CosmoBiz

Computer Supported Mobile Adaptive Business Processes for 3gERP Systems

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IT University of Copenhagen
*Department of Organization, CBS

The IT University of Copenhagen

Road Map

◆ Motivation and requirements for mobile ERP

◆ The CosmoBiz research project

◆ Microsoft Dynamics Mobile Framework & Development Tools

◆ Extensible and Higher-order Business Process Languages

◆ Conclusions and Future work

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Motivation and requirements

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◆ Give mobile workers access to ERP systems

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◆ Salesmen, Homecare, Healthcare, construction work

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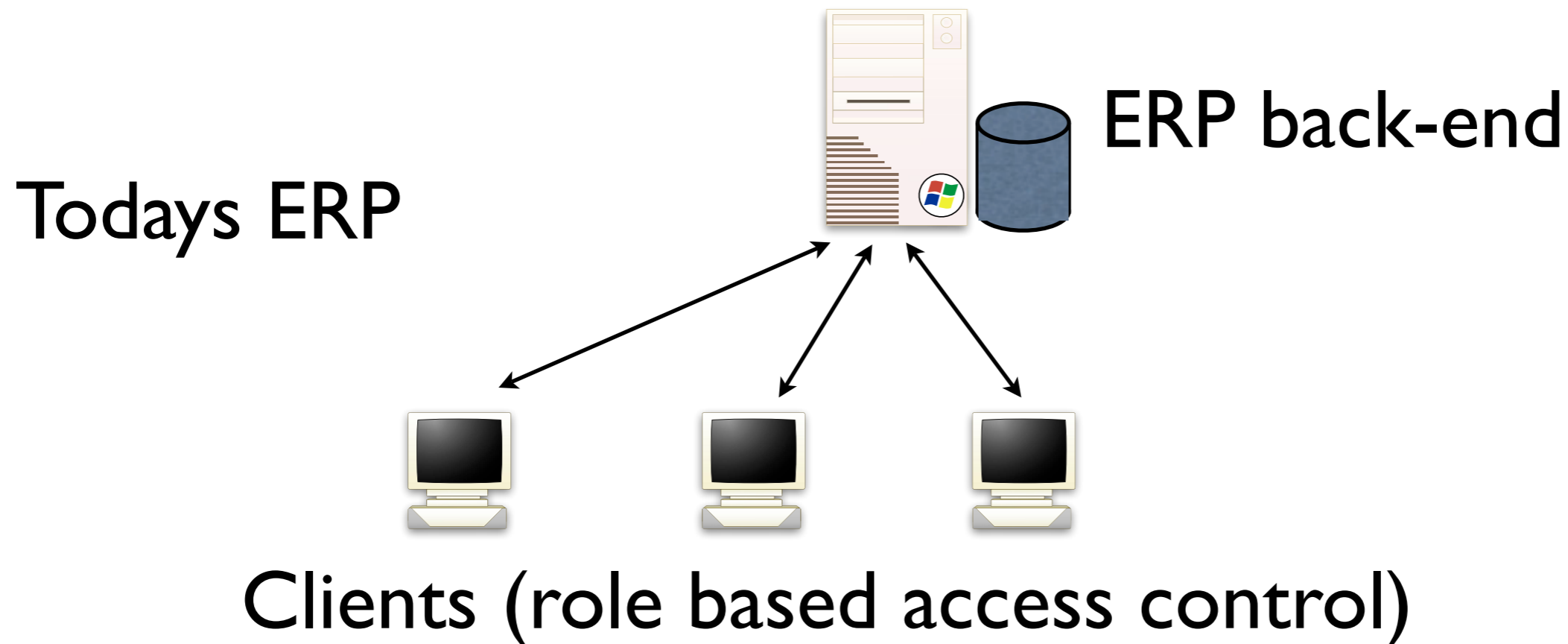◆ Must allow for disconnected operation

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Motivation and requirements

◆ Give mobile workers access to ERP systems

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◆ Can not move entire ERP system to the PDA

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Motivation and requirements

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◆ Can not move entire ERP system to the PDA

◆ Focused & specific tasks => role-based & task-driven

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Motivation and requirements

◆ Give mobile workers access to ERP systems

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◆ Must allow for disconnected operation

◆ Can not move entire ERP system to the PDA

◆ Focused & specific tasks => role-based & task-driven

◆ Must be flexible and (re)configurable

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Supporting specific and focussed tasks:
From Data to Process-oriented

Todays ERP

ERP back-end

Clients (role based access control)

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Supporting specific and focussed tasks:
From Data to Process-oriented

ERP back-end

Tomorrows ERP

Clients: role based access and task-driven (process-oriented)

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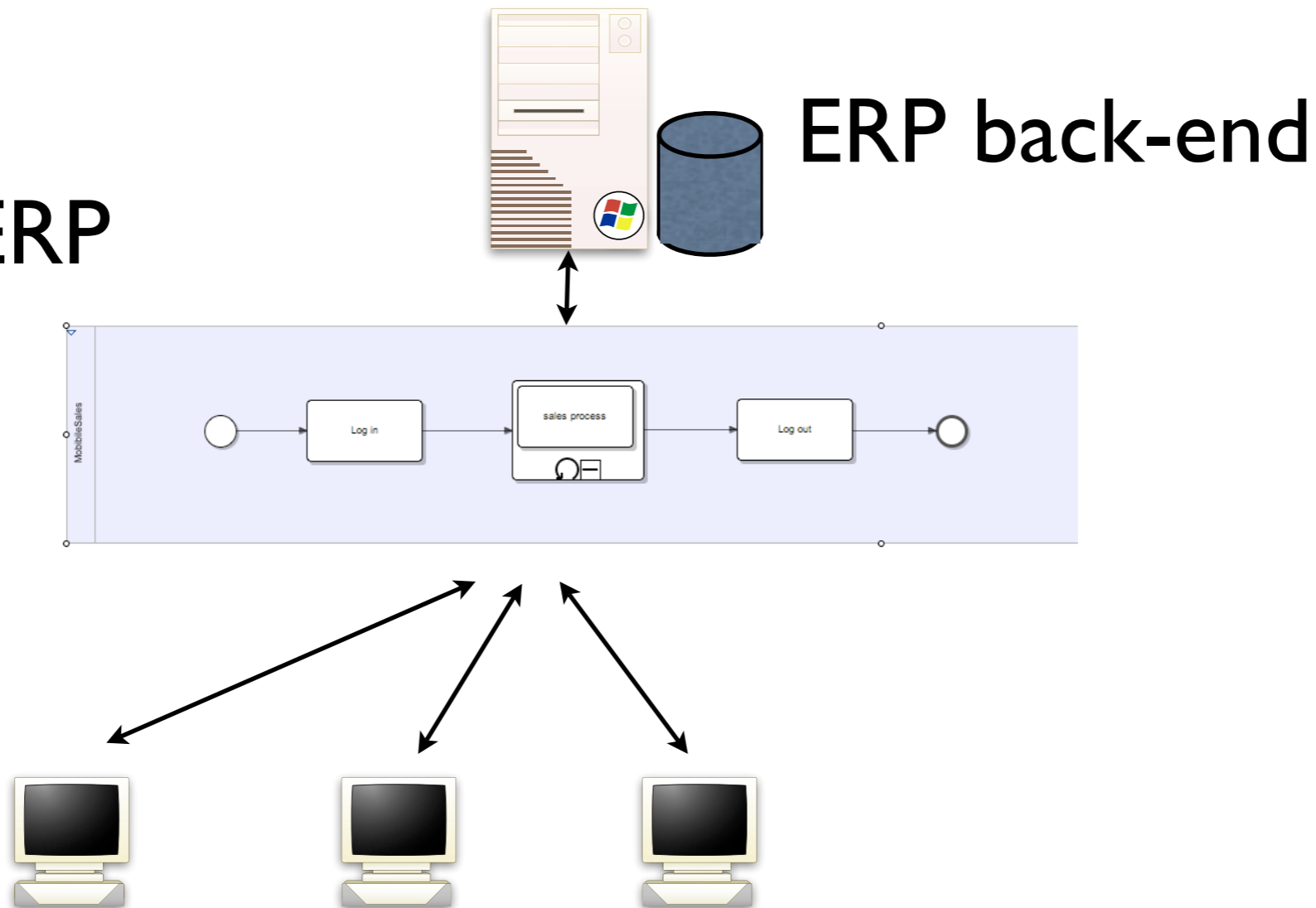
Supporting specific and focussed tasks:
From Data to Process-oriented

Mobile ERP

ERP back-end

Clients: role based access and task-driven (process-oriented)

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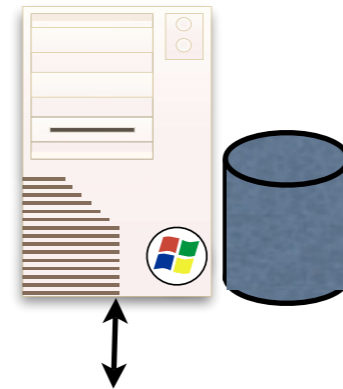
Disconnected operation **?**

Clients: role based access and task-driven (process-oriented)

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Microsoft Dynamics Mobile Development Tools (June 2007)

Disconnected task-driven operation

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Microsoft Dynamics Mobile Development Tools (June 2007)

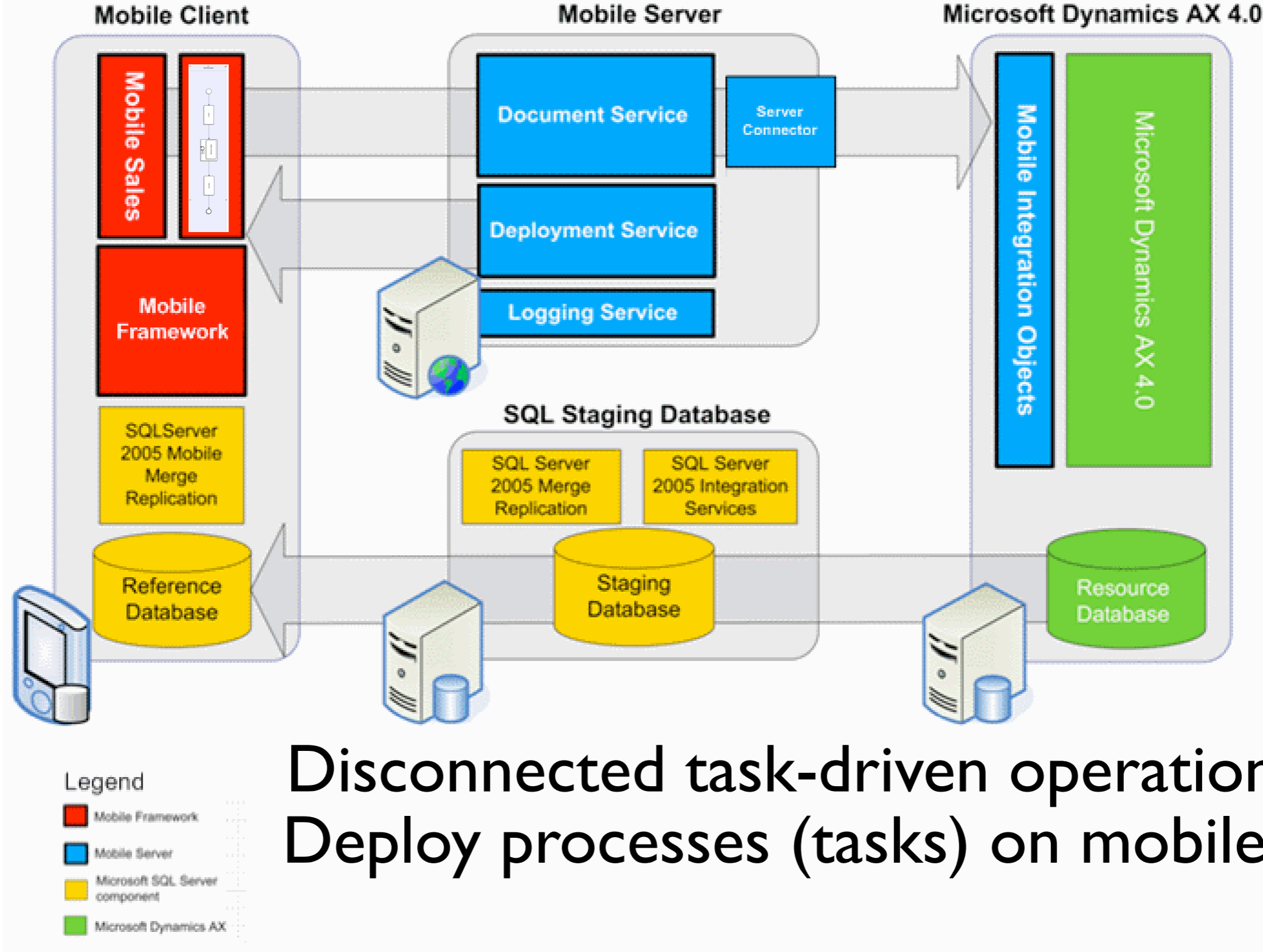Disconnected task-driven operation

http://msdn.microsoft.com/en-us/library/cc160851.aspx

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Disconnected task-driven operation
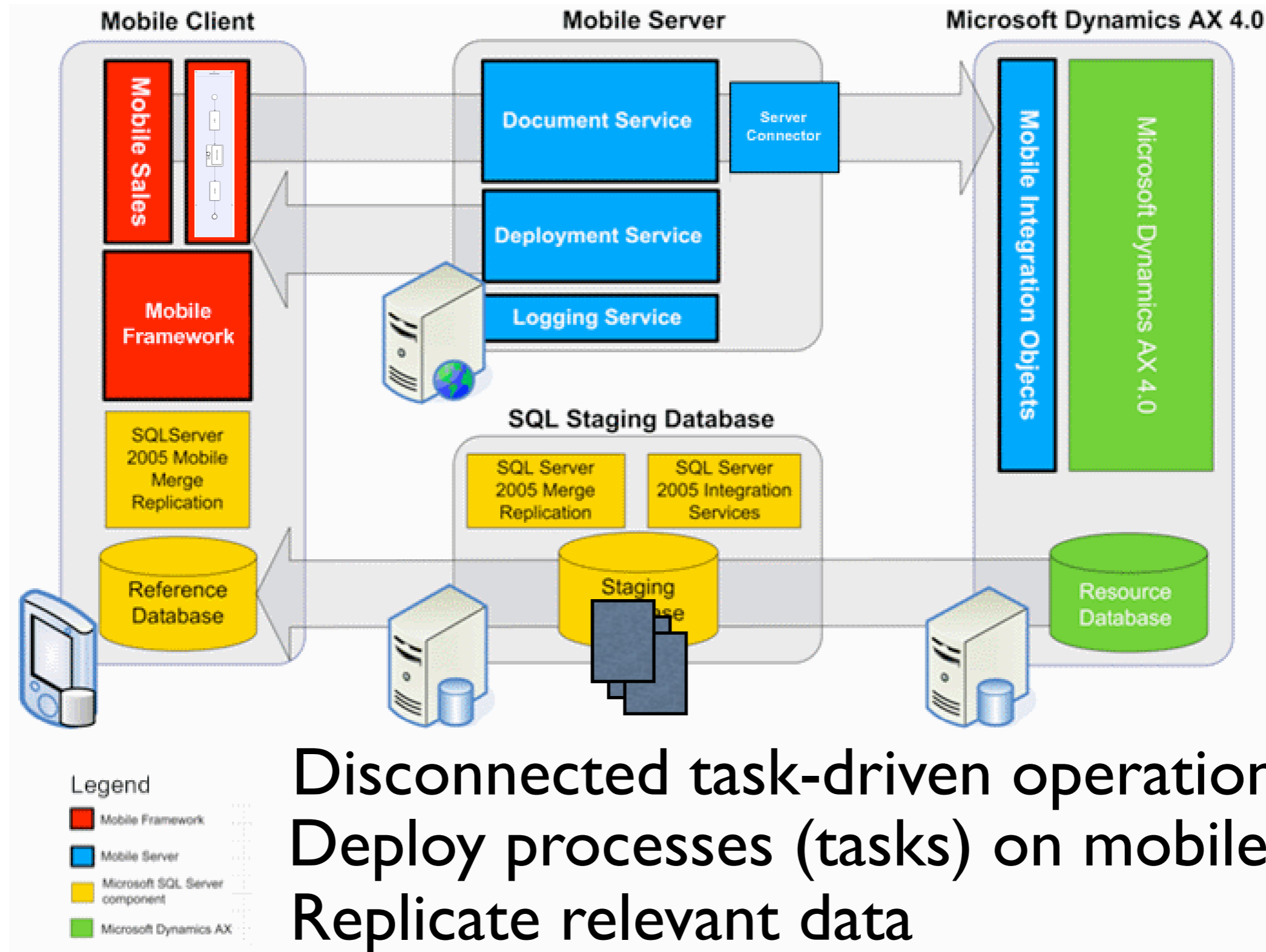Deploy processes (tasks) on mobile client

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Disconnected task-driven operation
Deploy processes (tasks) on mobile client
Replicate relevant data

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Disconnected task-driven operation
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http://msdn.microsoft.com/en-us/library/cc160851.aspx

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Tasklet Orchestration


```xml
<userRole xmlns="http://schemas.microsoft.com/Dynamics/Mobile/2007/04/Flow">
  <orchestrations>
    <orchestration text="Customer detail">
      <tasklets>
        <tasklet name="CustomerDetailTasklet">
          <actions>
            <open text="Contact" tasklet="CustomerContactDetailTasklet">
            </open>
            <open text="Credit Limit" tasklet="CustomerCreditLimitDetailTasklet">
            </open>
          </actions>
        </tasklet>
        <tasklet name="CustomerContactDetailTasklet">
        </tasklet>
        <tasklet name="CustomerCreditLimitDetailTasklet">
        </tasklet>
      </tasklets>
    </orchestration>
    <orchestration text="New Customer">

      ...
      <!-- Contact Details -->
      <tasklet name="ContactDetails" text="Contact Details"
type="CustomerContactDetailTasklet.CustomerContactDetailTasklet,
CustomerContactDetailTasklet">
        <actions>
          <previous priority="1" text="Previous">
          </previous>
          <exitOrchestration text="Finish"/>
        </actions>
      </tasklet>
      </tasklets>

    </orchestration>
  </orchestrations>
</userRole>
```
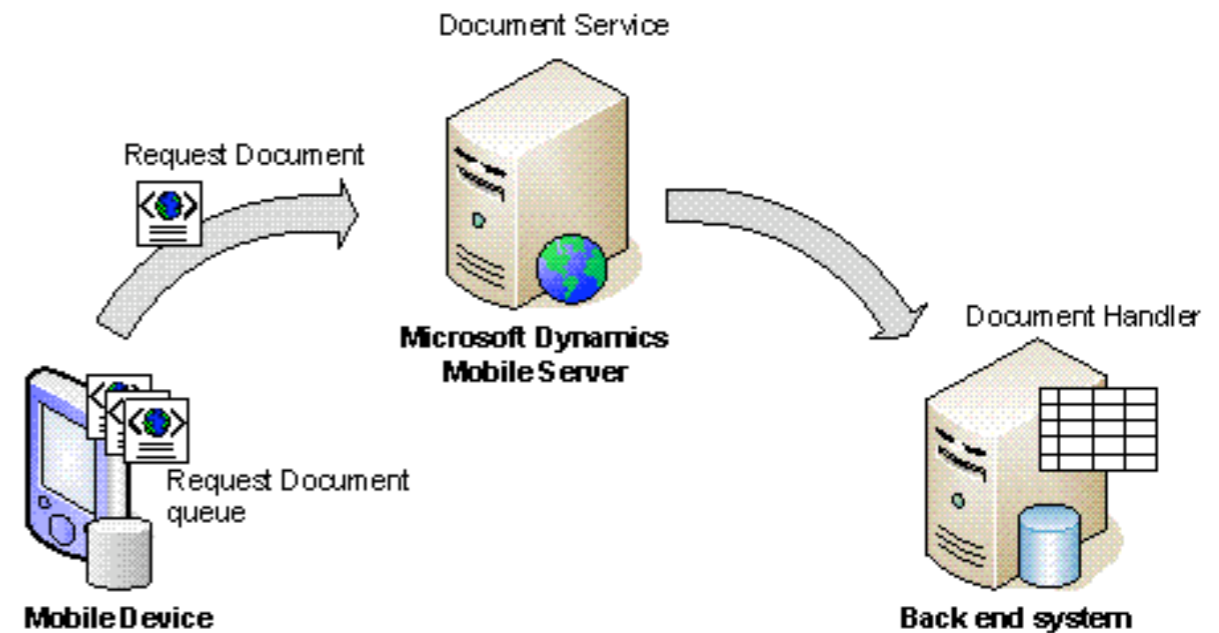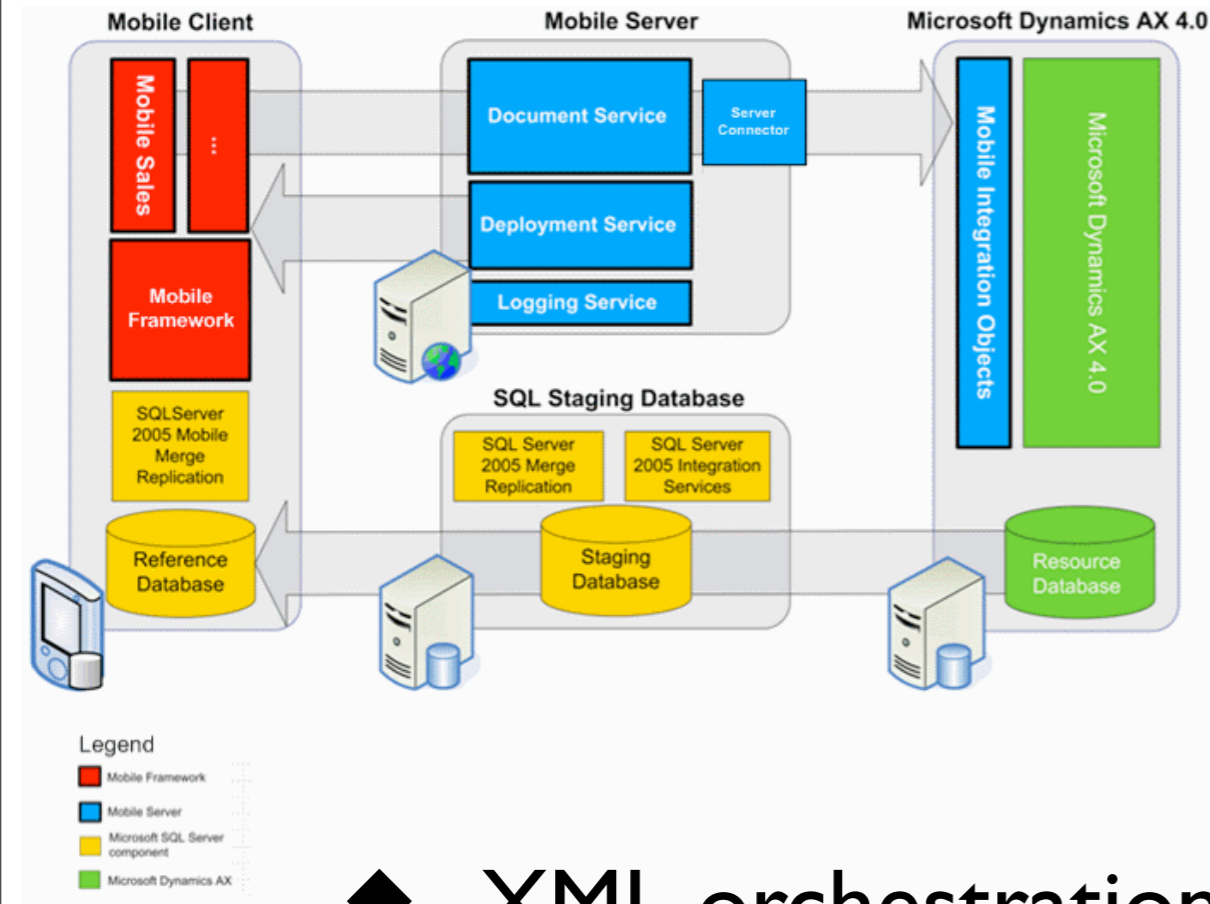
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Asynchronous requests back to ERP system
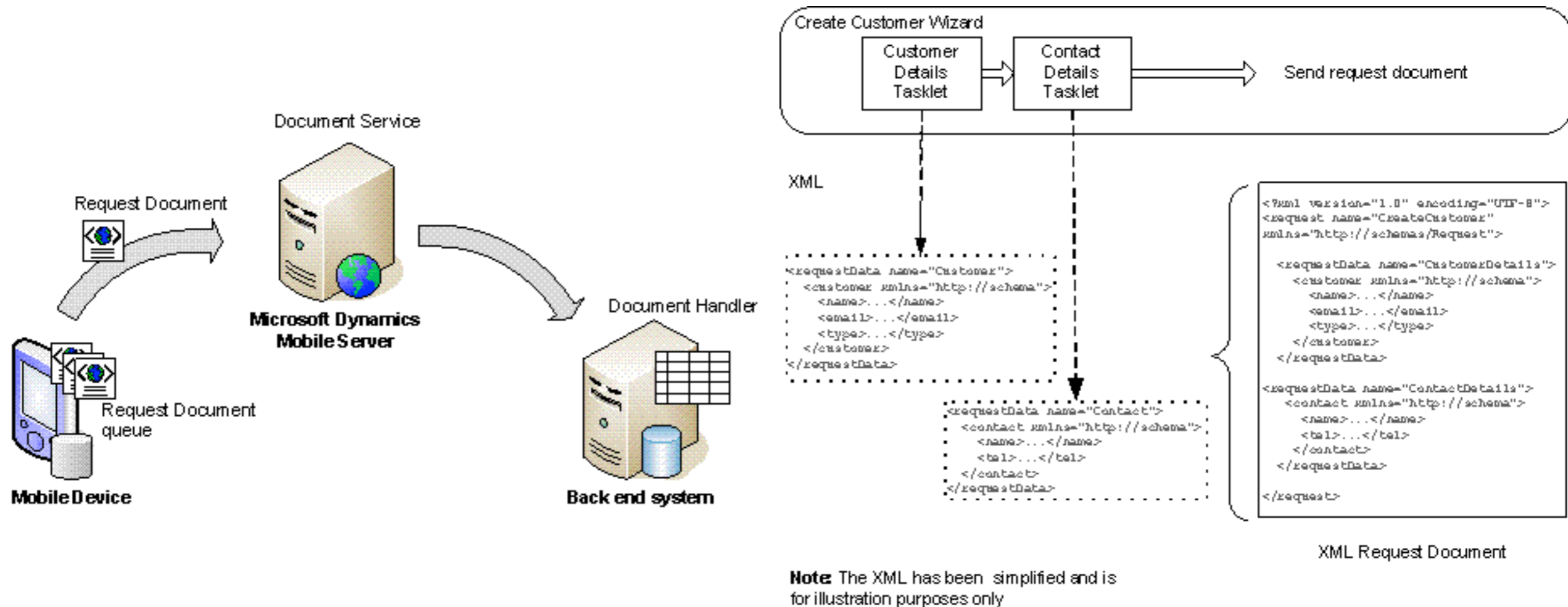
Achievements & Challenges

◆ XML orchestrations of tasklets allow easy customization by 3rd party developers

◆ Processes and data separate...

◆ Still some gluing and C# coding need to be done

Computer Supported Mobile Adaptive Business Processes *CosmoBiz*

Research Project funded by the Danish Research Agency (2007- 2011)

◆ **Aim:** Extensible business process languages and execution architecture for mobile & adaptive ERP

◆ **Partners:** IT University of Copenhagen (ITU) & Mobile Applications Group at Microsoft Development Center Copenhagen (MDCC)

◆ **Approach:**

  ◆ Research in **Computer Supported Cooperative Work** (field studies)

  ◆ Research in Design of **Domain Specific Languages** (formal models)

  ◆ **Software Development** (Mobile applications group, MDCC)

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CosmoBiz research so far and in the near future

◆ e**X**tensible Formalization of Business Process Execution (bigraphs)   [MTCOORD'05,COORDINATION'06]

◆ **H**igher-**o**rder **m**obile **e**mbedded **B**usiness **P**rocess **E**xecution **L**anguage (HomeBPEL)
[COORDINATION'08]

◆ Extensible Process Execution Engine

◆ Field studies & Domain specific process languages

Higher-order Mobile Embedded Processes?

◆ **Higher-order:**

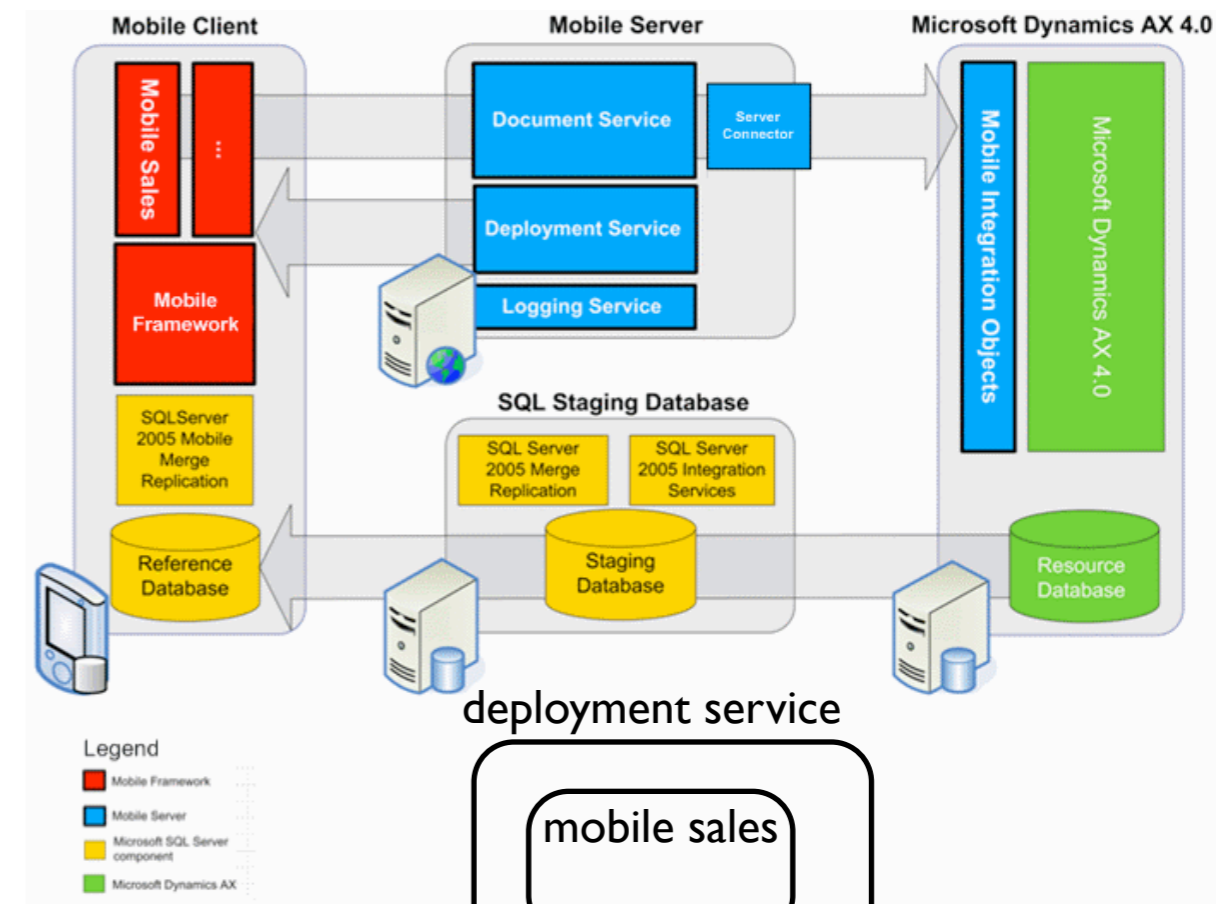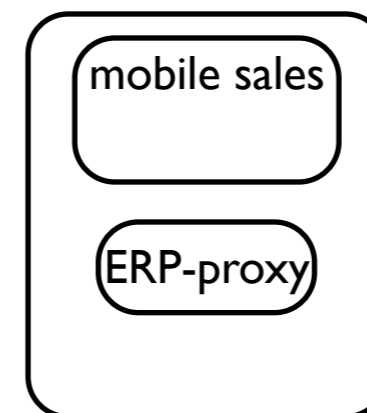Business process management processes as business processes (e.g. deployment, adaption delegation)

◆ **Mobile embedded:**

Support disconnected operation by moving sub processes

deployment service

mobile sales

mobile client

ERP back-end

ERP-proxy

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Higher-order Mobile Embedded Processes?

◆ Higher-order:

Business process management processes as business processes (e.g. deployment, adaption delegation)
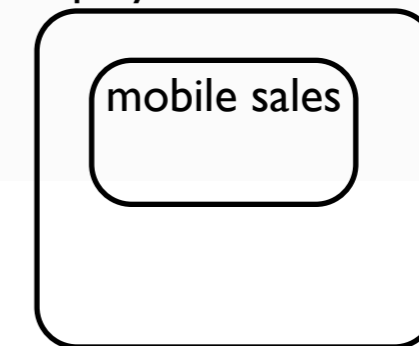
◆ Mobile embedded:

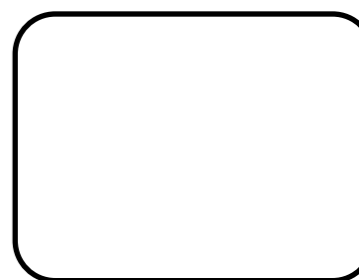Support disconnected operation by moving sub processes

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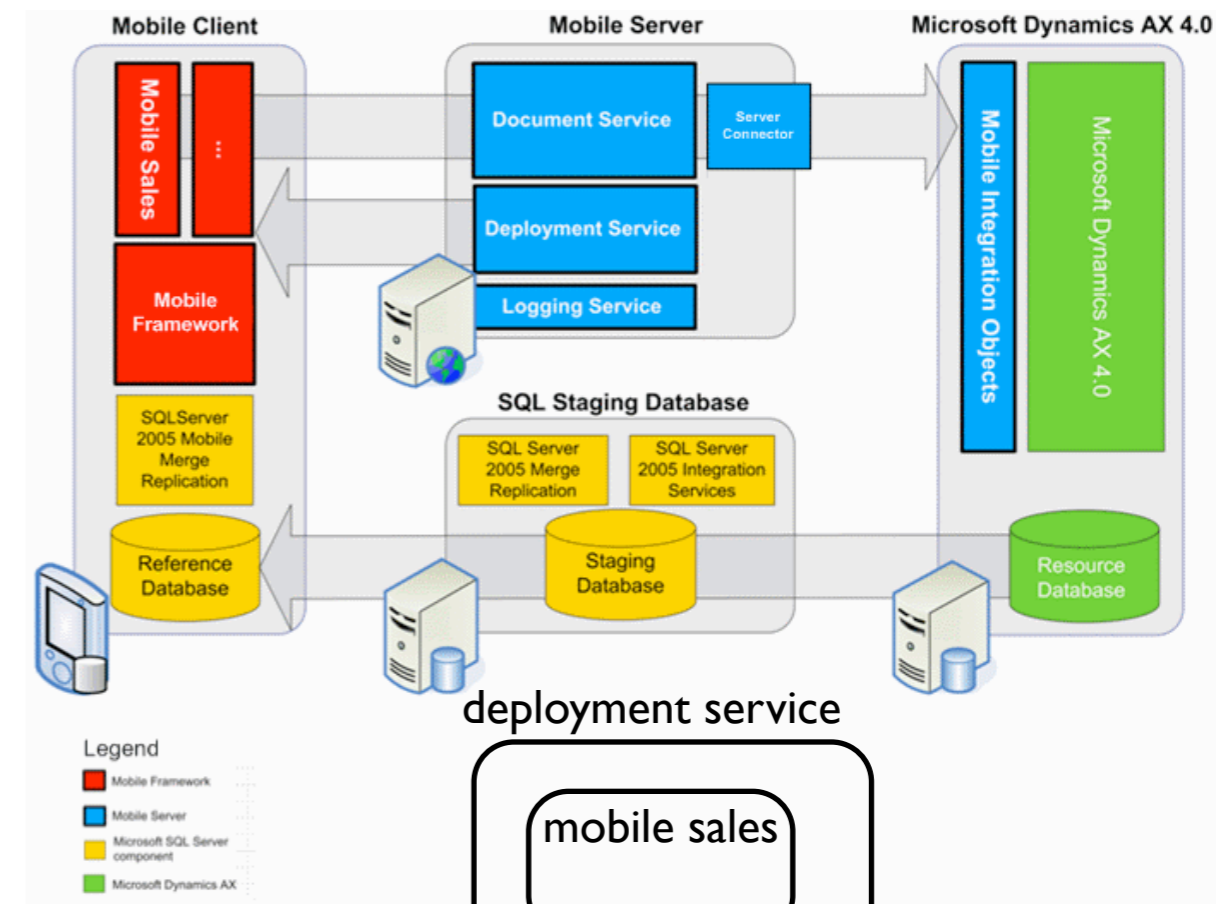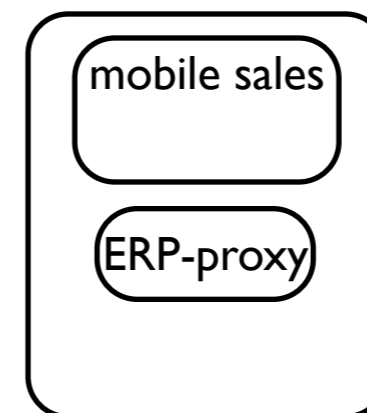
Higher-order Mobile Embedded Processes?

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Business process management processes as business processes (e.g. deployment, adaption delegation)

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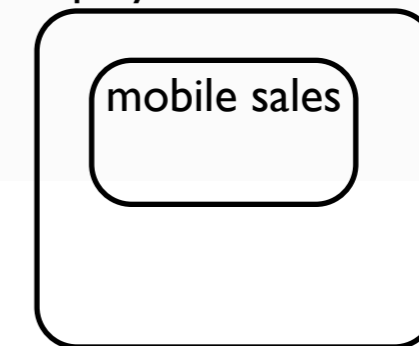Business process management processes as business processes (e.g. deployment, adaption delegation)

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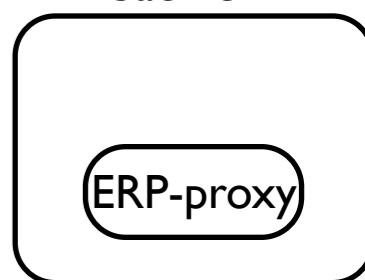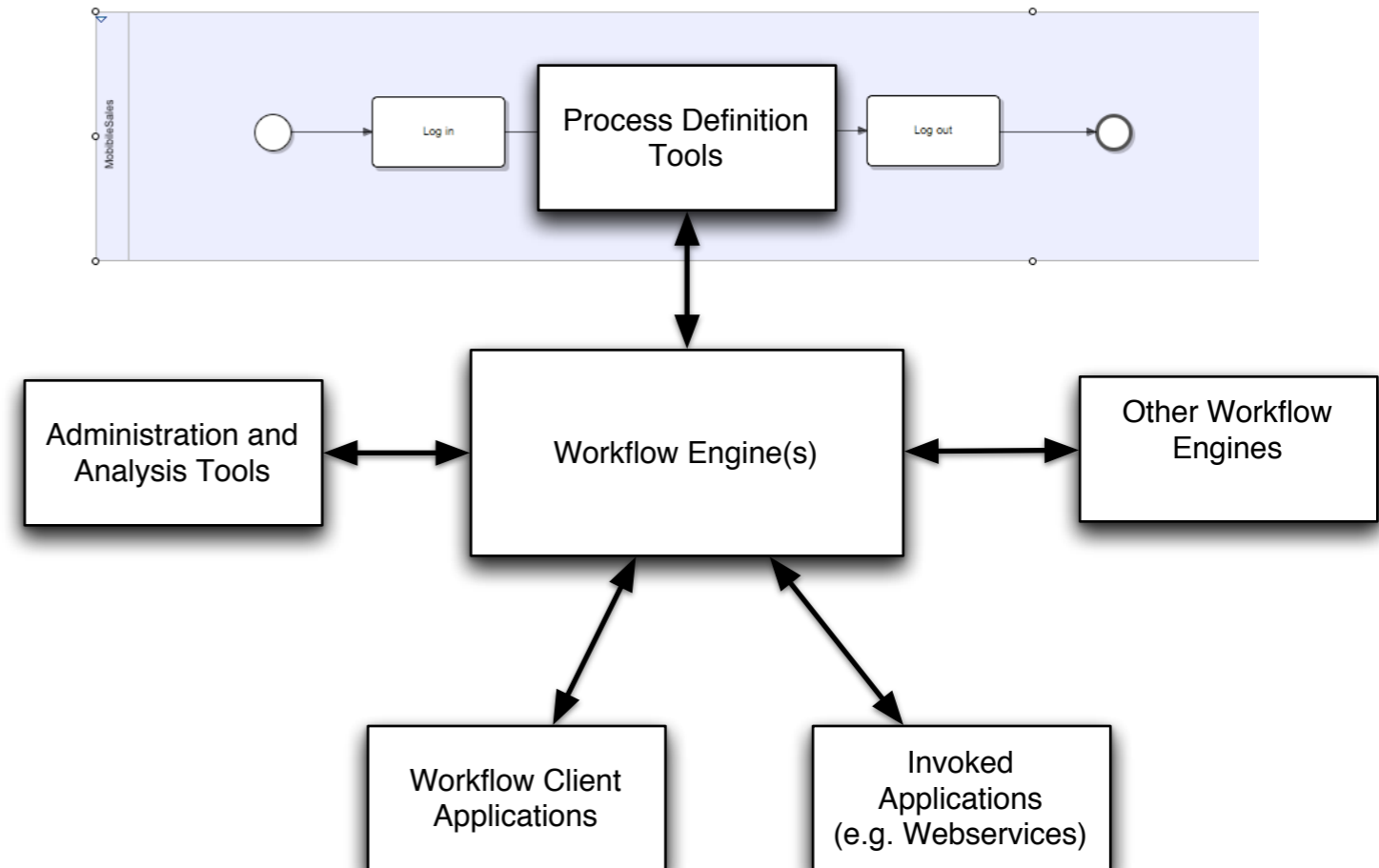Support disconnected operation by moving sub processes

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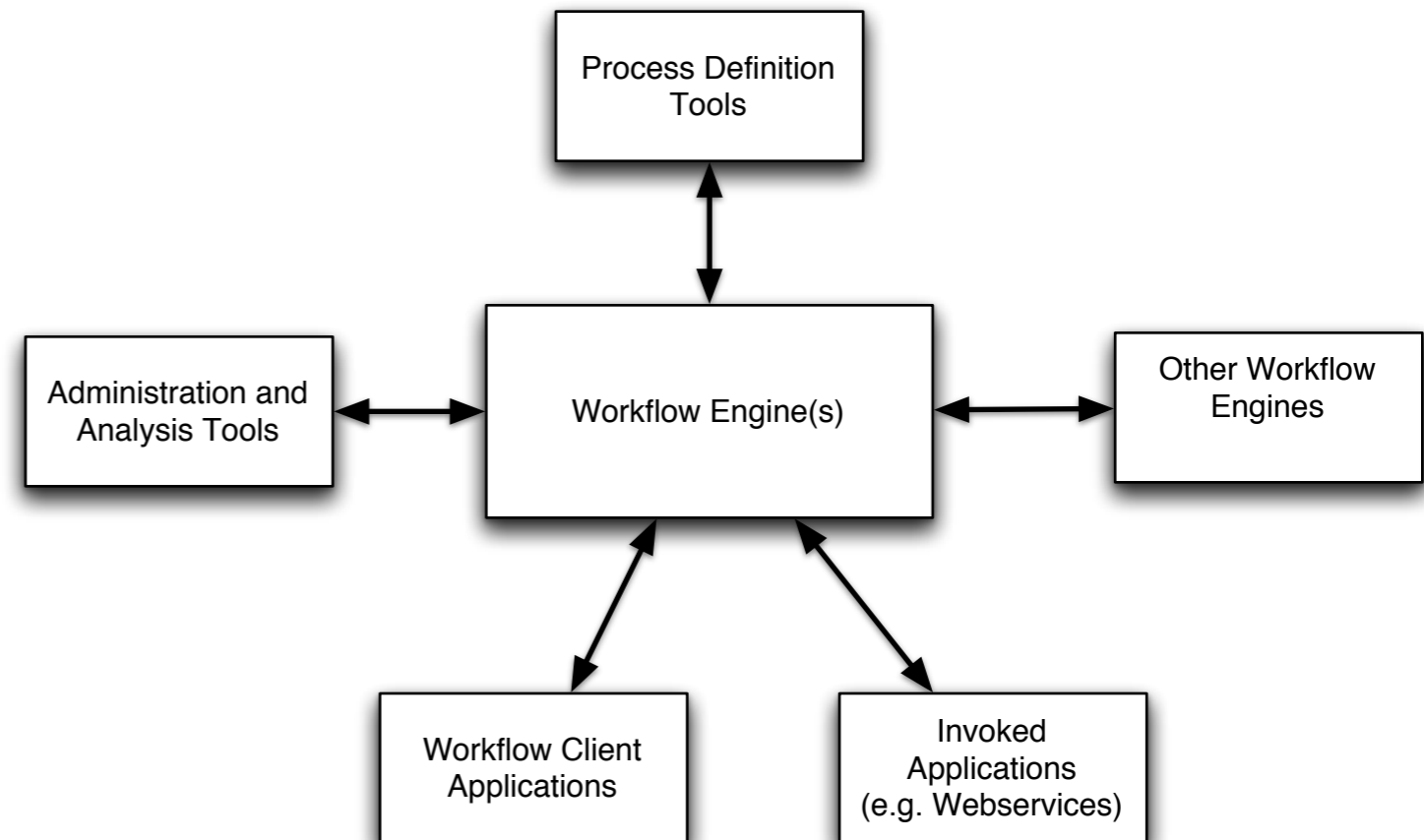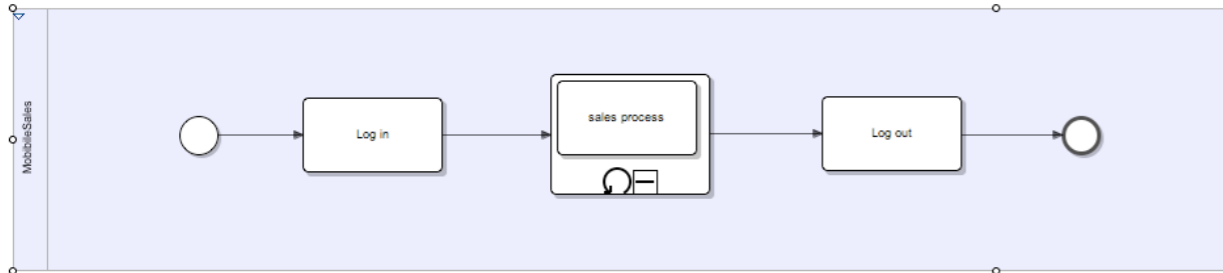
ERP back-end

ERP-proxy

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Extensible Formalization and HomeBPEL - a few details

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Business process execution today
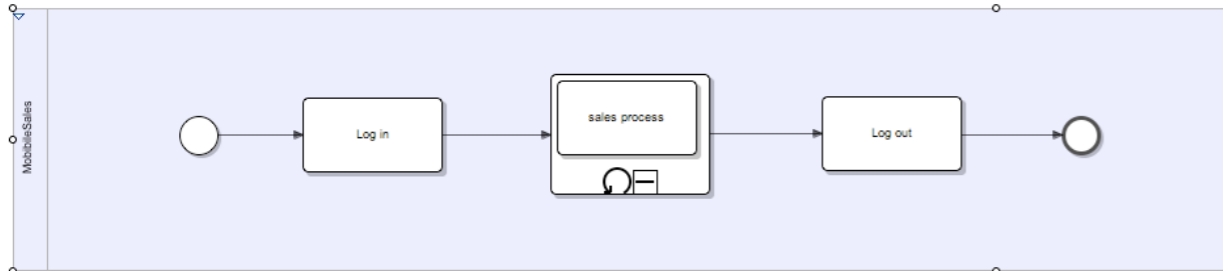
Business process execution today

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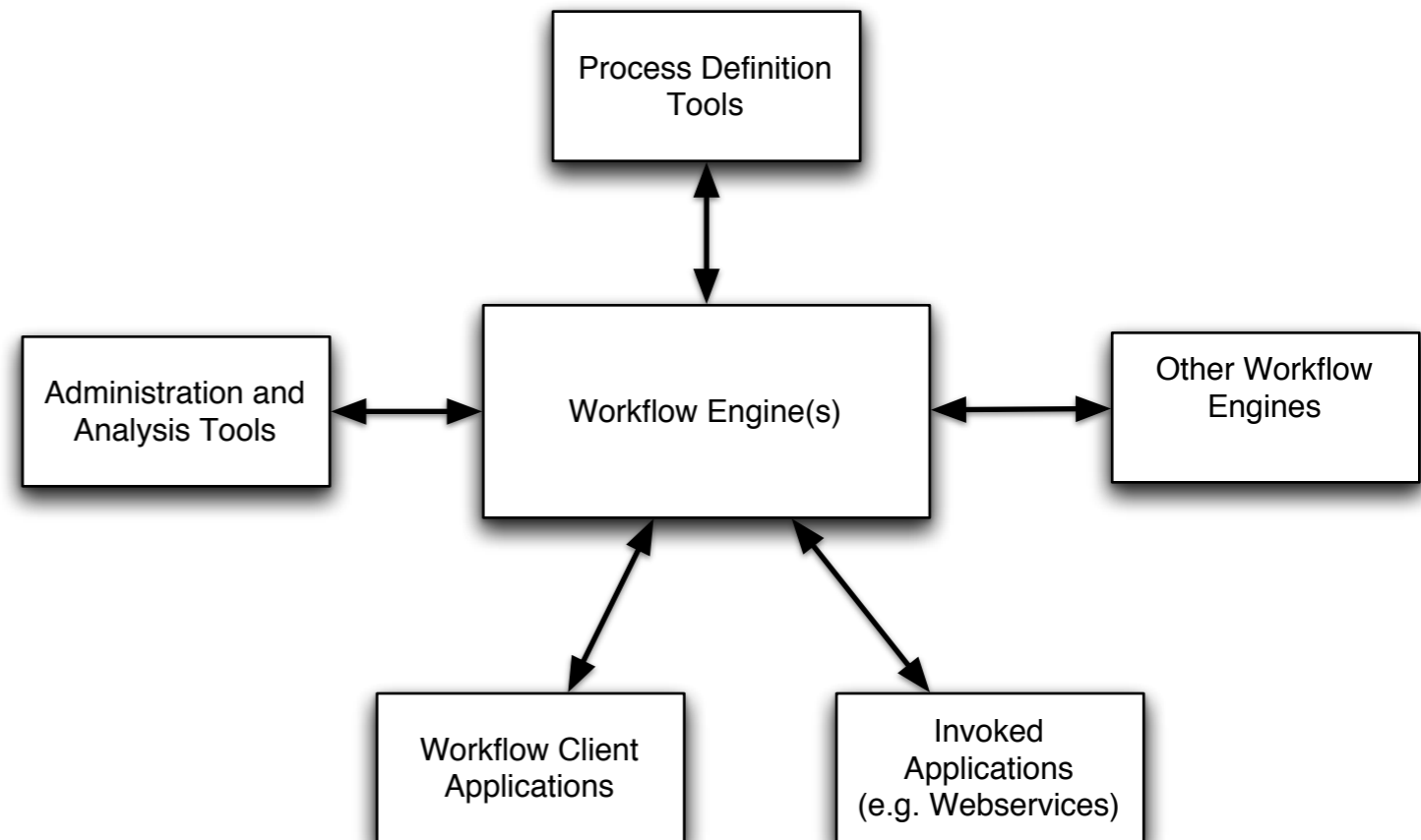


```
<?xml version="1.0" ?>

<process name="salesman"
         xmlns="http://schemas.xmlsoap.org/ws/2004/03/business-process/"
         xmlns:sales="..."
         xmlns:xsd="...">
<documentation>
A very small example of a BPEL process
</documentation>
<partnerLinks>
...
</partnerLinks>

<variables>
 <variable name="price" type="xsd:int"/>
 <variable name="customerid" type="xsd:string"/>
 <variable name="salesmanid" type="xsd:string"/>
 <variable name="record" type="sales:record"/>
</variables>

<sequence>
<receive partnerLink="..."" portType="..."
         operation="login" variable="salesmanid"/>
<receive partnerLink="..."" portType="..."
         operation="customer" variable="customerid"/>
<invoke partnerLink="..." portType="..."
         operation="checkrecord" inputVariable="customerid"
                                 ouputVariable="record"/>
<!-- calculate price -->

<reply partnerLink="..." portType="..."
       operation="customer" variable="price"/>
</sequence>
</process>
```
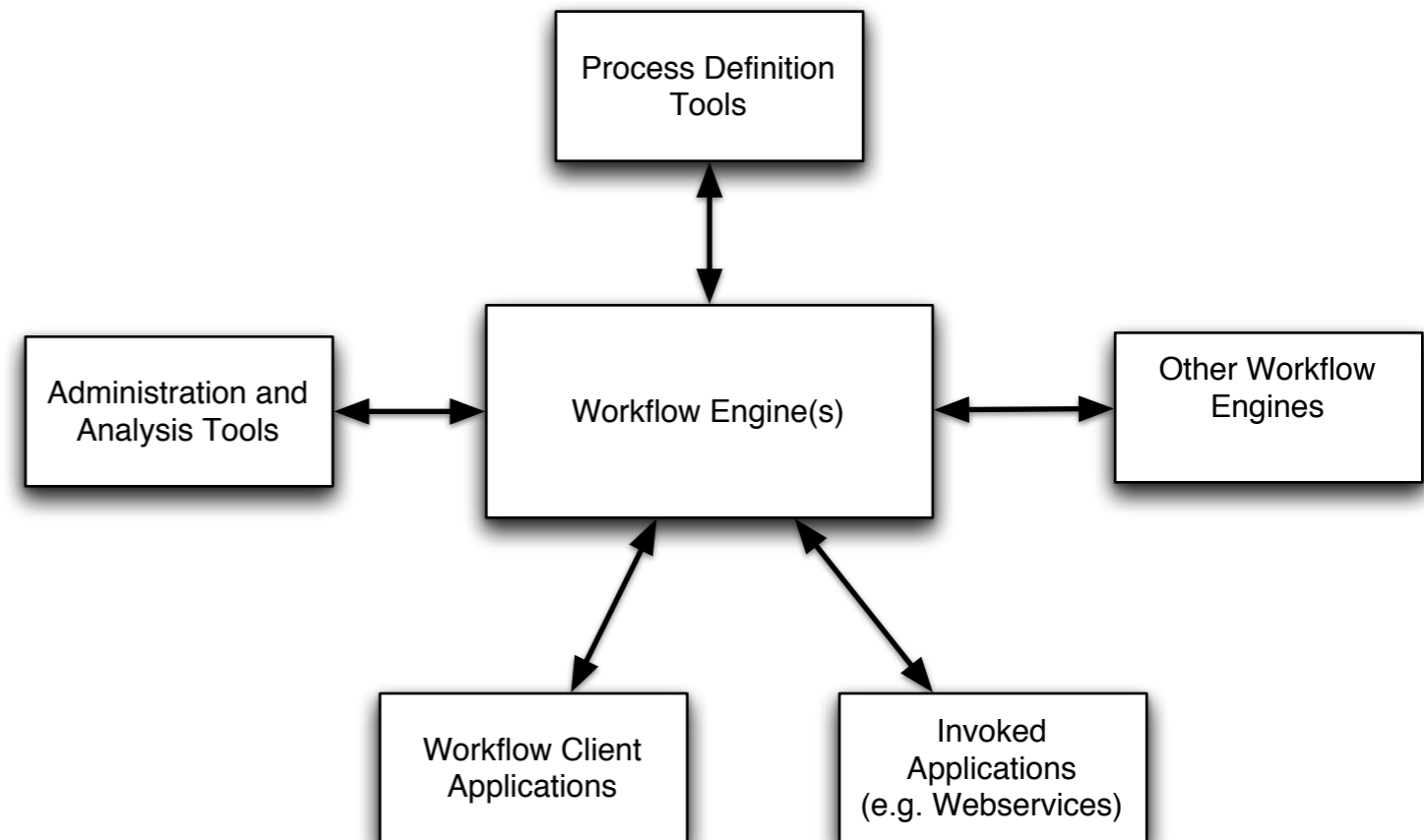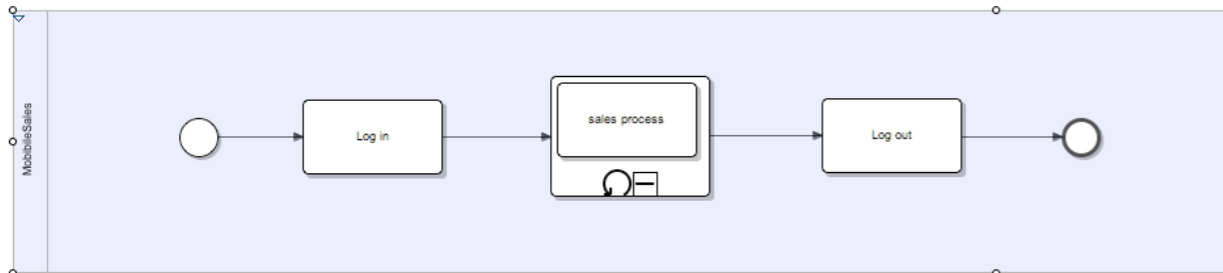
compilation

Business process execution today

Process Definition Tools

Administration and Analysis Tools ↔ Workflow Engine(s) ↔ Other Workflow Engines

Workflow Client Applications

Invoked Applications (e.g. Webservices)

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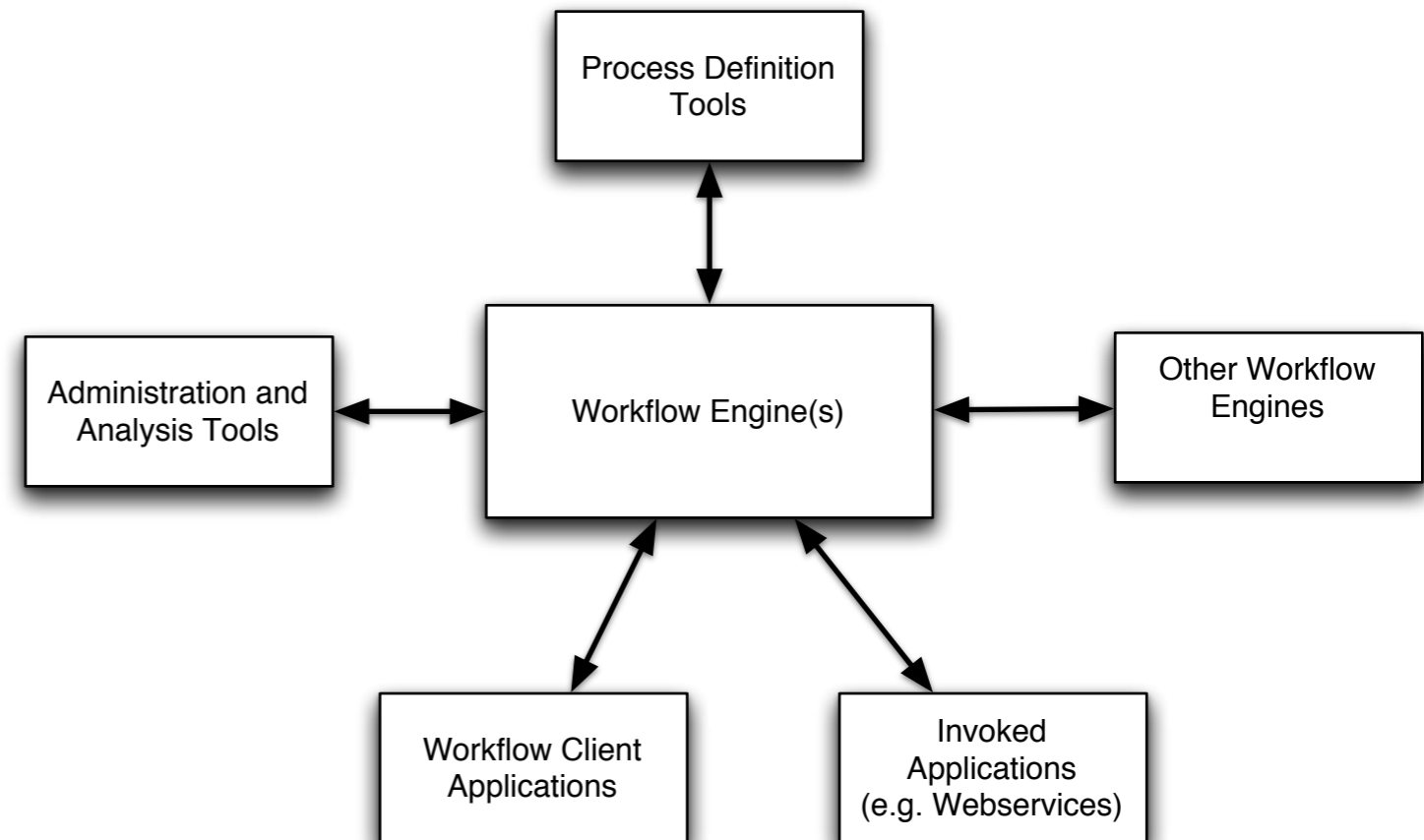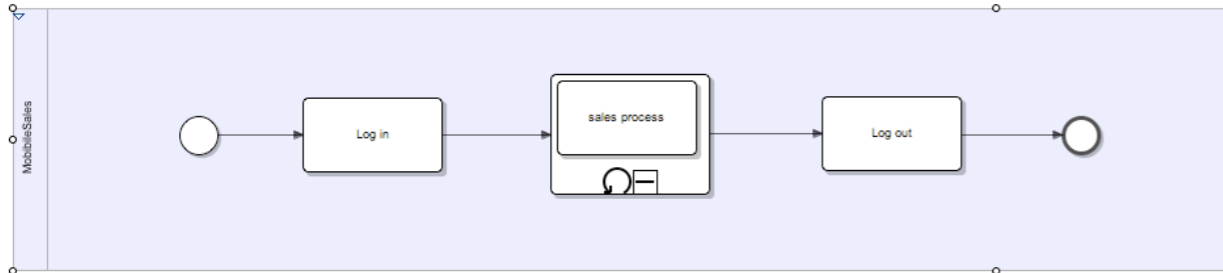
Business process execution today

Execution semantics of BPEL hidden (and fixed) in engine
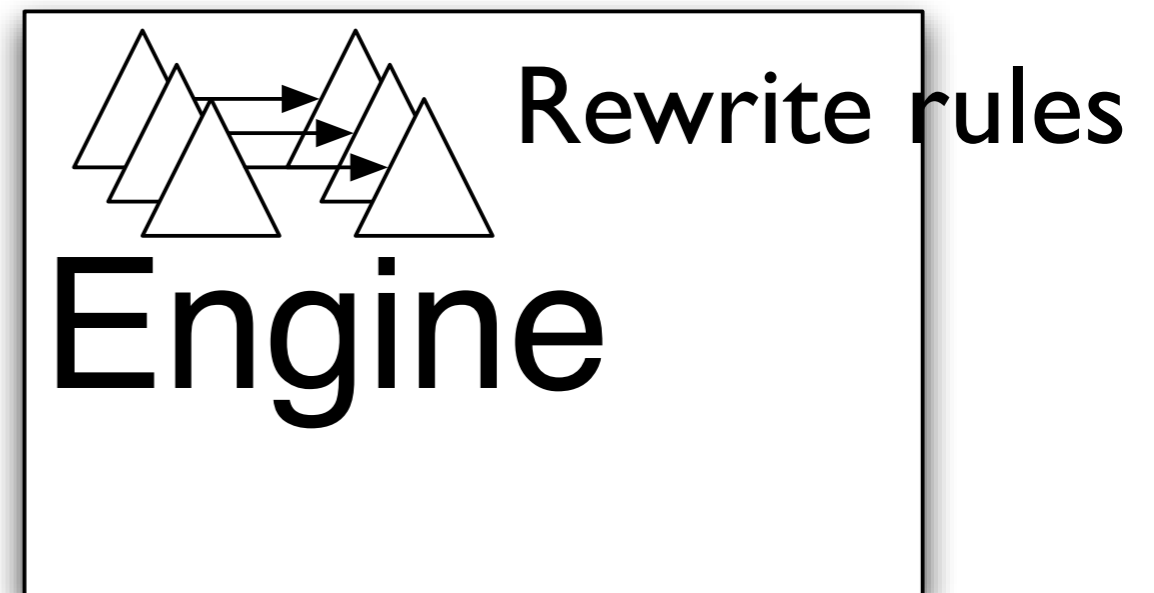
Extensible Formalization and Execution Engine

[MTCOORD'05,COORDINATION'06]

Rewrite rules

Engine

Extensible Formalization and Execution Engine

- Describe Process Language with XML Schema

Rewrite rules

Engine

Extensible Formalization and Execution Engine

- Describe Process Language with XML Schema

- Describe Semantics of Process Language by XML rewrite rules

Rewrite rules

Engine

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Extensible Formalization and Execution Engine

- Describe Process Language with XML Schema

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- Parametrize Engine with Schema and rewrite rule

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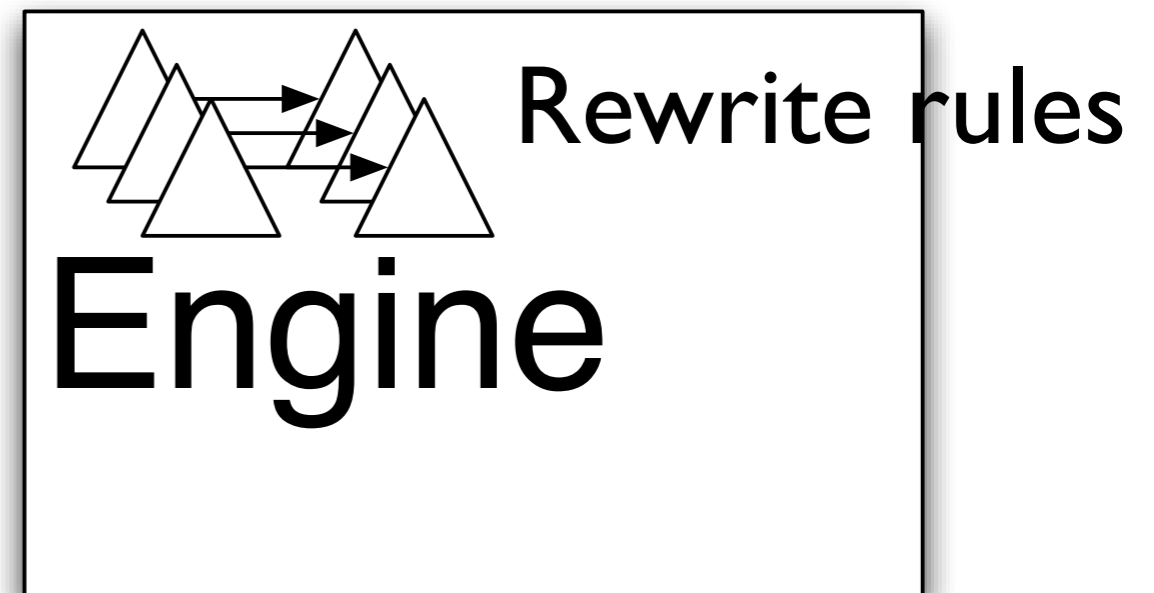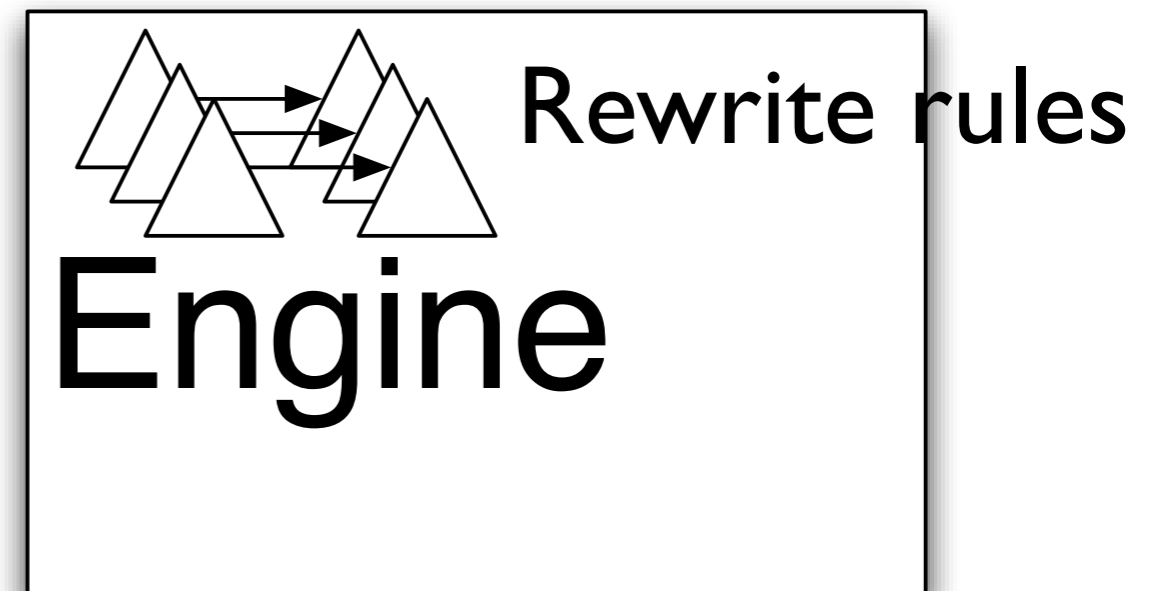- Bonus: Native XML Execution format - easy to persist, distribute and move

Rewrite rules

Engine

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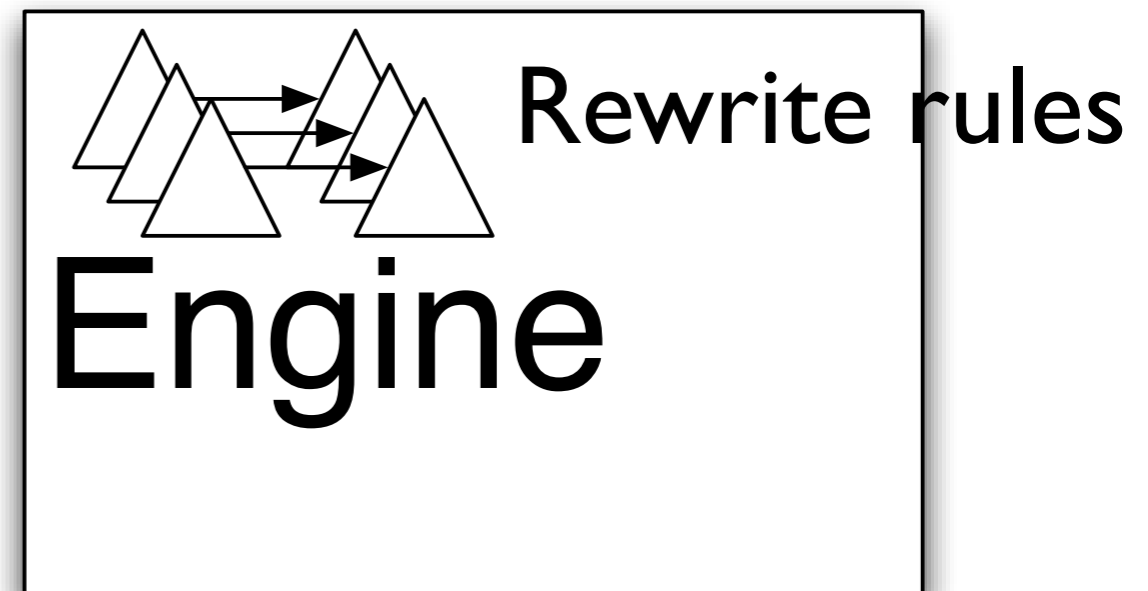
[MTCOORD'05, COORDINATION'06]

- Describe Process Language with XML Schema

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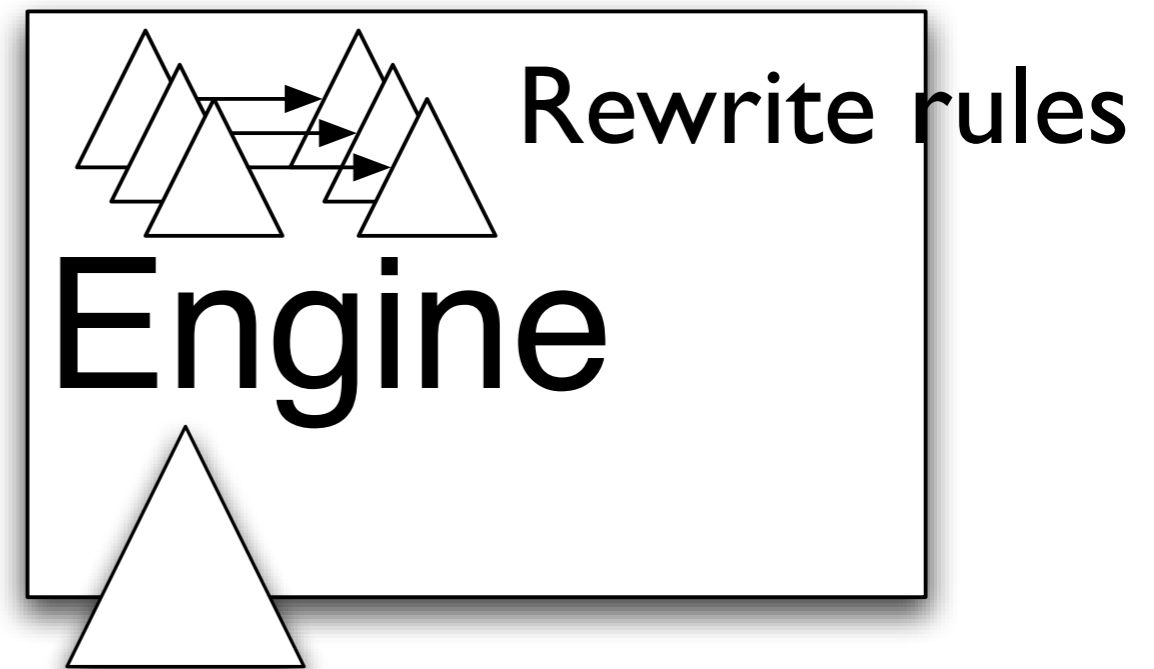
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Extensible Formalization and Execution Engine

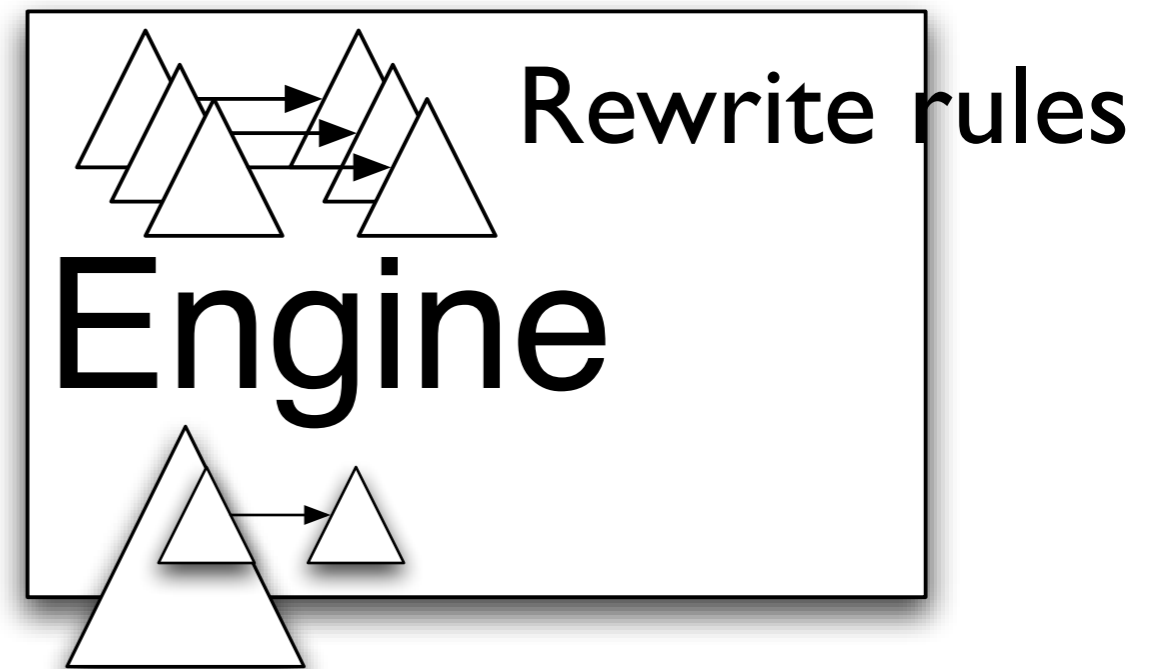[MTCOORD'05,COORDINATION'06]

- Describe Process Language with XML Schema

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Engine

Rewrite rules

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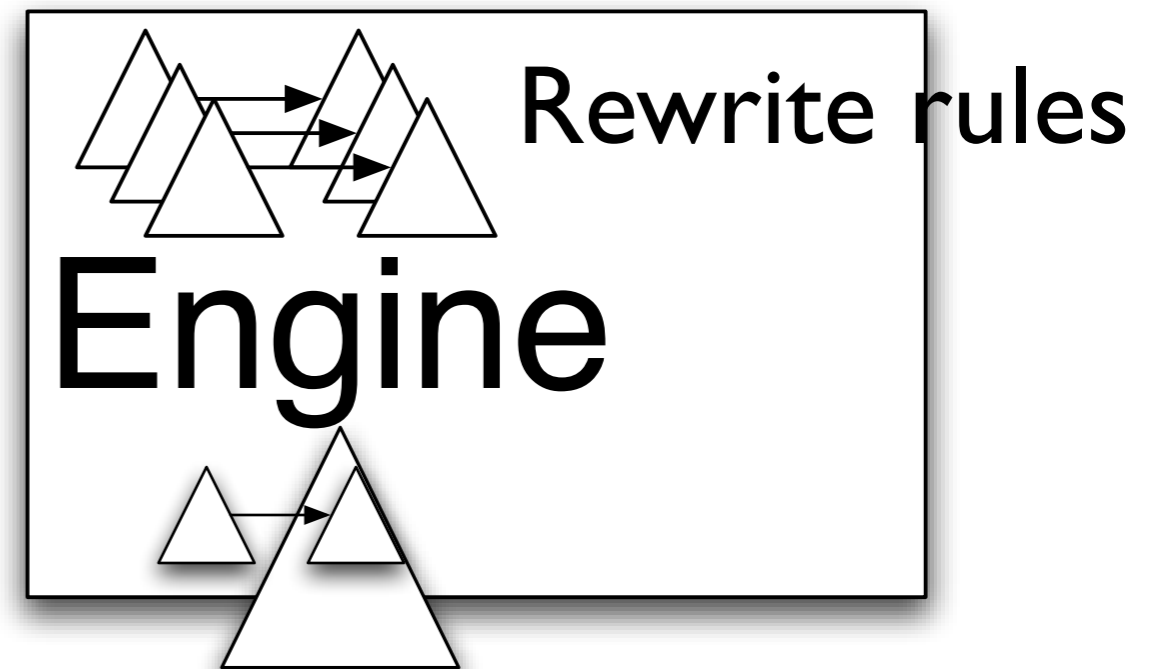# Extensible Formalization and Execution Engine

- Describe Process Language with XML Schema

- Describe Semantics of Process Language by XML rewrite rules

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Engine

Rewrite rules

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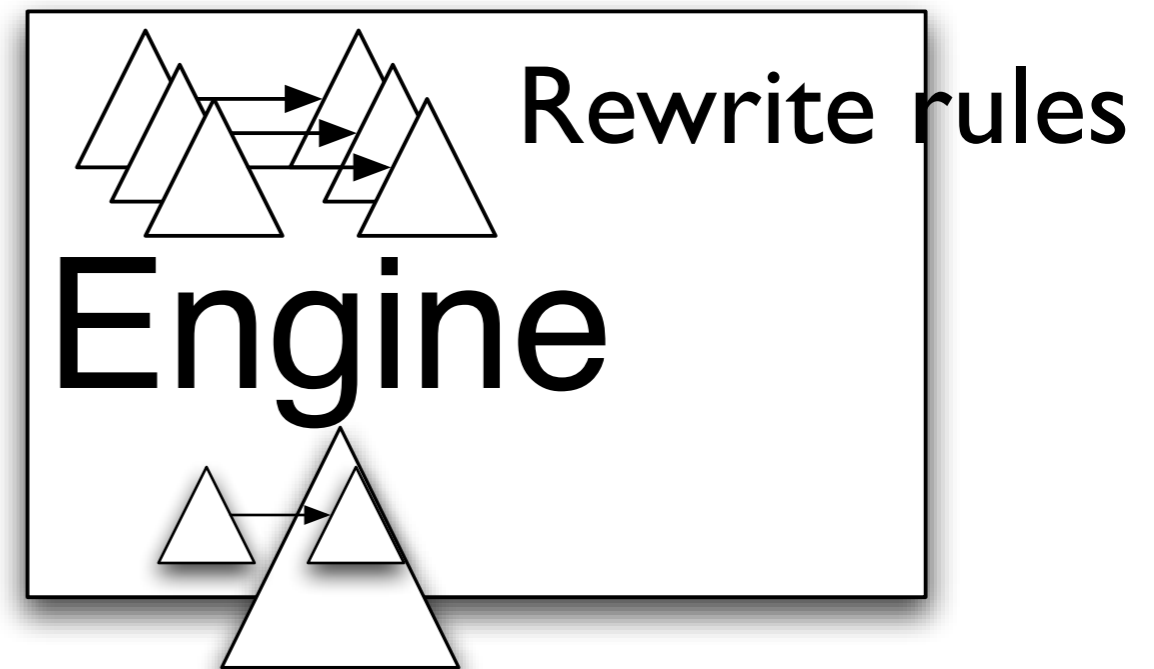# Extensible Formalization and Execution Engine

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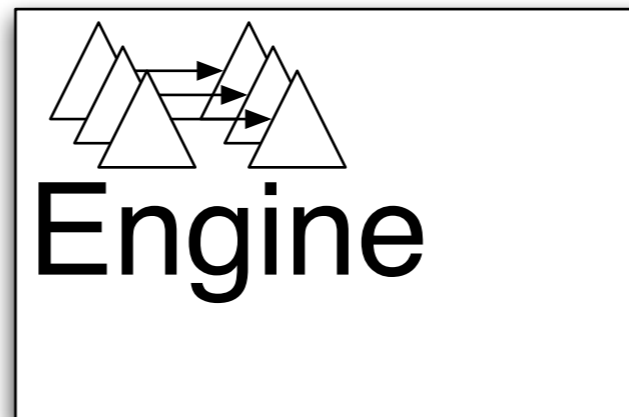

Rewrite rules

Engine

- Milners Bigraphical Reactive Systems are an ideal metamodel for formalizing XML rewriting

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XML rewriting example

```xml
<?xml version="1.0" ?>
<instance name="transfer">
<variables>
 <variable name="accountA">
   42
 </variable>
 <variable name="accountB">
 <variable name="accountC">
</variables>

<sequence>
 <assign>
  <copy>
    <from var="accountA"/>
    <to var="accountB"/>
  </copy>
 </assign>
 <next>
  <assign>
   <copy>
     <from var="accountB"/>
     <to var="accountC"/>
   </copy>
  </assign>
 </next>
</sequence>
</instance>
```

Engine

XML rewriting example

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<?xml version="1.0" ?>
<instance name="transfer">
<variables>
 <variable name="accountA">
   42
 </variable>
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 <variable name="accountC">
</variables>

<sequence>
 <assign>
  <copy>
    <from var="accountA"/>
    <to var="accountB"/>
  </copy>
 </assign>
 <next>
  <assign>
   <copy>
    <from var="accountB"/>
    <to var="accountC"/>
   </copy>
  </assign>
 </next>
</sequence>
</instance>
```

Engine

```
<?xml version="1.0" ?>

<process name="transfer">

<variables>
 <variable name="accountA">
 42
</variable>
<variable name="accountB">
 42
</variable>
<variable name="accountC"/>
</variables>

<sequence>
 <empty/>
 <assign>
  <copy>
    <from var="accountB"/>
    <to var="accountC"/>
  </copy>
 </assign>
</sequence>

</process>
```
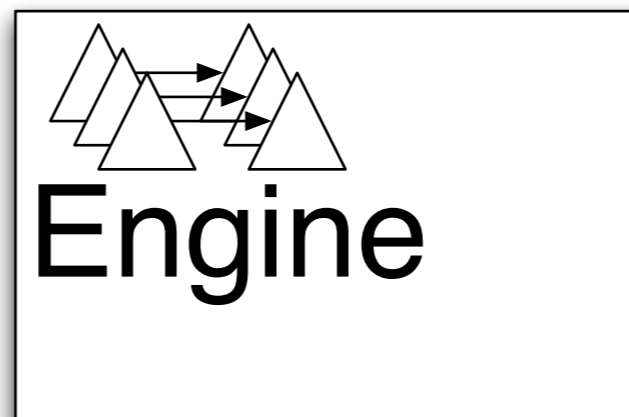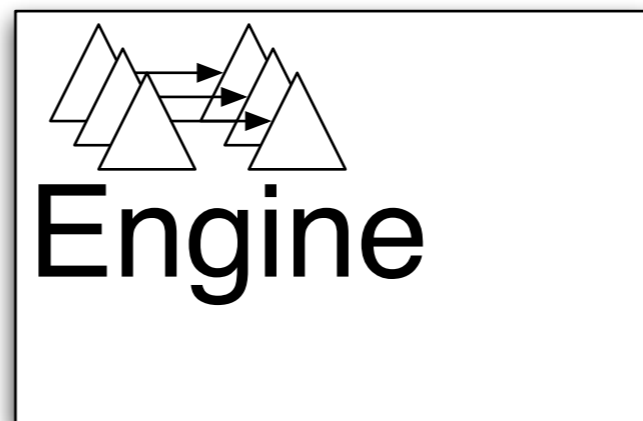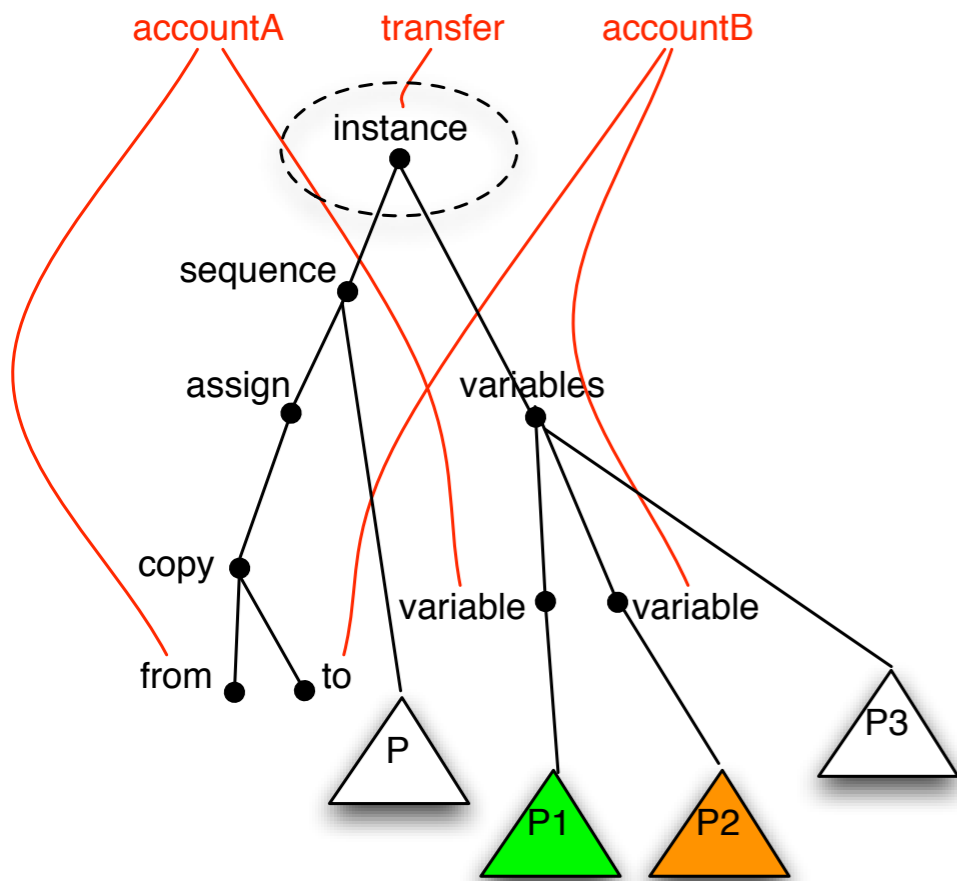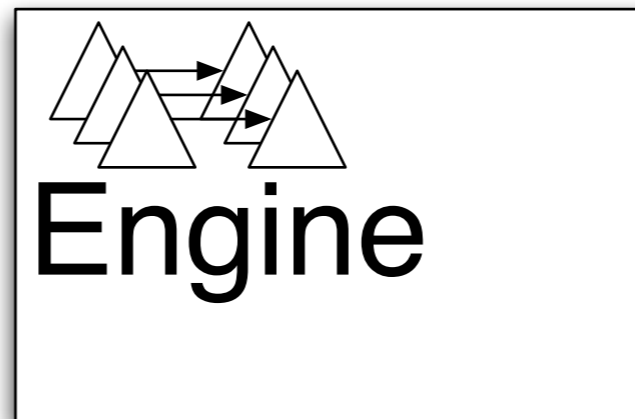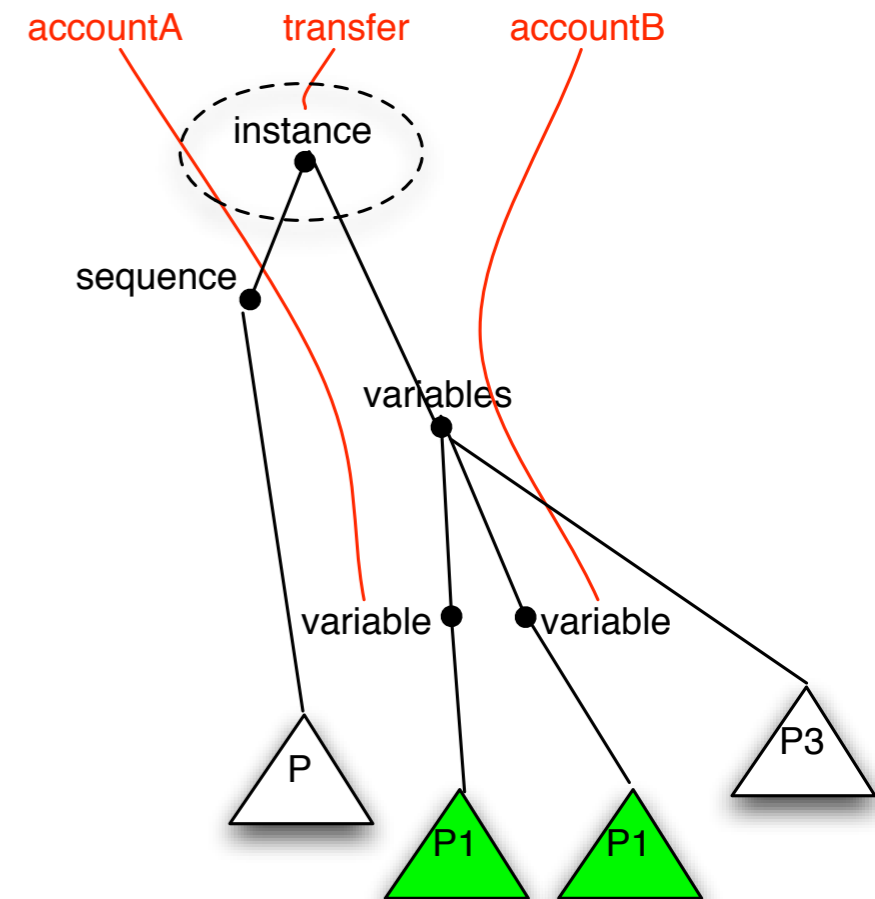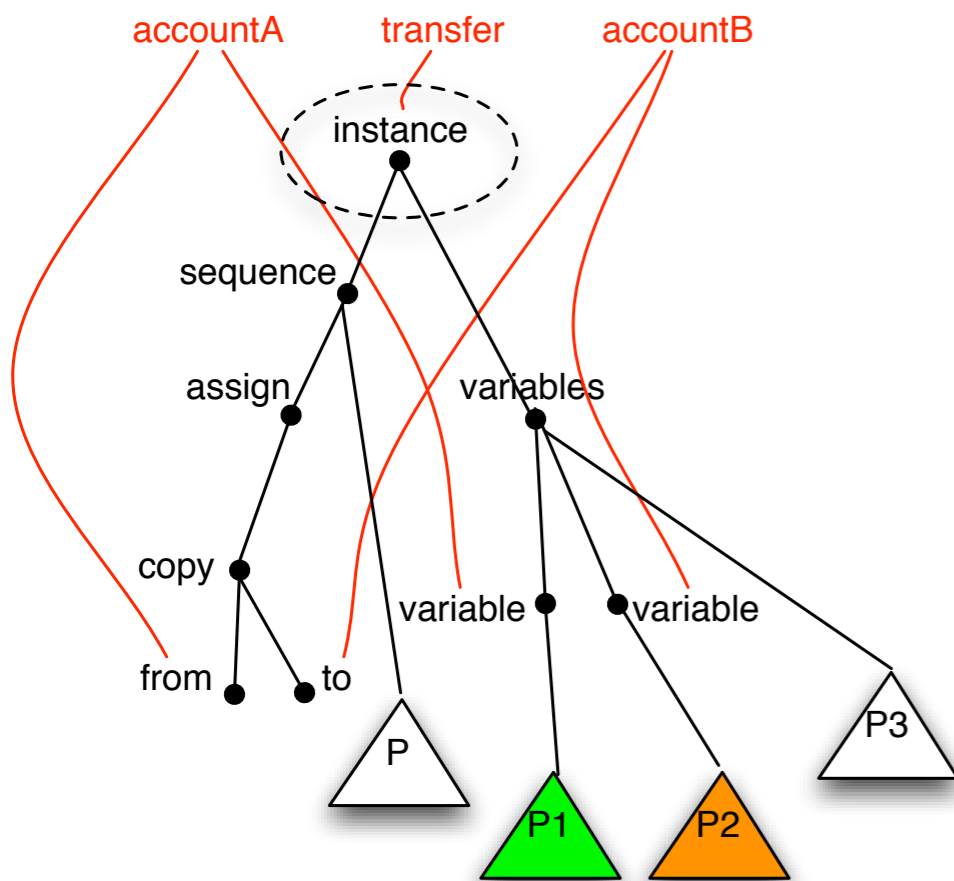
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XML rewriting example

XML rewriting example

Bigraph rewriting

accountA   transfer   accountB

instance

sequence

assign   variables

copy

from   to   variable   variable

P   P1   P2   P3

Engine

accountA   transfer   accountB

instance

sequence

variables

variable   variable

P   P1   P1   P3

Tasklet orchestration revisited

- implemented prototype tasklet orchestration language

- extended with BPEL- like conditional control flow

```
<tasklet assembly ="IOTasklet" name="IOTasklet" type="MD">
 <input type="constant" name="ToShow" value="How much is 19*
</tasklet>

<if>
 <condition>19*16 &lt; [Result]</condition>
 <tasklet assembly ="IOTasklet" name="IOTasklet" type="MD">
  <input type="constant" name="ToShow" value="Isn't that a bit m
 </tasklet>
 <elseif>
  <condition>19*16 > [Result]</condition>
  <tasklet assembly ="IOTasklet" name="IOTasklet" type="MD">
   <input type="constant" name="ToShow" value="That's a bit low
   </tasklet>
 </elseif>
 <else>
  <sequence>
   <sequence>
    <tasklet assembly ="IOTasklet" name="IOTasklet" type="MD"
     <!--Tasklet1View-->
     <input type="constant" name="ToShow" value="Correct!"/>
    </tasklet>
   </sequence>
   <sequence>
   </sequence>
  </sequence>
 </else>
</if>
```
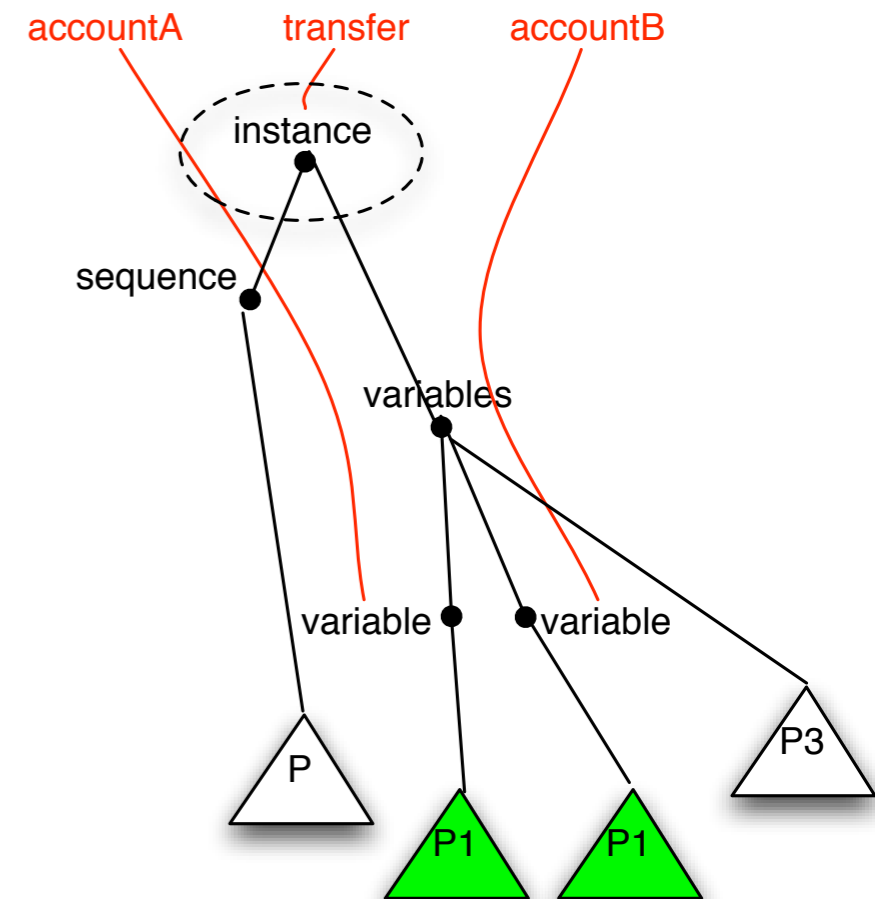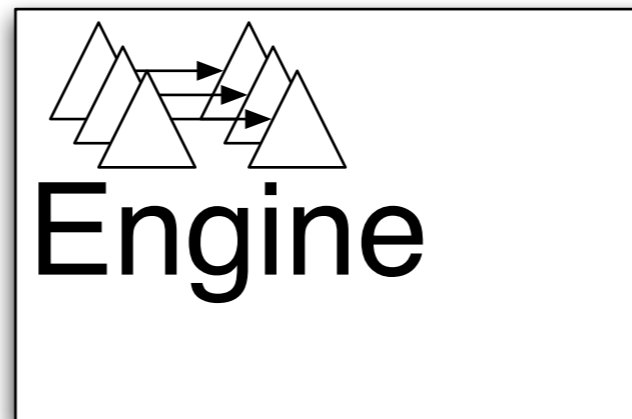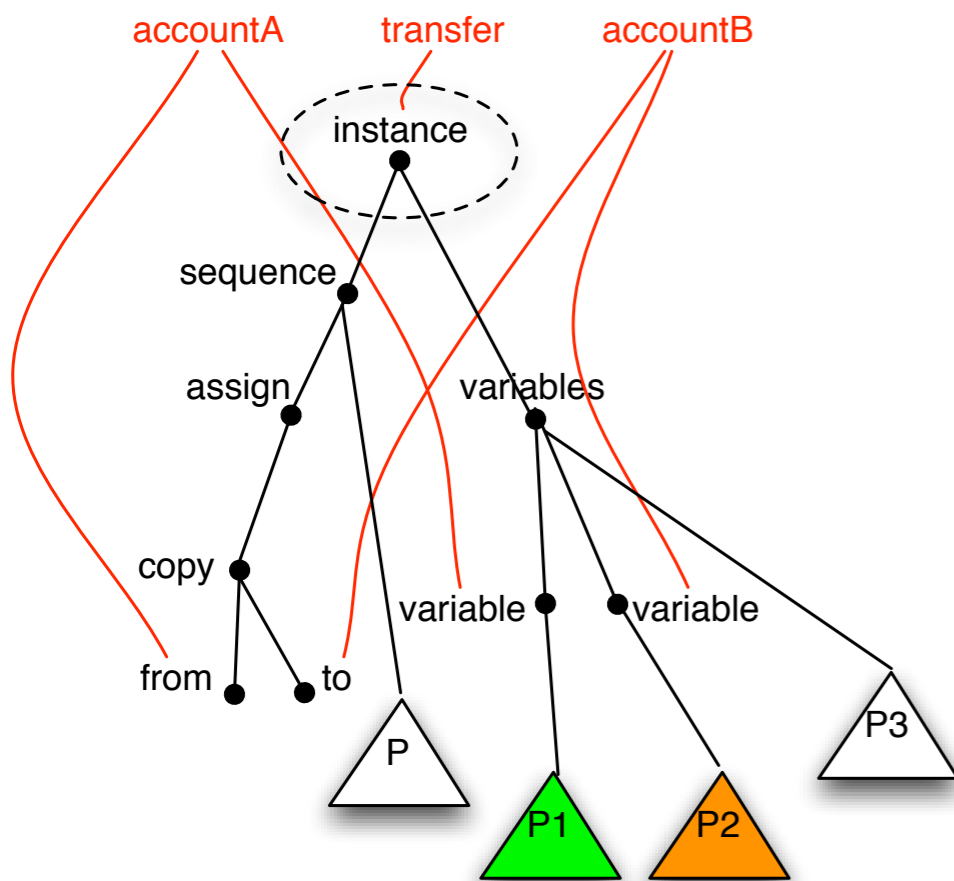
HomeBPEL Extensions

```
<variables>
  <variable name="treatment_template">
    <process name="treatment_template">...</process>
  </variable>
  <variable name="x" />
  <variable name="y"><from>true()</from></variable>
</variables>




<thaw       subLink="treatment" variable="treatment_template" />
<invokeSub subLink="treatment" operation="consultation"
           inputVariable="y" outputVariable="y" />
<freeze subLink="treatment" variable="x" />
<invoke partnerLink="patient" operation="run"
        inputVariable="x" outputVariable="y" />
```

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HomeBPEL Extensions

Allow process descriptions as values

```
<variables>
  <variable name="treatment_template">
    <process name="treatment_template">...</process>
  </variable>
  <variable name="x" />
  <variable name="y"><from>true()</from></variable>
</variables>



<thaw        subLink="treatment" variable="treatment_template" />
<invokeSub subLink="treatment" operation="consultation"
           inputVariable="y" outputVariable="y" />
<freeze subLink="treatment" variable="x" />
<invoke partnerLink="patient" operation="run"
        inputVariable="x" outputVariable="y" />
```

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[COORDINATION'08]

Allow process descriptions as values

```
<variables>
  <variable name="treatment_template">
    <process name="treatment_template">...</process>
  </variable>
  <variable name="x" />
  <variable name="y"><from>true()</from></variable>
</variables>
```

Allow for *thawing* a process as a subprocess
and invoke services inside it

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Allow subprocesses to be dynamically frozen

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<variables>
  <variable name="treatment_template">
    <process name="treatment_template">...</process>
  </variable>
  <variable name="x" />
  <variable name="y"><from>true()</from></variable>
</variables>
```

Allow process descriptions as values

Allow for *thawing* a process as a subprocess and invoke services inside it

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<invokeSub subLink="treatment" operation="consultation"
           inputVariable="y" outputVariable="y" />
<freeze subLink="treatment" variable="x" />
<invoke partnerLink="patient" operation="run"
        inputVariable="x" outputVariable="y" />
```

Allow subprocesses to be dynamically frozen

Allow for *sending processes*

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Conclusions

◆ Process-oriented architecture supports customizable task-driven ERP access

◆ Light-weight orchestration on PDA allows disconnected operation

◆ XML rewriting/bigraphical reactive systems allows extensible languages, engines and formalizations

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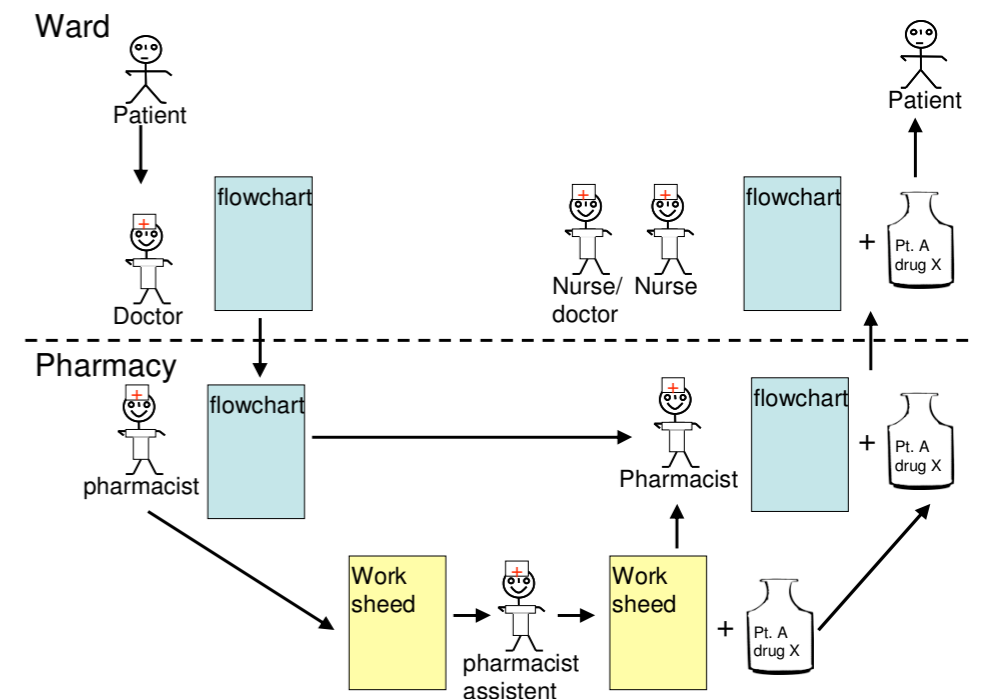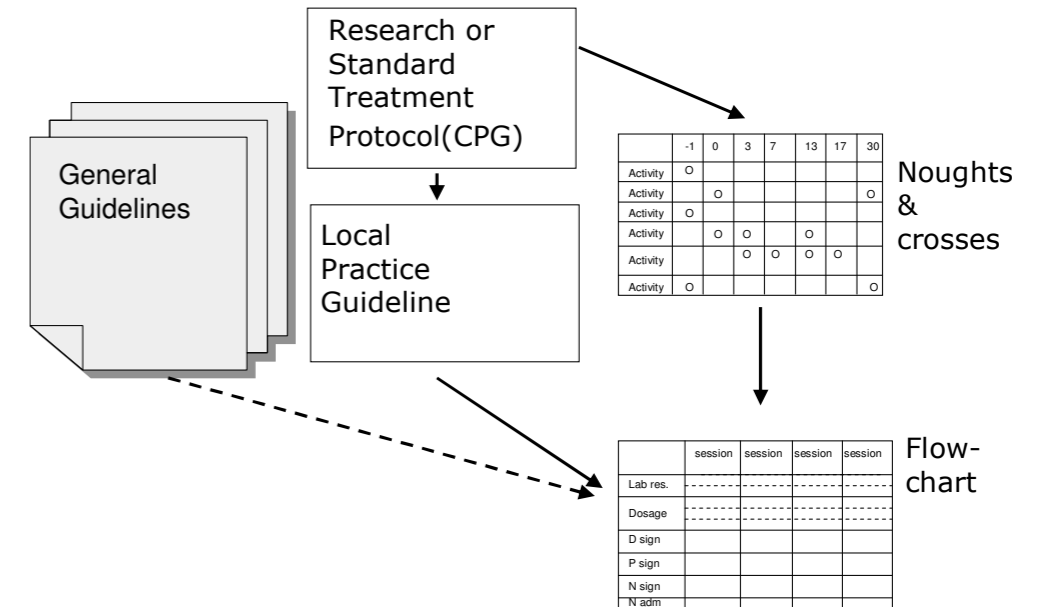
Processes as data !
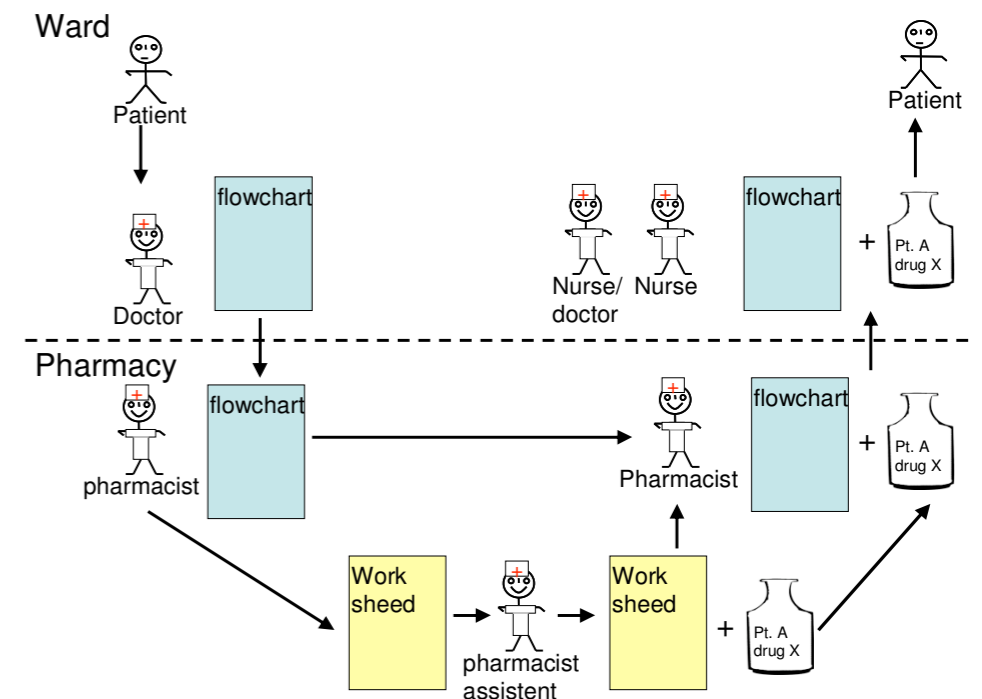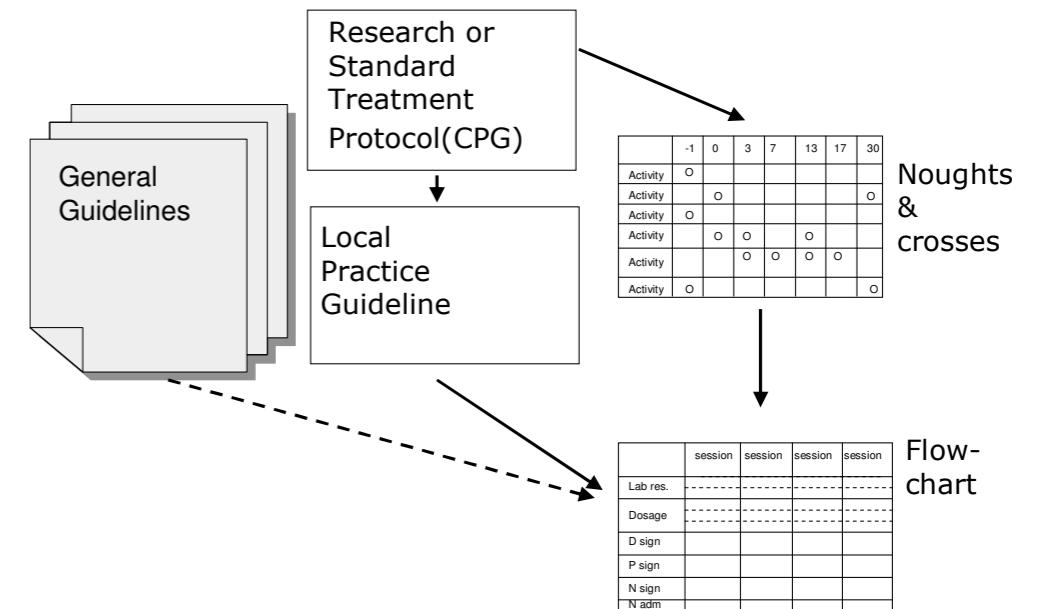
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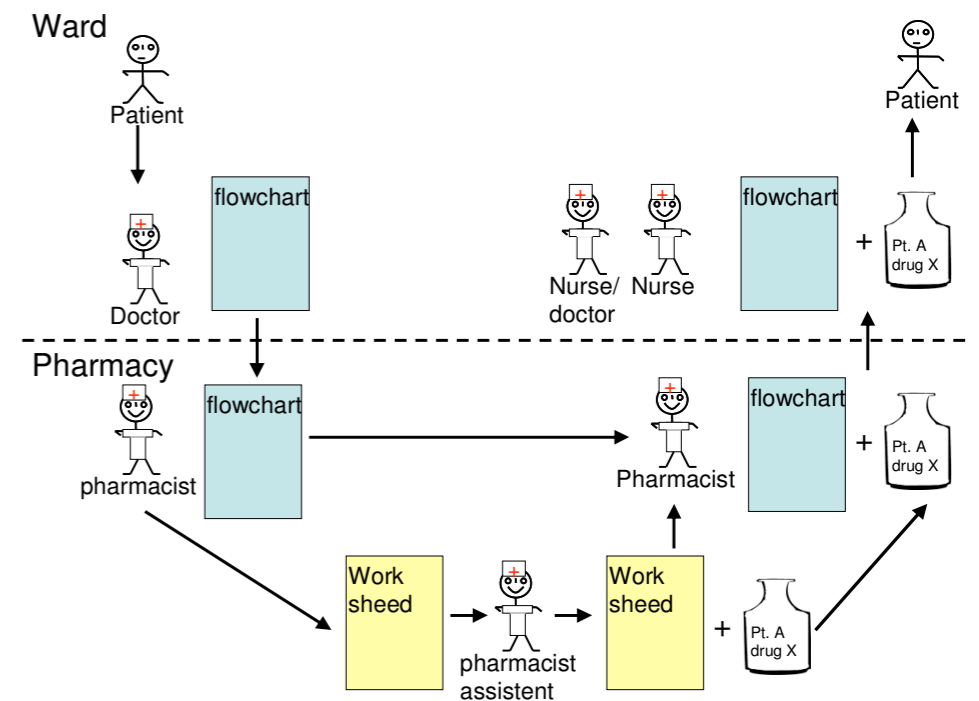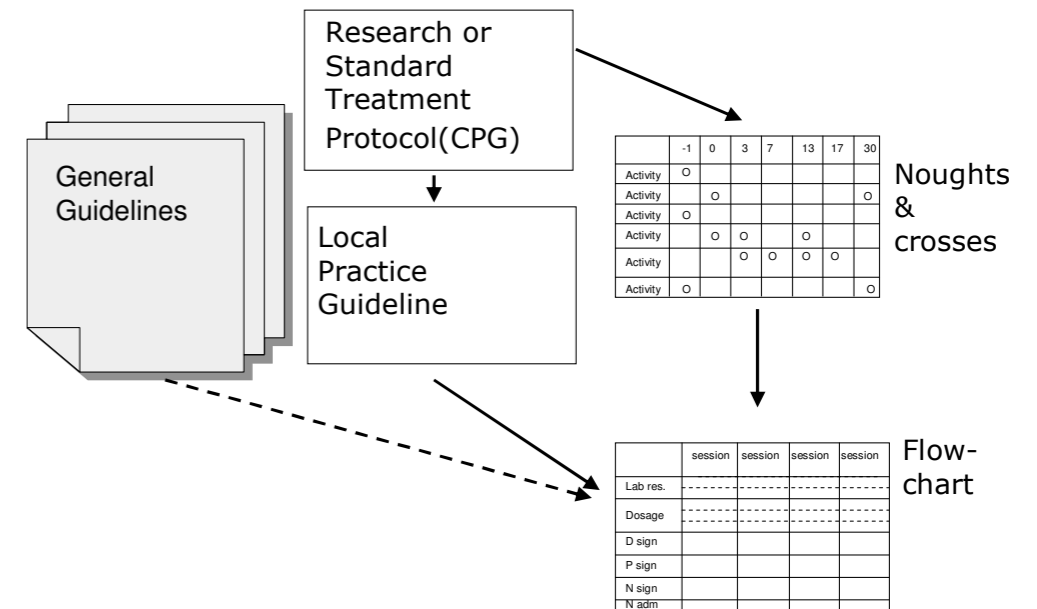
Future work

Future work
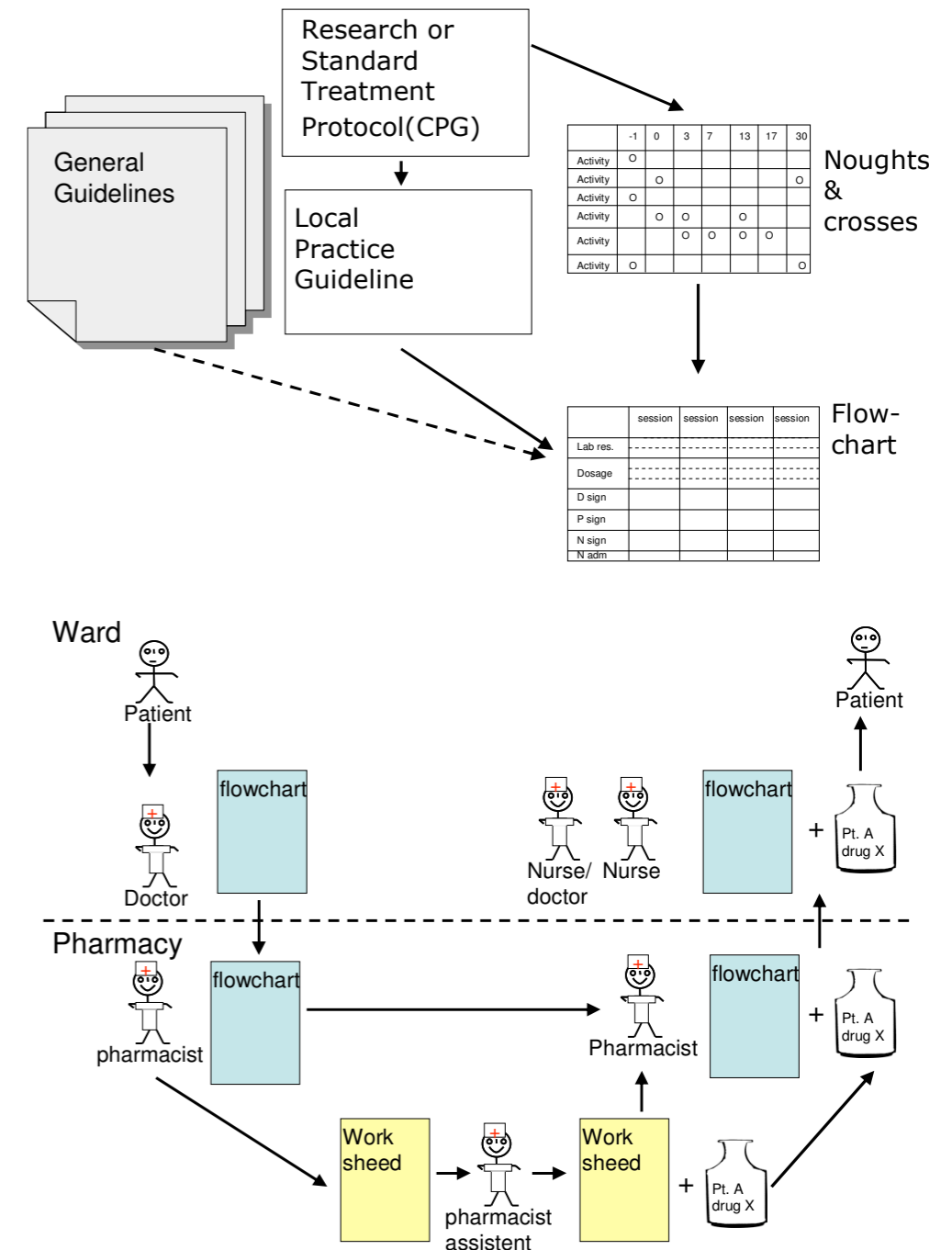
◆ Field studies of mobile work processes and coordination

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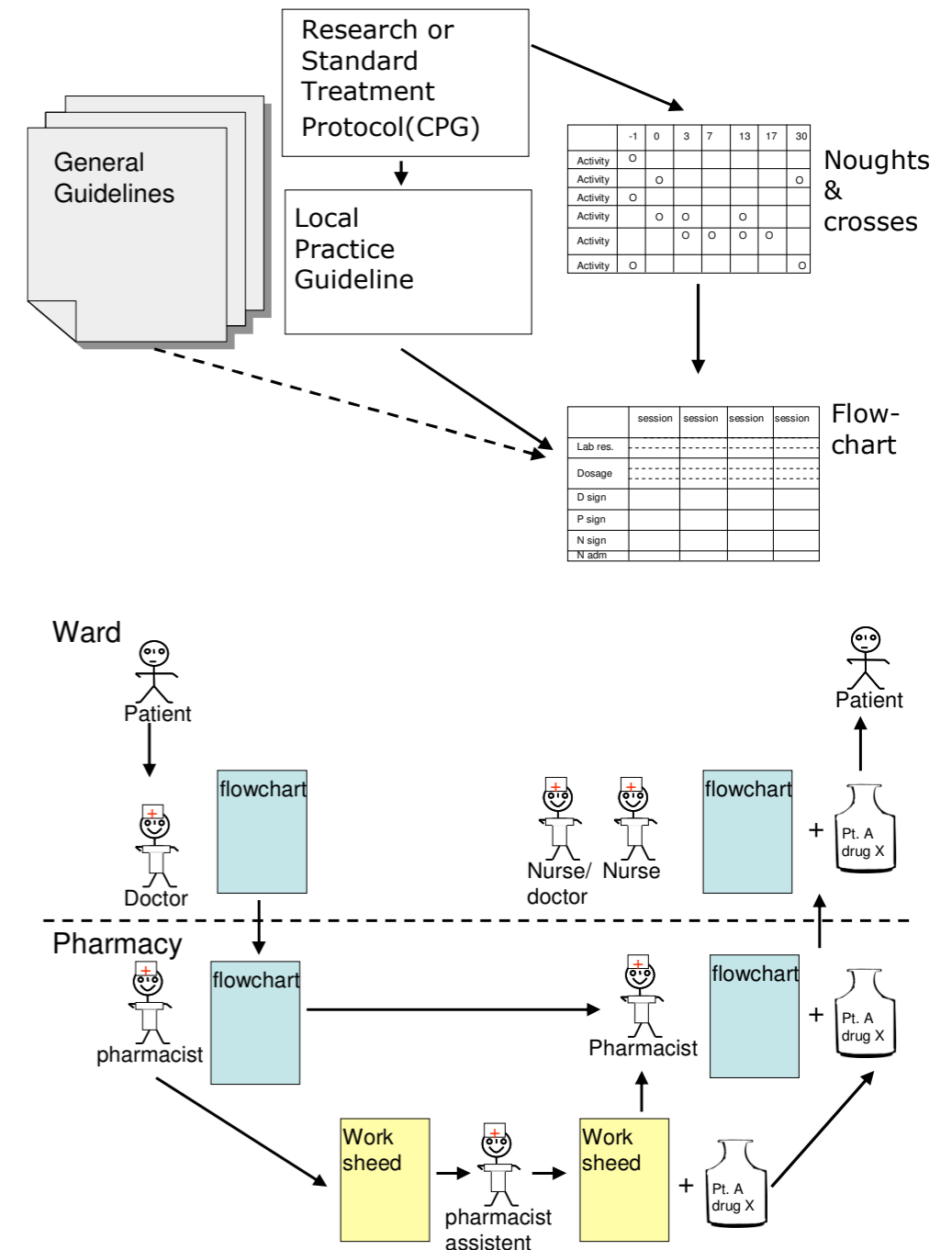
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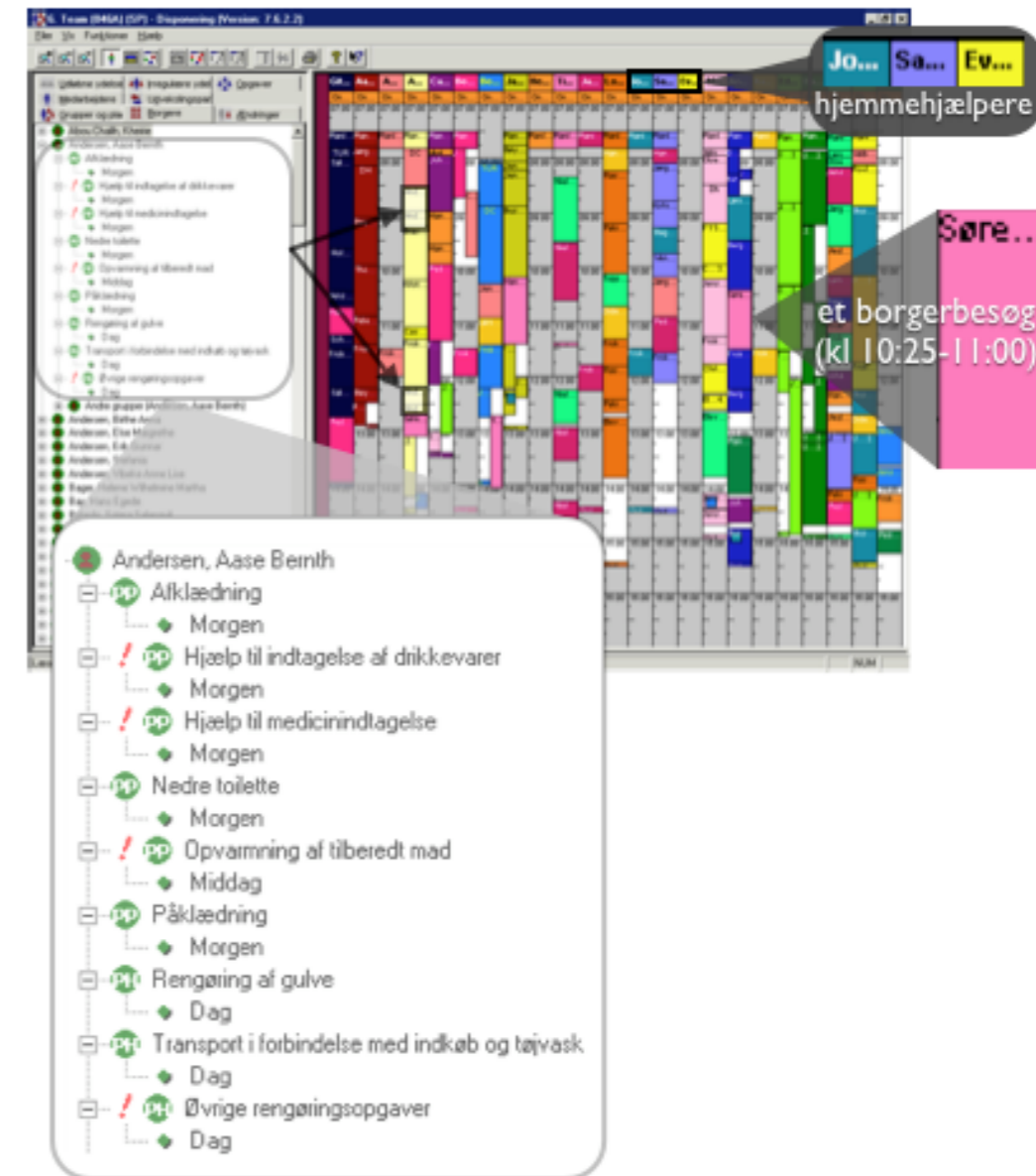◆ Types for secure higher-order processes and process interaction

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◆ Types for secure higher-order processes and process interaction

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Thank you for your attention!

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