Middleware and Web Services

Lecture 8: Enterprise Service Bus

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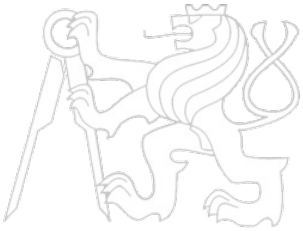

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Humla v0.3

Overview

- Central intermediary in SOA
  - *Types of services: shared and infrastructure*
  - *Types of processes: Technical and Business*
- ESB Application
  - *Application running on an application server*
  - *Exposes functionality via Web service interface*
  - *Allows to communicate with various messaging protocols*
- Integration Patterns
  - *Technical-level interoperability – message broker*
  - *Location transparency*
  - *Dynamic routing*
  - *Data transformations – mediator*
  - *Resequencing of messages*
  - *Session pooling*
  - *Service orchestrations – BPMN, BPEL*
  - *Message enrichment*

ESB Vendors

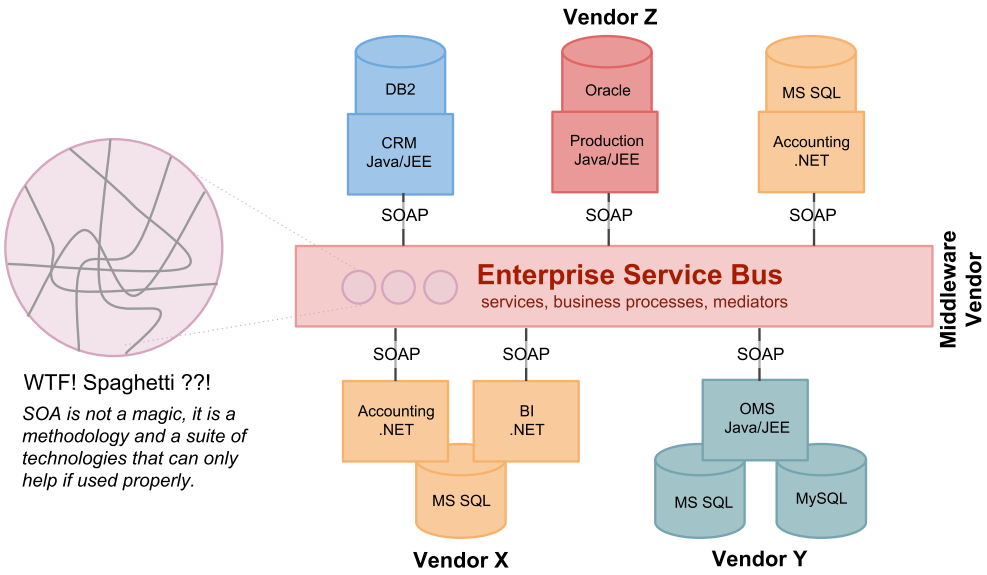
- Oracle
  - *Oracle Service Bus (OSB)*
  - *Oracle SOA Suite*
  - *Oracle Enterprise Gateway (OEG)*
- IBM
  - *IBM WebSphere*
- SAP
  - *SAP NetWeaver*
- Microsoft
  - *.NET Framework*
  - *BizTalk server*
- Opensource
  - *JBoss*
  - *Apache ServiceMix*
  - *WSMX – Semantic Web Service Execution Environment*

Overview

- Architecture
  - *Service Component Architecture*
  - *Metadata Repository*
  - *Service Types*
- Integration Patterns

Enterprise Service Bus

- Integration organized
  - *Enterprise Service Bus, to be used wisely*



WTF! Spaghetti ??!

SOA is not a magic, it is a methodology and a suite of technologies that can only help if used properly.

Overview

- Architecture
  - *Service Component Architecture*
  - *Metadata Repository*
  - *Service Types*
- Integration Patterns

Service Component Architecture

- Industry standard
  - *SCA defines an architecture and a technology for composing applications following SOA principles*
- SCA Application

Composite

collection of components, services, references

Component

application bulding block that provides certain functionality; it can be implemented by various technologies (BPEL, Java, etc.)

Services

exposed services by the application

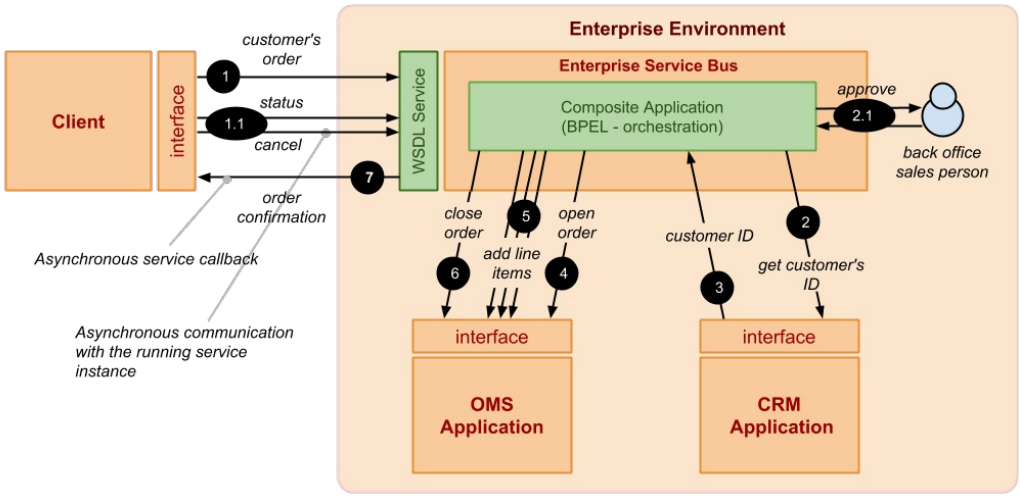
References

references to external services that the application uses

Wires

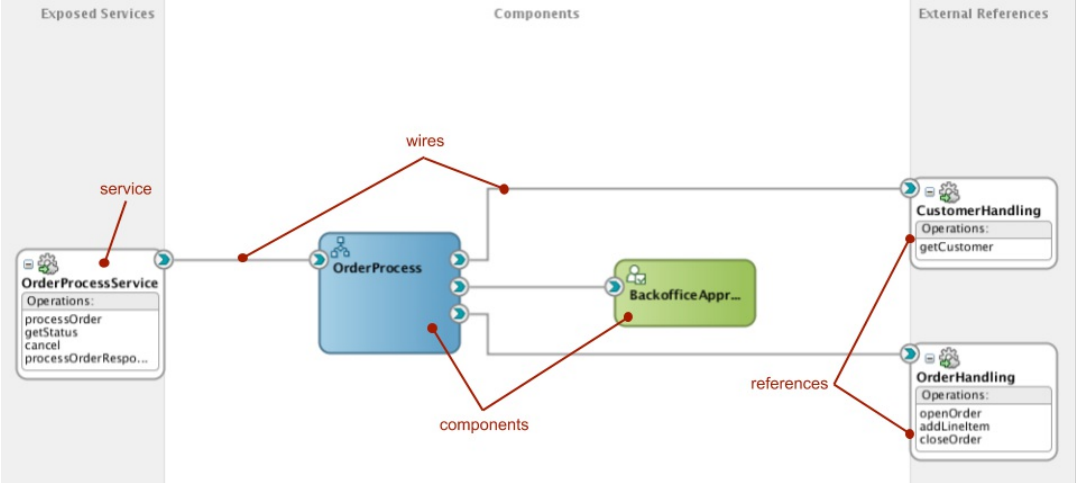
links between components, services and references.

Simplified Order Process



Order Process – SCA Application

- SCA Application Composite
  - *Service implements Order Process WSDL interface (processOrder, getStatus, cancel, processOrderResponse callback)*
  - *A screenshot from JDeveloper IDE:*



Composite.xml

- Main configuration file of the composite application
  - *previous slide shows its graphical representation*
- `service` – exposes the composite as a service

`{ns-path}='mimdw.fit.cvut.cz/mdw_examples/ProcessOrder'`

```
<service name="OrderProcessService" ui:wsdlLocation="OrderProcess.wsdl">
  <interface.wsdl
    interface="http://{ns_path}/OrderProcess#wsdl.interface(OrderProcess)"
    callbackInterface="http://{ns_path}/OrderProcess#wsdl.interface(OrderProcessCallback
  <binding.ws
      port="http://{ns-path}/OrderProcess#wsdl.endpoint(OrderProcessService/OrderProcess
    <property name="weblogic.wsee.wsat.transaction.flowOption"
              type="xs:string" many="false">NEVER</property>
  </binding.ws>
  <callback>
    <binding.ws
      port="http://{ns-path}/OrderProcess#wsdl.endpoint(OrderProcessService/OrderProcess
  </callback>
</service>
```

- `component` – implements the composite in a specific technology

```
<component name="OrderProcess" version="2.0">
  <implementation.bpel src="OrderProcess.bpel"/>
  <property name="bpel.config.oneWayDeliveryPolicy" type="xs:string"
            many="false">async.persist</property>
</component>
```

Composite.xml (cont.)

- `reference` – provides an access to an external service

`{ns-path}='mimdw.fit.cvut.cz/mdw_examples/APP_CRM_GetCustomer'`

```
<reference name="CustomerHandling"
    ui:wsdlLocation="http://sb.vitvar.com/soa-infra/services/mdw-examples/APP_CRM_GetCus
  <interface.wsdl
      interface="http://{ns-path}/GetCustomer#wsdl.interface(GetCustomer)"/>
  <binding.ws
      port="http://{ns-path}/GetCustomer#wsdl.endpoint(getcustomer_client_ep/GetCustomer
      location="http://sb.vitvar.com/soa-infra/services/mdw-examples/APP_CRM_GetCustomer
      soapVersion="1.1">
    <property name="weblogic.wsee.wsat.transaction.flowOption"
              type="xs:string" many="false">WSDLDriven</property>
  </binding.ws>
</reference>
```


Order Process SCA Application Instance

Overview

- Architecture
  - *Service Component Architecture*
  - *Metadata Repository*
  - *Service Types*
- Integration Patterns

Metadata Repository

- Central Store
  - *Central store for common artefacts used by applications*
- Artefacts
  - *Abstract WSDLs – common interface for integration between clients and ESB and among applications running in ESB*
  - *XML Schemas – common information models used in WSDLs*
    → Common Data Model (CDM)
- Oracle SOA Suite 11g
  - *MDS – Metadata Store; can be in the DB or on file system*
  - *Common artefacts as above + deployed composites*
  - *Artefacts can be referenced/access by* `oramds` *protocol:*

```
1  ...
2  <wsdl:types>
3      <schema
4          xmlns="http://www.w3.org/2001/XMLSchema">
5          <import namespace="http://mimdw.fit.cvut.cz/mdw-examples/cdm/order"
6              schemaLocation="oramds:/apps/MDWMetaData/order.xsd"/>
```

Overview

- Architecture
  - *Service Component Architecture*
  - *Metadata Repository*
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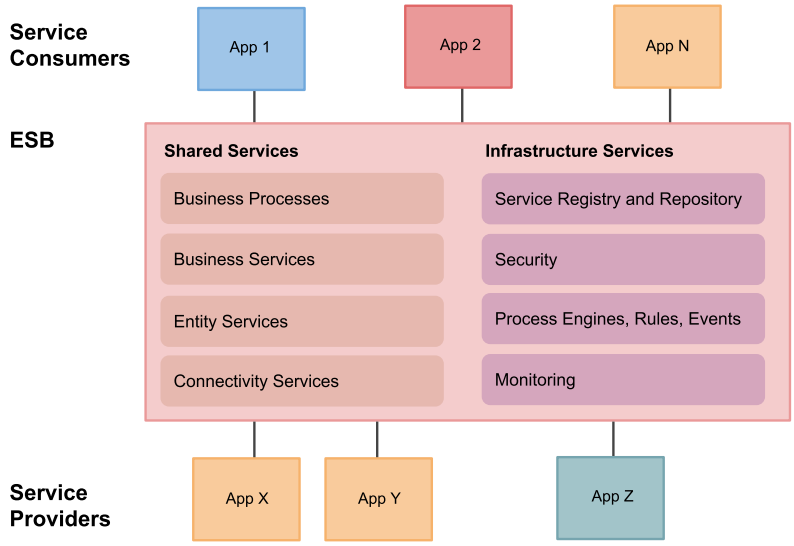
Service Types

- ESB services
  - *shared services – created for particular domain*
  - *infrastructure services – support integration and interoperability*



Service and non-service enabled providers

Connectivity Services

- Purpose
  - *Adapters for various back-end technologies*
  - *Connectivity to legacy applications*
  - *No business logic, Usually stateless, ESB internal*
- Example
  - *Database adapters*
    - → *SQL statement:*

```
1 | SELECT ID, NAME FROM CUSTOMERS C
2 | WHERE  C.REVENUE > :revenue
```

`Revenue` – *input parameter*

`ID, NAME` – *structure of output message*

→ *Expose the SQL statement as a connectivity service*

  - *Example implementation: OSB Proxy service, JCA adapters*

JCA Adapters

- JCA – Java EE Connector Architecture
  - *Standard Java interface to connect to back-end systems*
  - *Standardized in JSR 112*
  - *Main JCA Adapters*
    - → *JCA DB Adapter – access to DB objects*
    - → *JCA JMS Adapter – JMS queues*
    - → *JCA AQ Adapter – Oracle AQ (in a database)*
    - → *JCA MQ Adapter – IBM MQ*
    - → *JCA FTP Adapter – FTP access*
    - → *JCA File Adapter – File system access*
- Major Features (Contracts)
  - *Connection pool*
    - → *cache of connections to a back-end system (DB, etc.)*
  - *Transaction management*
    - → *JCA adapters can participate in a distributed transaction*

Entity Services

- Purpose
  - *Expose services on top of one or more entities in a database*
  - *Do not add any specific logic to entities' operations*
    - → *Provide CRUD operations only*
  - *May be used to facilitate a Common Data Model*
    - → *Business entities – entities of CDM*
    - → *Business objects – instances of business entities*
    - → *Business Entity Service – manipulations for business entities*
  - *No business logic, usually stateless, ESB internal*
- Example
  - *Two entities in a database:* `CUSTOMERS`, `ADDRESS` *(1:N)*
  - *Business entity* `CUSTOMER`

```
<customer>
    <name>Company.cz</name>
    <invoice-address>
        …
    </invoice-address>
    <main-address>
        …
    </main-address>
</customer>
```

  - *Operarions: read, write*

Business Services

- Purpose
  - *Business/integration logic, can be stateful or stateless*
  - *Atomic business activities*
    - → *direct mapping to back-end application services*
  - *Can be "imported" in ESB to be used in a business process*
  - *Can be exposed by ESB and add values in terms of business/integration logic or technical processing*
- Example
  - *Data transformation*
    - → *Back-end application service exposed in CDM language*
  - *Message enrichment*
    - → *Adds information to content from other sources*
  - *Monitoring*
    - → *Every invocation of the service logged*
    - → *Monitoring of business metrics*
      - → *Number of orders, total revenue per customer*

Business Processes

- Purpose
  - *Business/integration logic, usually stateful*
  - *Complex processes involving invocations of multiple business services at various back-end applications*
  - *Handles transformations from various data formats of back-end applications*
  - *Handles **key-mapping***
    - *→ Business entities exist in multiple systems*
    - *→ Each back-end application maintains its own ID for corresponding business objects*
  - *Usually implemented in a process language such as BPMN or BPEL*
  - *OSB uses its own orchestration language which translates to XQuery*
- Example
  - *Order processing*
    - *→ Get customer information from the CRM system*
    - *→ Add line items to OMS*
    - *→ Close order*

Overview

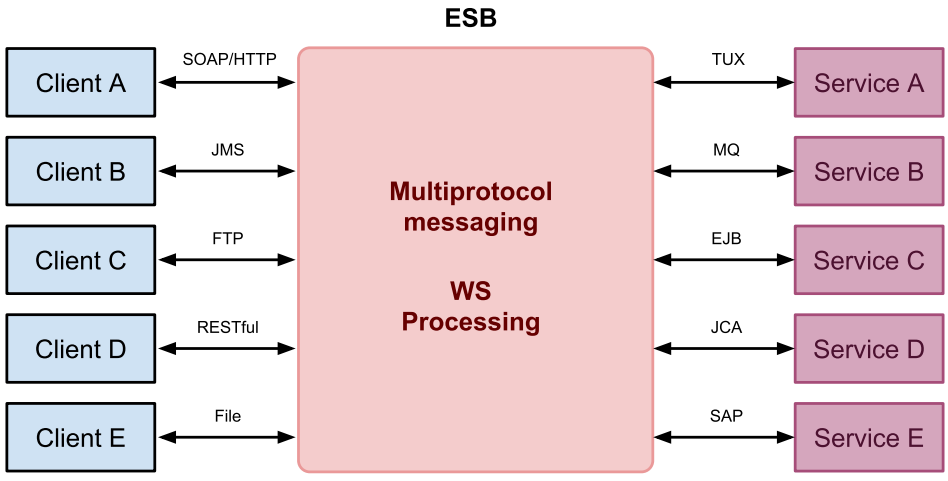
- Architecture
- Integration Patterns

Overview

- Applied in implementation of business services and processes
  - *Usually a combination of more patterns*
- Technical patterns
  - *Deals with technical aspects of service communication*
  - *Message broker – technical-level interoperability*
  - *Location transparency*
  - *Session pooling*
- Business patterns
  - *Deals with business aspects (message content) of service communication*
  - *Dynamic routing*
  - *Data transformations – mediator*
  - *Service orchestrations – BPMN, BPEL*
  - *Message enrichment*
  - *Resequencing of messages*

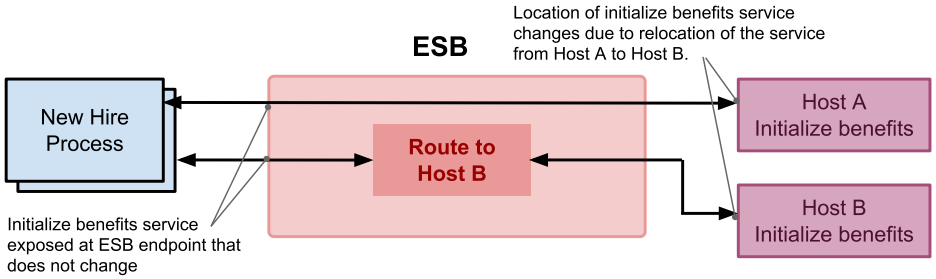
Message Broker

- Message broker
  - *ESB can mix and match transports both standard and proprietary*



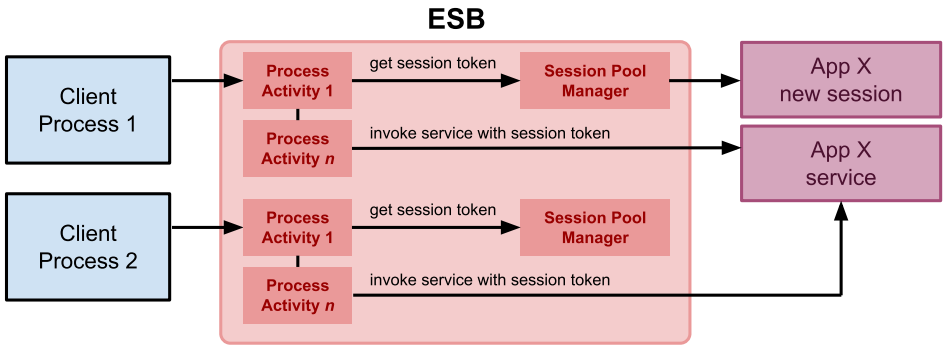
Location Transparency

- Location transparency
  - *ESB can hide changes in location of services*
  - *Such changes will not affect clients*
  - *Can also be used for load balancing for multiple service instances*



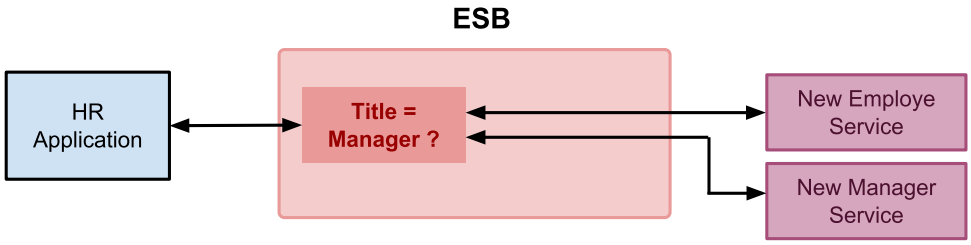
Session Pooling

- Session Pooling
  - *ESB can maintain a pool of connections (session tokens) to a back-end app when creating a new connection is expensive*
  - *A single session token can be reused by multiple instances of business processes*



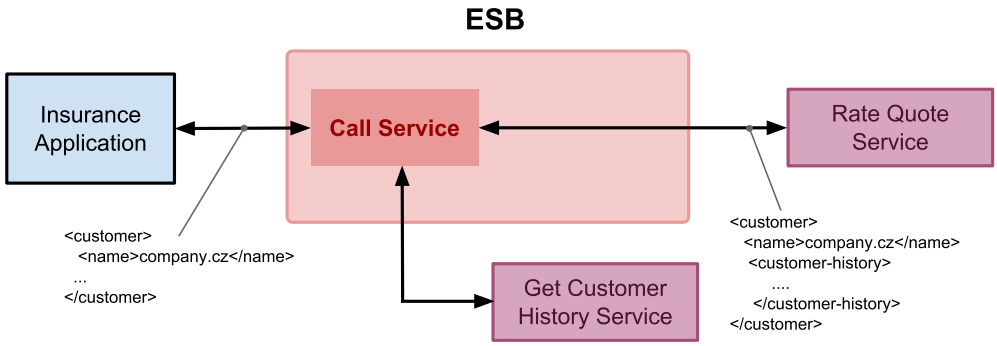
Dynamic Routing

- Dynamic routing
  - *ESB exposes a service that routes to various back-end services based on message contents.*



Message Enrichment

- Message enrichmenet
  - *Enriches a message before invoking back-end application service.*

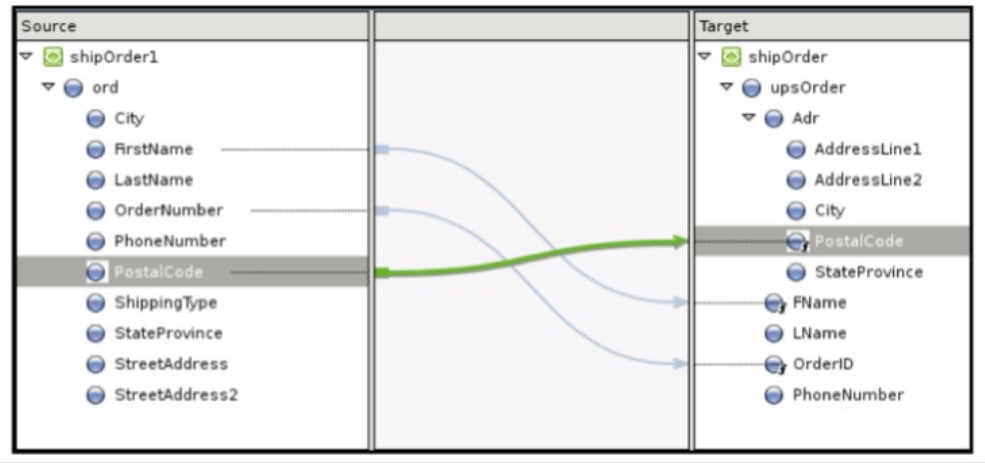


Data Transformation

- Data transformation phases:
  - *Definition of mapping and execution of mappings*
- Definition of mappings (design-time)
  - *A mapping associates one data structure to another data structure and defines a conversion between them.*
  - *Mapping languages*
    - *→ graphical for design that translates to XSLT, XQuery*
    - *→ Sometimes implemented in 3rd gen. languages (e.g., Java)*
- Execution of mappings (runtime)
  - *application of mappings to instance data*
- CDM terminology
  - *Application Business Message – back-end app format*
  - *Enterprise Business Message – CDM format*

Definitions of Data Mapping Example

- Source and target schemas
  - *Source: Order – flat data structure*
  - *Target: UPS order with address as a sub-entity*
  - *Differences in names of entities*
  - *Conversion function applied to postal code*

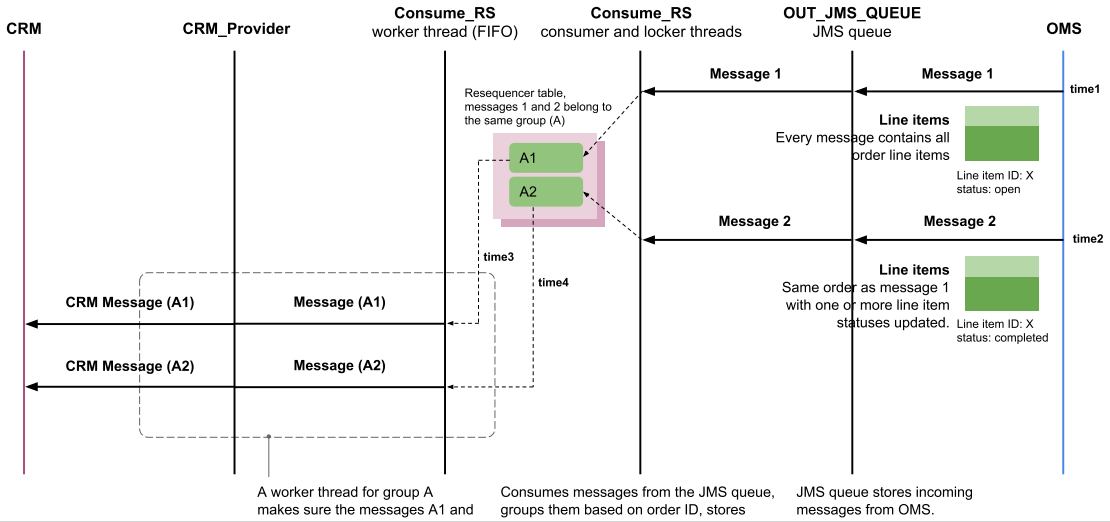


Service Orchestration

- Orchestration of multiple business services
  - *Includes transformation, message enrichmenet, service callouts, etc.*
  - *A step in orchestration is an activity*
- Patterns
  - *Sequential processing of activities*
  - *Parallel processing of activities with synchronization points*
  - *Decision branches, iterations*
- Technologies
  - *Graphical languages*
  - *Standard representations: BPEL, BPMN*
  - *Proprietary, for example OSB uses graphical language that translates to XQuery*
- Good design
  - *Orchestration faciliates communication in CDM*
  - *Orchestration handles key-mapping*

Message Sequencing

- Resequencer in update sales order
  - *Every order line item needs to update its status several times (e.g. open, completed)*
  - *Resequencer makes sure that the update status messages arrive to CRM in the same order as they were created in OMS system (FIFO resequencer)*



Message Aggregation