Many-to-Many: Interaction in Artifact Choreographies

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Where innovation starts
A process that needs multiple instances
A process that needs multiple instances

complex relations between service instances
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complex relations between service instances
The reason of complex relations

- Data
  - each process is founded in its data objects
    - an order
    - a delivery tour
  - the data-objects can be in complex relations
Artifacts

- encapsulate each class of data objects in a service
- service behavior = data object life-cycle
- service interface = retrieve data, update data, …
Choreography inherits relations

- **wiring**: relations between service instances (= objects)
- **cardinality constraints** express how many instances interact with each other
Formal notation: Proclets

order
- create
- split
- notify
- bill

delivery
- load
- deliver
- undeliv.
- retry
- finish
- next
- *
Example execution
Many instances talking to each other
Artifacts

- a service instance encapsulates a data object
- relations between data objects
- complex communications between service instances

Two research problems
1. addressing instances: correlation
2. completing artifact choreographies
Conversation

- a set of corresponding communication events
- between a fixed set of instances
  - C1: order1, delivery1
  - C2: order2, delivery1, delivery2
  - C3: order1, delivery2
- conversations can overlap
Correlation

- conversation = a set of related interaction events

- **correlation**: mechanism to define whether an event is part of a specific conversation

- key-based correlation: data-fields of the event

- same value \(\rightarrow\) same conversation (e.g. orderID, deliveryID)

- available in BPEL and BPMN 2.0
Correlation Handling in WS-BPEL

incoming message: service instance now participates in the conversation \textbf{C} defined by \texttt{PurchaseOrder}

outgoing message part of conversation \textbf{C} and initiates a new conversation \textbf{C2}

[\textit{wsbpe1-v2.0-OS, page 81}]

```xml
<receive partnerLink="Buyer" portType="SP:PurchasingPT" operation="PurchaseRequest" variable="PO">
  <correlations>
    <correlation set="PurchaseOrder" initiate="yes" />
  </correlations>
</receive>

...  

<invoke partnerLink="Buyer" portType="SP:BuyerPT", operation="PurchaseResponse" inputVariable="POResponse">
  <correlations>
    <correlation set="PurchaseOrder" initiate="no" />
    <correlation set="Invoice" initiate="yes" />
  </correlations>
</invoke>
```
Artifacts Require Stronger Correlation

- **BPEL**
  - expresses correlation on a per-message basis
  - two correlation patterns required
- **multiple consumption:**
  - one send event
  - several receive events in different instances
- **dynamic list of correlation values**
Artifacts Require Stronger Correlation

- **atomic consumption**: several send events in different instances → one receive event
- **dynamic list of send events**
- **correlation values** not known to receiver
- → OR-join problem
Artifacts

- a service instance encapsulates a data object
- relations between data objects:
- complex communications between service instances

Two research problems

1. addressing instances: correlation
2. completing artifact choreographies
Intuitively not allowed

incomplete conversation
Specify conversations

- describe interaction between service instances
- from start to completion
- proposal: specify as an artifact again
Refine choreography

- Replace channels with conversation artifact

- composition: synchronous, dynamic
New problem: choreography completion

- **Given:**
  - artifact choreography with asynchronous channels
  - correlation specification
  - and desired properties, e.g.
    - goal states per artifact + “no messages in channels”

- **Wanted:**
  - conversation artifacts s.t.
  - the composition satisfies the desired properties and
  - artifacts fit correlation specification
    (e.g. each conversation artifact implements associated correlation properties)
Take home points

- Processes in reality are driven by data objects
- Artifacts: each service instance encapsulates a data objects
- Choreography: wiring reflects object relations

- Two new problems
  - More involved correlation: which events belong to one conversation?
  - Choreography completion: find the conversation protocol s.t. the choreography has desired properties
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