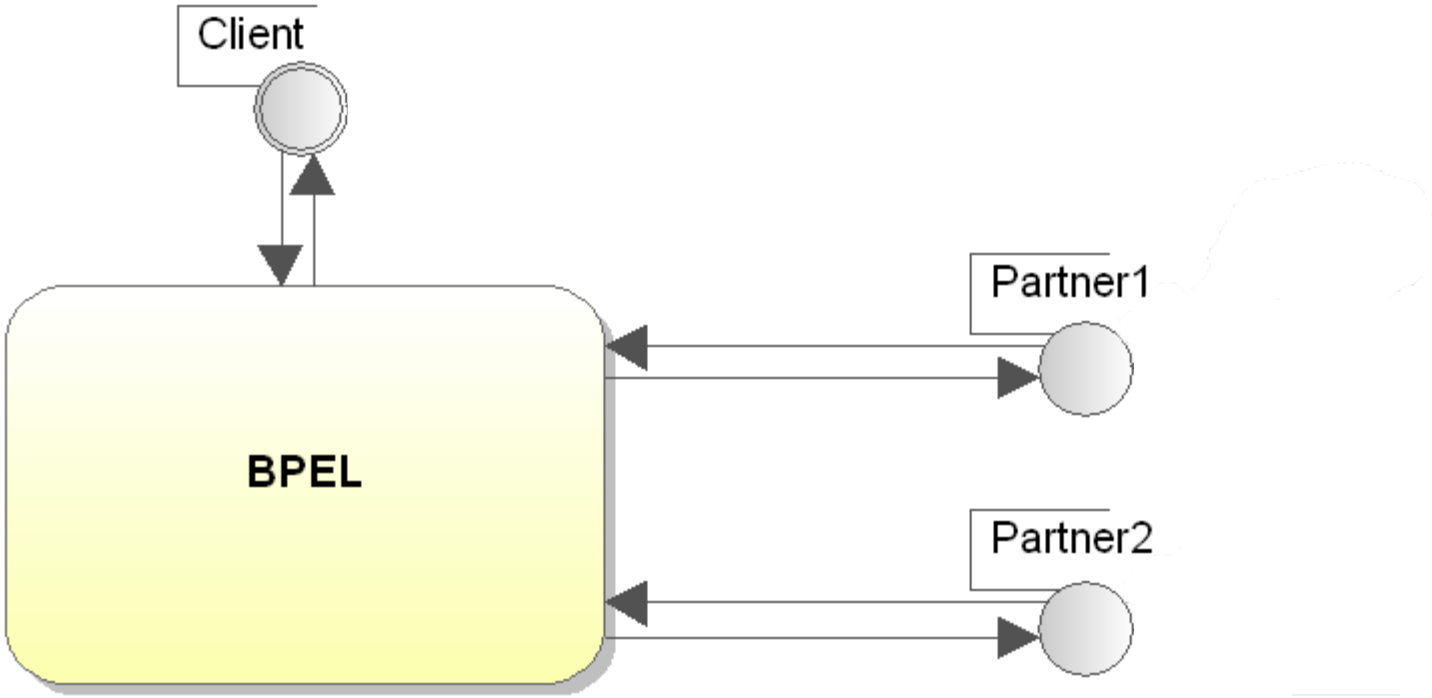
Outline

- Introduction
- Testability
- ABPEL to STS?
- Testability Issues
- Testability Propositions & Enhancement
- Conclusion & Perspectives

Introduction

- Web Services: independent object instances called by operations
- BPEL: an OASIS standard language used for describing interactions in Service Oriented Architectures (SOA)

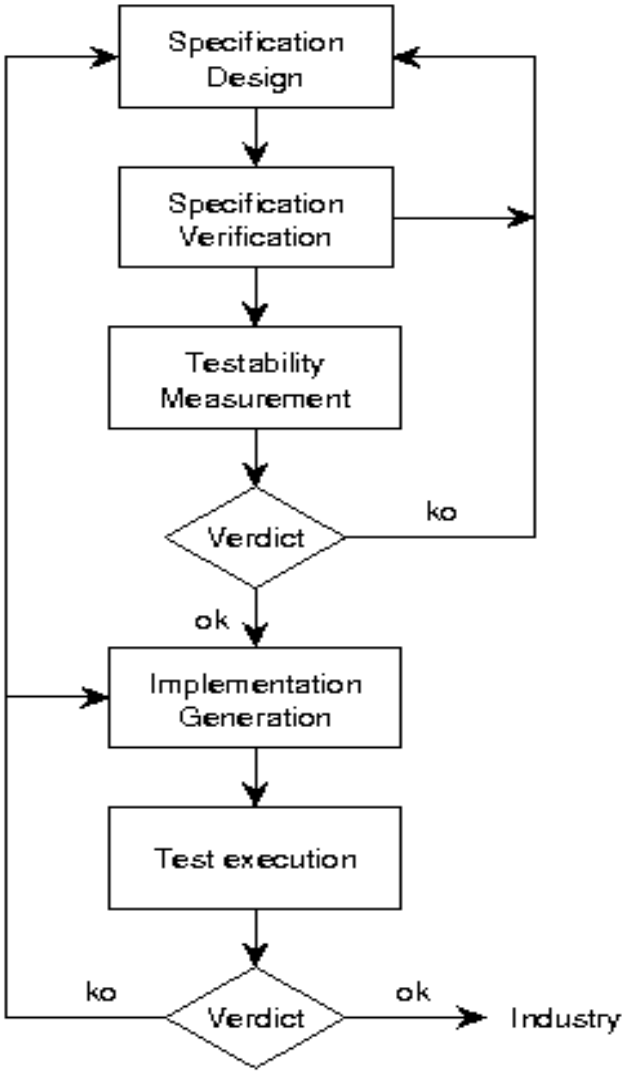
Introduction



Testability

- Testability gathers several criteria which evaluate the system capacity
  - To reveal its faults
  - the accessibility of its components
  - its testing cost
- Testability can be used to model and to implement testable systems

Testability

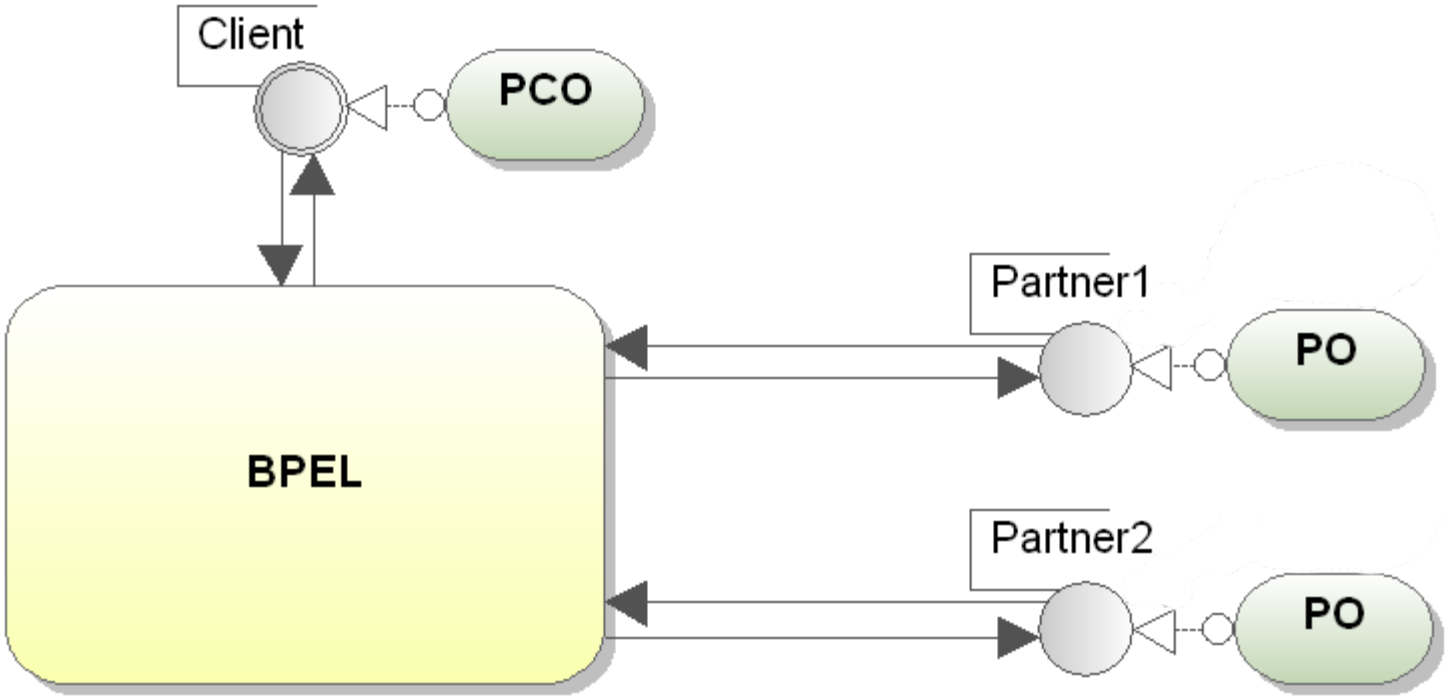


Testability in software life cycle

Testability

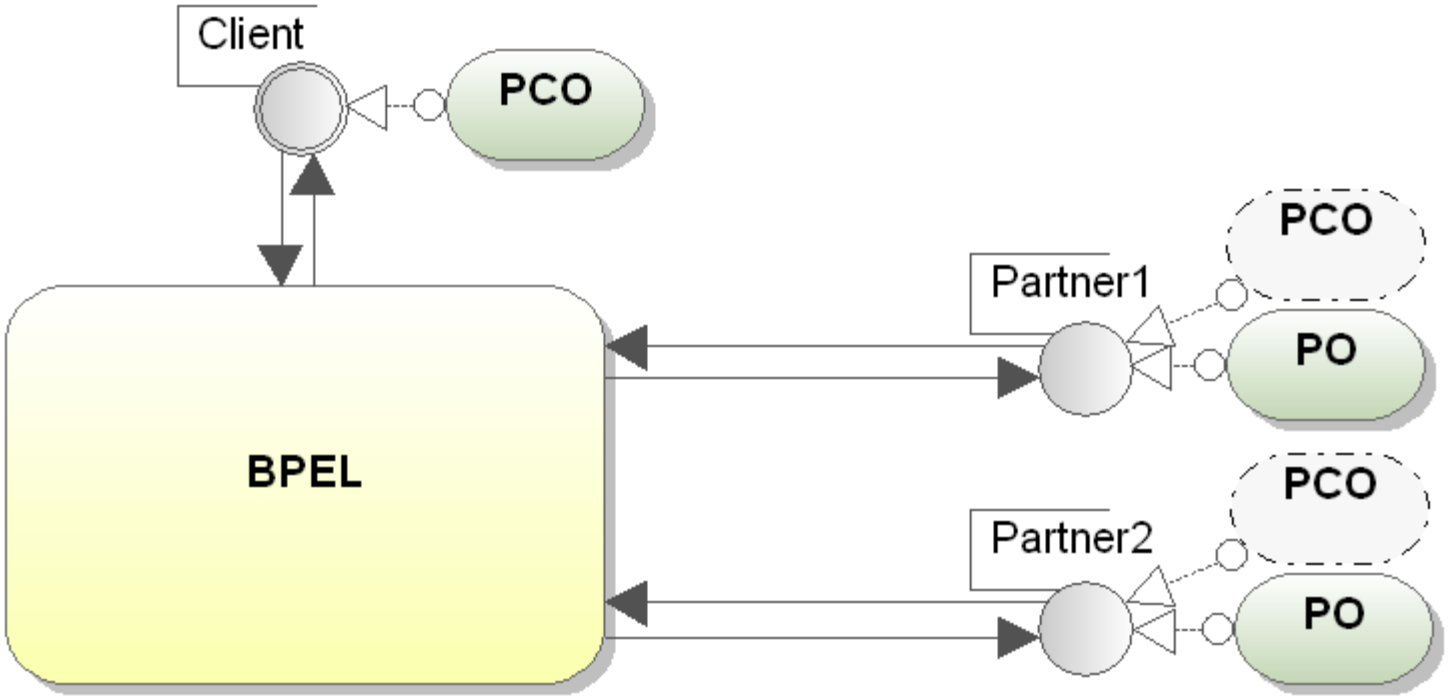
- Observability
  - ”a system is observable if for each input given to the system, a different output is observed”
- Controlability
  - ”a system is controllable if for each observed output, it exists an input which forces the observation of this output”.

Testability



Architecture 1

Testability

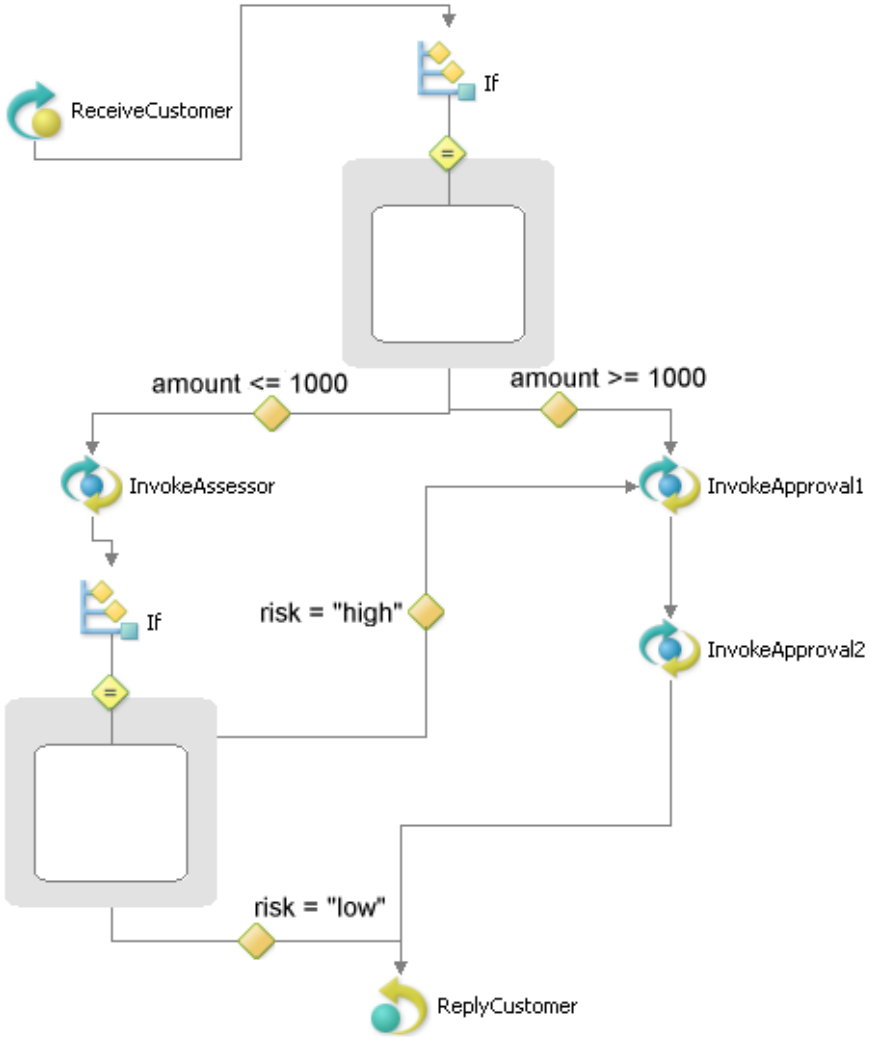


Architecture 2

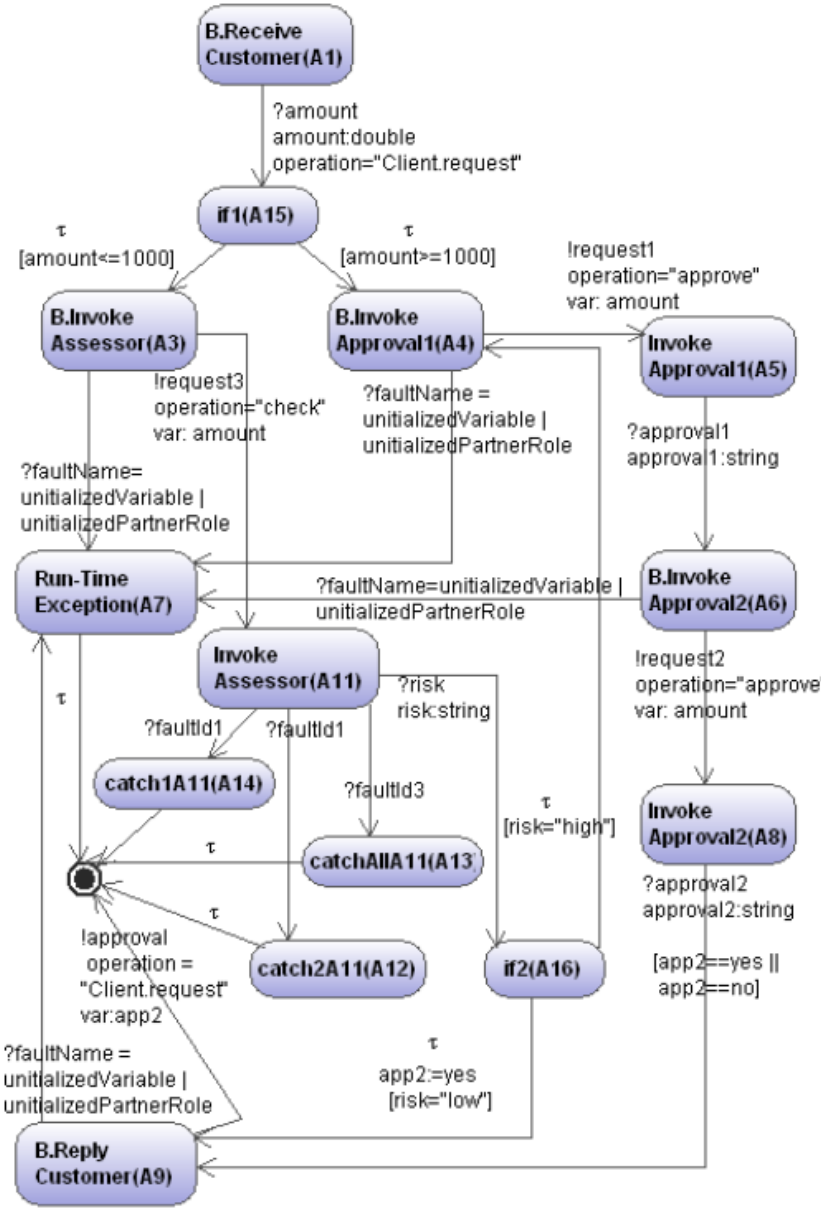
ABPEL to STS ?

- To flatten the nested BPEL activities
- To spread fault handlers into sub-activities
- To retrieve irrelevant properties
- STS offers a large formal background
  - definitions of implementation relations
  - test case generation algorithms

ABPEL Example



STS Example


B.Receive Customer(A1)
?amount
amount:double
operation="Client.request"
if1(A15)
τ
[amount<=1000]
τ
[amount>=1000]
!request1
operation="approve"
var: amount
B.Invoke Assessor(A3)
B.Invoke Approval1(A4)
Invoke Approval1(A5)
!request3
operation="check"
var: amount
?faultName =
unitializedVariable |
unitializedPartnerRole
?approval1
approval1:string
?faultName=
unitializedVariable |
unitializedPartnerRole
Run-Time Exception(A7)
?faultName=unitializedVariable |
unitializedPartnerRole
B.Invoke Approval2(A6)
Invoke Assessor(A11)
?risk
risk:string
!request2
operation="approve
var: amount
τ
?faultId1
?faultId1
catch1A11(A14)
?faultId3
τ
[risk="high"]
Invoke Approval2(A8)
τ
catchAllA11(A13
?approval2
approval2:string
τ
!approval
operation =
"Client.request"
var:app2
catch2A11(A12)
if2(A16)
[app2==yes ||
app2==no]
?faultName =
unitializedVariable |
unitializedPartnerRole
τ
app2:=yes
[risk="low"]
B.Reply Customer(A9)

Testability issues

- Observability issues:
  - (?amount, amount =1000) and (?risk, risk = high; amount = 1000) give the same reaction (!request1, amount = 1000)
  - (?risk, risk = low) and (?approval2, app2 = yes) are followed by the same reaction (!approval,app2 = yes)

Testability issues

- Controlability issues:
  - A3 (invoke assessor), A4 (B.Invoke approval1), A6 (B. Invoke Approval2), A9(B. Reply Customer) on account of partner roles not initialized
  - A15: two conditions [amount >= 1000] and [amount <= 1000] are not exclusive.

Propositions

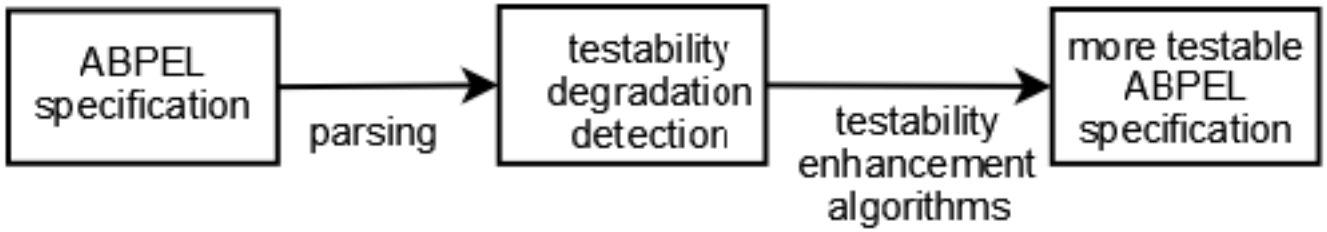
- Observability propositions:
  - An ABPEL specification not terminated by a ”reply” (one-way ”invoke”) activity is not observable
  - An ABPEL specification composed of a couple of non identical ”catch” (”catchall”) activities , followed by two ”invoke” activities using the same operation and parameter values, is not observable

Propositions

- Controlability propositions:
  - ”invoke” activities, depending on partners whose the role is not initialized, involve to uncontrollable ABPEL processes
  - An ABPEL process, composed of a ”faulthandler” activity gathering two identical ”catch” activities, is not controllable.

Testability Enhancement

- Testability Enhancement Tool :



Testability Enhancement

- Observability Enhancement:
  - ”reply” activity addiction:

Algorithm 1: ”reply” activity addiction

input : ABPEL specification *bpel*

1 Compute $sts =< L, l_0, Var, var_0, I, S, \rightarrow >$ from *bpel*;

2 **if** $\exists l_i \xrightarrow{e,\varphi,\varrho} l_f$ *with* $e \in S_I \cup \{\tau\}$ *and* l_f *a final location* **then**

3 Add a reply activity $reply(param, partner, op)$ in *bpel* with partner=client, op= client operation used for calling the ABPEL process, param=”last message from $branch_i$”;

Testability Enhancement

- Controlability Enhancement :
  - partner role addiction:

Algorithm 3: PartnerRole addiction

input : ABPEL specification *bpel*

1 **foreach** *"invoke" activity* $invoke(mess, resp, partner, op)$ **do**

2 **if** *partner has not a role in the BPEL "partnerLink" section* **then**

3 add <partnerLink name= *partner_name* partnerRole="*partner_name*Provider" partnerLinkType="ns:*partner_name*"/>

4 , with "ns" a new variable equals to the web service WSDL URL (xmlns:ns="http://...");

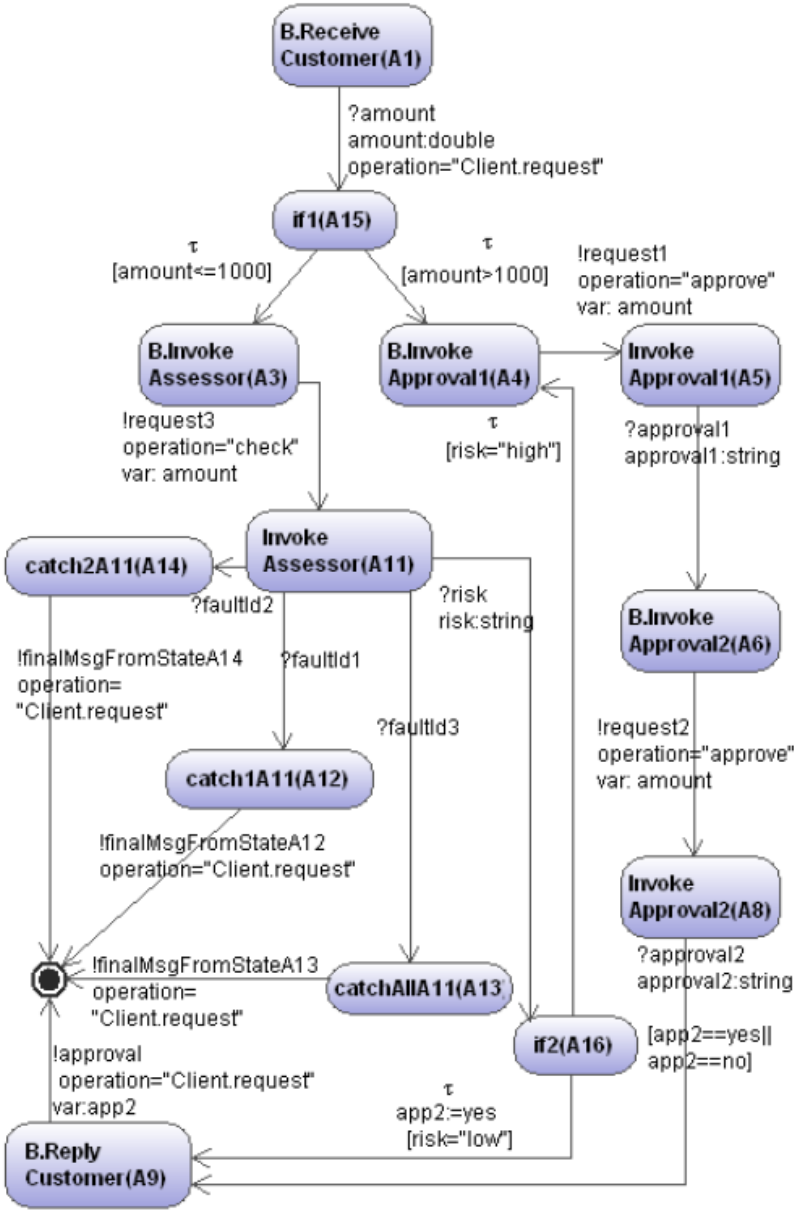
Testability Enhancement

- Controlability Enhancement :
  - fault distinction in fault handlers:

Algorithm 4: Fault distinction

1 **foreach** *"faulthandler" activity composed of the catch activities* $catch_1(fault_1, act_1)$,..., $catch_n(fault_n, act_n)$ **do**
2 // $?fault_k = (faultName_k, faultElement_k, fault\ Message\ Type_k)$;
3 **if** *it exists* $catch_i(fault_i, act_i)$, $catch_j(fault_j, act_j)$ *with* $fault_i == fault_j$ **then**
4 **if** $MessageType_i == null$ **then**
5 $MessageType_i = type$ in (string, integer,etc.) such as ;
6 $\forall(1 \leq k \neq i \leq n), faultMessageType_k \neq type$;
7 **else**
8 Add a random integer value at the end of $faultName_i$;

The modified STS



Conclusion & Perspectives

- We suggest some propositions to:
  - directly write more testable ABPEL specifications
  - evaluate observability and controllability criteria.
- We also propose some testability enhancement methods, which have been implemented in an academic tool.

Conclusion & Perspectives

- The execution time
- The completeness
- The accessibility of BPEL parts