Fraunhofer Innovation Cluster
Logistics Mall - Cloud Computing for Logistics

OAGIS Implementation for the Logistics Mall
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The Fraunhofer Institute for Material Flow and Logistics IML and the Fraunhofer Institute for Software and Systems Engineering ISST have developed an OAGIS 9.5.1 Overlay for Logistics, used as a Business Object (BO) model in the Logistics Mall (http://www.ccl.fraunhofer.de/en.html). The Logistics Mall consists of a Cloud-based marketplace for logistics software and apps and a platform for using and administering rented apps via a Web browser. On top of this, the Logistics Process Designer enables users to orchestrate their apps by business process models run in the Cloud.

The BO model (being an OAGIS overlay and implementation) is used for three purposes within the Logistics Mall:

- Communication of apps and applications (A2A)
- Orchestration of apps by business process models (A2A, B2B, B2C)
- Persisting BOs used by apps and processes

Used OAGIS Nouns

We are using the following OAGIS nouns as our BOs, most of which have been lightened and extended:

- PartyMaster, ItemMaster, PurchaseOrder, SalesOrder, WarehouseShippingOrder, PickList, Shipment, Invoice, ReceiveDelivery, Movelnventory, InventoryBalance, InventoryCount, Location, ProductionSchedule, PlanningSchedule, CarrierRoute

and we have added the following nouns and some components, based on existing components:

- BinLocationMaster, BinLocation, LoadSupportMaster, LoadSupport, TransportEquipmentMaster, TransportEquipment, HandlingUnit, InventoryCorrection, InventoryPosting, WarehouseLocation, Transport, Quality, CapacityForecast, ExternalBO (encapsulating e.g. EDIFACT)

Logistics BO Model – from Domain Experts for Domain Experts

Besides the technical XML-Schema model (OAGIS lightened using sample instances with the XMLHelpline tool, www.xmlhelpline.com), we have an abstract logistics BO model in UML with a simplified structure, developed by domain experts and easily understandable by business users. E.g. unused attributes are hidden and access paths are shortened, as shown by Figure 1.

This functional BO model also contains alias names for BOs / nouns in certain states, e.g. NotificationOfDispatch for an announced Shipment and this model is multilingual. Moreover, its documentation is provided by our metadata repository.
Technical BO Models – XSD, Java, RDB, etc.

The Logistics BO model is strictly coupled to the technical OAGIS Overlay: Each UML class and each attribute has a unique OAGIS XPath mapping, from which XML/JSON marshaling information for binding Java objects are generated.

Besides the OAGIS Overlay we also have a Java representation of the BO model: These Java classes are generated from the UML model, hereby implementing the functional model on a programming level.

The UML model is also attributed with JPA annotations used for persistence support in the Java model, having sophisticated fetching and cascading strategies. JPA is not restricted to RDBMS, but also has implementations for Cloud databases.

Communication

We do not use the BODs originally shipped with OAGIS, but generated overlays for all needed BODs (and WSDLs) based on verb-noun templates and a configuration file. Although WSDL files have also been generated, we focus on REST communication (using OAGIS-XML or JSON) and Java RMI communication.

Orchestration

We developed a Logistics Process Designer which empowers business people to orchestrate Logistics Mall apps by generating BPMN 2.0 code run in the Cloud. BO-based interfaces of all Logistics Mall apps ease verification of process models and especially ease the implementation of the process models. By providing reusable pre-implemented process activities with BO inputs and BO outputs, the process implementation is completely generated. During runtime, mainly references to BOs stored in the BO Instance Repository are used by process instances.
Software Components

We have not only developed a BO model based on OAGIS, but also created some software components which employ this model:

- **BO Instance Repository** (provides persistence of all supported nouns), having
  - a REST and RMI-APIs with CRUD capabilities, and
  - a graphical BO Browser

- **BO Metadata Repository** (provides internationalization and documentation of nouns and attributes in functional and technical view, imported from Excel sheets structurally merged with the UML model), having
  - a REST-API for metadata access, and
  - a GUI for metadata access and administration

- **Marshaller**: the stored XPath mappings are used to generate unmarshalling components, implemented using JAXB. Hereby, Java objects can be serialized as OAGIS-conformant XML or JSON and vice versa, e.g. used for REST-based services.

- **Approaches for BO Converters** (e.g., from/to EDIFACT), based on Smooks and Dozer.

Benefits of the Approach

Our BO model approach narrows different typical vertical and horizontal gaps in IT platforms:

- **Common language of the Business** (e.g., Logistics): domain experts from different companies use the *domain BO model (UML)* as a common domain language. Explanations (metadata) are available in various natural language (German, English, etc.) to overcome national boundaries.

- **Common language of IT systems**: all applications offered by the Logistics Mall use the *technical BO model representations (XML, JSON, Java)* for direct communication or communication via the BO instance repository and/or the BPMN process engine (orchestration). This is based on OAGIS and all the standards which OAGIS uses.

- **Bi-directional mapping between Business and IT**: the domain model not only has a strong mapping to its technical representations – it is bi-directionally executable. Hereby, all BOs in the domain model have standard-based pre-implementations, and conversely, the domain BO model is somehow standardized by the underlying technical standards.

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