



Supply Chain Management Sample Application Architecture

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Status of this Document

This is a final specification. Readers should refer to the WS-I.org web site for errata and updates.

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1 Introduction

This document details the technical design and implementation of the Basic Profile 1.0 Sample Application. The sample application described herein was modeled after the “simple” supply chain management (SCM) application outlined in the SCM Use Cases V1.0 document; it is not intended to exhibit all of the characteristics of a real world SCM design and implementation. Rather, it serves to document and demonstrate how WS-I Basic Profile 1.0 conformant web services might be designed, implemented and deployed.

One of the goals of the Sample Application is to explore as many of the features found in the Basic Profile as possible. To this end, the sample application employs a variety of schema naming conventions, SOAP message formats, SOAP message styles, and WSDL design practices that are all Basic Profile conformant. In many places coverage of Basic Profile features has been traded for best practice.

To fully understand the contents of this document it is highly recommended that the *SCM Use Cases v 1.0* as well as the *Usage Scenarios v 1.0* documents be consulted in conjunction with this document. A quick overview of the various stages of interactions for the Sample Application can be found in section 5.2, Figure 9.

In order to inject some realism into the sample application, a single top down design was not attempted. Rather each main system (Retailer, Manufacture, Demo) has been designed and architected separately and brought together via web services. This should reflect the real world of connecting autonomous organizations together without the luxury of a global architecture and design.

The document is divided into four main sections and has an intended audience which includes Architects, Designers and Implementers of WS-I compliant web services. Each section of this document starts with a glossary of terms used to help clarify specific areas of discussion.

Section 3, “Retailer System Architecture”: This section provides an in-depth look at the various web services and associated methods required for a consumer to order product and simultaneously receive a response indicating which items were shipped. Additionally, this section describes a web service that is invoked by the retailer’s warehouse which checks each line item in the order for product availability.

Included in this section are several architectural diagrams that provide different views of the application mechanics, including interfaces, roles and responsibilities, business rules to help facilitate WSDL design, processes as well as the information collected and maintained. Also, the reader will discover which usage scenarios were implemented as well as the recommended message style.

Section 4, “Manufacturing System Architecture”: Here we look at the various web services and associated methods required to supply finished goods to the warehouses. Like Section 3, this section contains detailed architectural mechanics, usage scenario and message style selection as they relate to the manufacturing architecture.

Section 5, “Demo System”: This section examines how various use cases were implemented in the development of the demo application that will be showcased on the WS-I web site. Section 5.2 provides the reader with a step-by-step roadmap of the processes involved to interact with the demo. Like previous sections, this section contains detailed architectural mechanics, usage scenario and message style selection as they relate to specific pieces of the demo application.

Section 6. “Design Aspects of the Basic Sample Application”: This section describes the technical design aspects of the Basic Sample Application. The technical descriptions of the Web services and their

associated schemas are included here, as are the fundamentals of the showcase User Interface, logging of events, fixed sample data, and the advertisement of sample Web services in UDDI. The reader will find several examples of XML code to assist them in the UDDI registration of their web services.

2 Document References

Document	Description
Usage Scenarios	This document describes Usage Scenarios, as defined by the Scenarios and Design Sub-team of the Basic Sample Applications Workgroup for the WS-I.
SCM Use Cases	This document contains the use cases on which this Architecture and Domain Model has been based.

3 Retailer System Architecture

This section pertains to the technical design and implementation of the Basic Profile Sample Application. In particular it defines the Retailer part of the system defined in the SCM use case document.

The domain model and architecture described in this section relates to the retailer system and its related use cases as defined in the *SCM Use Cases v 1* document, and as such should be read in conjunction with that document.

The various types of diagrams (class, sequence, deployment, etc.) included in this section each provide a different view of the application, including its interfaces, roles and responsibilities, business rules, processes as well as the information collected and maintained.

In general this model is implementation independent except where technical constraints are given as part of the requirements.

3.1 Retailer System Glossary

Term	Description
Catalog	A listing of catalog entries
Catalog Entry	The details about a product (name, description, category, price, etc)
Consumer	A party that wishes to purchase product from a Retailer

Inventory Item	The details of a product as it relates to a warehouse (product code, warehouse location, number in stock, minimum stock level, maximum stock level)
Line Item	An entry in an order relating to a single product (product code, required quantity)
Manufacturer	A party that supplies finished goods to a Retailer's warehouses.
Order (or Purchase Order/PO)	A request from a Consumer asking to purchase products. An order consists of one or more line items
Product	A tangible entity that can be sold – finished goods
Shipping Notice (SN)	A notice sent to a consumer in response to a purchase order stating that the line items have been shipped.
Retailer	A party that offers products for sale
Warehouse	An entity that stores products and maintains an Inventory level for each stocked product

3.2 Retailer System Overview

The Retailer will present a Web service for some third party system to access its services. In the Sample Application this will be the Demo System. The Retailer web service provides a façade onto the Retailer System, providing operations to access the catalog of products and to place orders. Within the Retailer System there are three instances of the warehouse web services, one for each of warehouse A, B and C defined in the Use Case document. These warehouses will in turn call out to the three Manufacturing systems, whose architecture is defined in Section 4. To facilitate this interaction the warehouse has to provide a callback interface – these and the retailer web service are the only external entry points into the Retailer system. For the purpose of the Sample Application the Retailer System relies on the Logging service provided by the Demo System.

3.3 Deployment Diagram

Figure 1 shows a conceptual view of an implementation of a Retailer System.

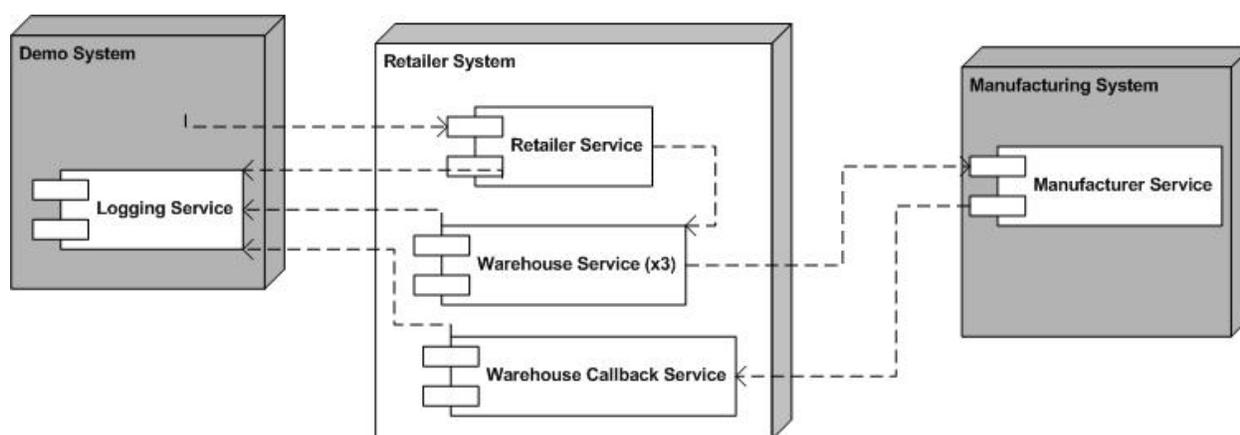


Figure 1: Retailer System Deployment Diagram

3.4 Retailer System Web services

The operations, message types and other relevant information for each Web service are outlined in the sections below. These sections specify key details to be defined in the associated WSDL files. The exact structure of these files is to be resolved as part of the implementation of this sample application.

The Retailer System will contain the following web services:

- Retailer Service
- Warehouse Service
- Warehouse Callback Service.

In addition, the Retailer System depends on two other services external to itself and defined elsewhere:

Logging Service - defined in the Demo System section.

Manufacturer Service – defined in the Manufacturing System section.

Profiles

The web services will be based on the WS-I Basic Profile V1.0.

Usage Scenarios

The web services in the retailer system will rely on the following usage scenarios (refer to Usage Scenarios document):

- Synchronous Request/Response
- Basic Callback
- One-way

3.4.1 Retailer Service

Operations/Message Types

The following operations/message types should be supported, and shall follow the synchronous request/reply scenario:

Operation	Msg. Type	Message	Parameters	Type
submitOrder	Input	submitOrderRequest	PartsOrder	PartsOrderType
			Customer Details	CustomerDetailsType
			Configuration Header	Configuration
	Output	submitOrderResponse	Response	PartsOrderResponseType
	Fault	BadOrder		Client

	Fault	InvalidProductCode		Client
	Fault	ConfigurationFault		Client

Operation	Msg. Type	Message	Parameters	Type
getCatalog	Input	getCatalogRequest		
	Output	getCatalogResponse	return	CatalogType

3.4.1.1 submitOrder

Description

Refer to UC (Use Case)1 and UC2. The consumer submits an order and receives a response indicating which goods will be shipped. To determine which goods can be shipped Warehouse A, B, and C are asked in turn (see warehouse service).

The input of the `submitOrder` operation is a `PartsOrder` of type `PartsOrderType`. This is a sequence of items consisting of "productNumber", "quantity", and "price". The output of the `submitOrder` operation is a `Response` of type `PartsOrderResponseType`. This is a sequence of items consisting of "productNumber", "quantity", "price", and "comment". Each "productNumber" in the request will have a corresponding item in the response. In the response, the "quantity" will either be the same as the "quantity" in the request, or zero if no Warehouse is able to fulfill the order. Also, the "price" in the response is actually the sub-total for that particular item, which is calculated as the "quantity" in the response times the product price as obtained from the product catalog (i.e. *not* the "price" in the request).

A `BadOrder` fault is returned if the order is malformed and cannot be interpreted, or contains no line items.

An order is rejected, with an `InvalidProductCode` fault, if it contains a line item with an invalid (i.e. unknown) product code.

A `ConfigurationFault` fault is returned if there is a problem in the configuration header.

Scenario

The scenario used will be Synchronous Request/Response using SOAP over HTTP.

Message Style

The `rpc/literal` message style will be used.

3.4.1.2 getCatalog

Description

Refer to UC1. A call to this operation results in the Retailer sending over the list of products that it sells, this list would need to be rendered in order to present to a user. There are no input parameters as there is no choice of catalogs or parts of a catalog.

Scenario

The scenario used will be Synchronous Request/Response using SOAP over HTTP.

Message Style

The the rpc/literal message style will be used.

3.4.2 Warehouse Service**Operations/Message Types**

The following operations/message types should be supported, and all shall follow the synchronous request/reply scenario:

Operation	Msg. Type	Message	Parameters	Type
ShipGoods	Input	ShipGoodsRequest	ItemList	ItemList
			Customer	CustomerReferenceType
			Configuration Header	Configuration
	Output	ShipGoodsResponse	Response	ItemShippingStatusList
	Fault	ConfigurationFault		Client

3.4.2.1 ShipGoods**Description**

Refer to UC 1 and UC2. A call to this service results in the warehouse checking each line item in the order. If for each line item the required quantity is in stock, the warehouse will ship that line item (and hence reduce the stock level). It will record which ones it has shipped and which ones it does not have enough stock for and hence cannot ship; the response will contain this list.

A `ConfigurationFault` fault is returned if there is a problem in the configuration header.

The reduction of the stock level below the minimum level will trigger the warehouse to call on the Supply service of the relevant manufacturer (defined in the Manufacturing System Domain Model and Architecture section).

Scenario

The scenario used will be Synchronous Request/Response using SOAP over HTTP.

Message Style

The rpc/literal message style will be used.

3.4.3 Warehouse Callback Service**Operations/Message Types**

The following operations/message types should be supported:

Operation	Msg. Type	Message	Parameters	Type
SubmitSN	Input	SNSubmit	shippingNotice	doc
			ConfigurationHeader	Configuration
			CallbackHeader	CallbackHeader
	Output	ackSN	Response	boolean
	Fault	ConfigurationFault		Client
	Fault	CallbackFault		Server

Operation	Msg. Type	Message	Parameters	Type
ErrorPO	Input	ProcessPOFault	ProcessPOFault	SubmitPOFault
	Output	AckPO	Response	boolean
	Fault	ConfigurationFault		Client
	Fault	CallbackFault		Server

3.4.3.1 SubmitSN

Description

Refer to UC3 and UC4. A call to this service indicates that the manufacturer has finished processing an order.

If the manufacturer's processing has been successful, the manufacturer will submit the shipping notice using the `SubmitSN` operation. If the shipping notice can be correlated to an order placed with a manufacturer, a positive acknowledgement is sent in the reply; otherwise a `callbackfault` is returned.

In this version of the sample application, all responses will cause the Manufacturer to consider the order request complete i.e. no further processing of the order will take place.

Scenario

The scenario used will be the reply/callback portion of the Basic Callback Scenario using SOAP over HTTP.

Message Style

The doc/literal message style will be used.

3.4.3.2 ErrorPO

Description

Refer to Use cases 3 and 4. A call to this service indicates that the manufacturer has finished processing an order but there had been an error in doing so.

If the Manufacturer's processing of the order has not been successful, the Manufacturer will provide a reason using the `ErrorPO` operation.

For any PO, a Manufacturer may only invoke one of `submitSN` or `ErrorPO`.

Scenario

The scenario used will be the reply/callback portion of the Basic Callback Scenario using SOAP over HTTP.

Message Style

The doc/literal message style will be used.

3.4.4 WSDL

The Retailer Service is defined by two schemas and one WSDL document. The schemas are imported into the *types* section of the WSDL.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Retailer.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/RetailOrder.xsd>

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/RetailCatalog.xsd>

Because the Retailer uses and passes showcase configuration information to Warehouses in a Configuration header, the Retailer also imports a Configuration WSDL and schema. The Configuration Header Fault is described in the WSDL, and the data types used in the Configuration header and header fault are described in the schema.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configuration.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configuration.xsd>

The Warehouse Callback Service is defined as part of the Manufacturing system and consists of one schema and one WSDL document.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Manufacturer.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/ManufacturerPO.xsd>

3.5 Class Diagram

The class diagram below describes the different types of objects and data elements involved in the retailer system and the relationships that exist among them. It serves to define the vocabulary of the system and helps to define the schemas. This is a conceptual diagram and is not meant to impose any structure on implementations.

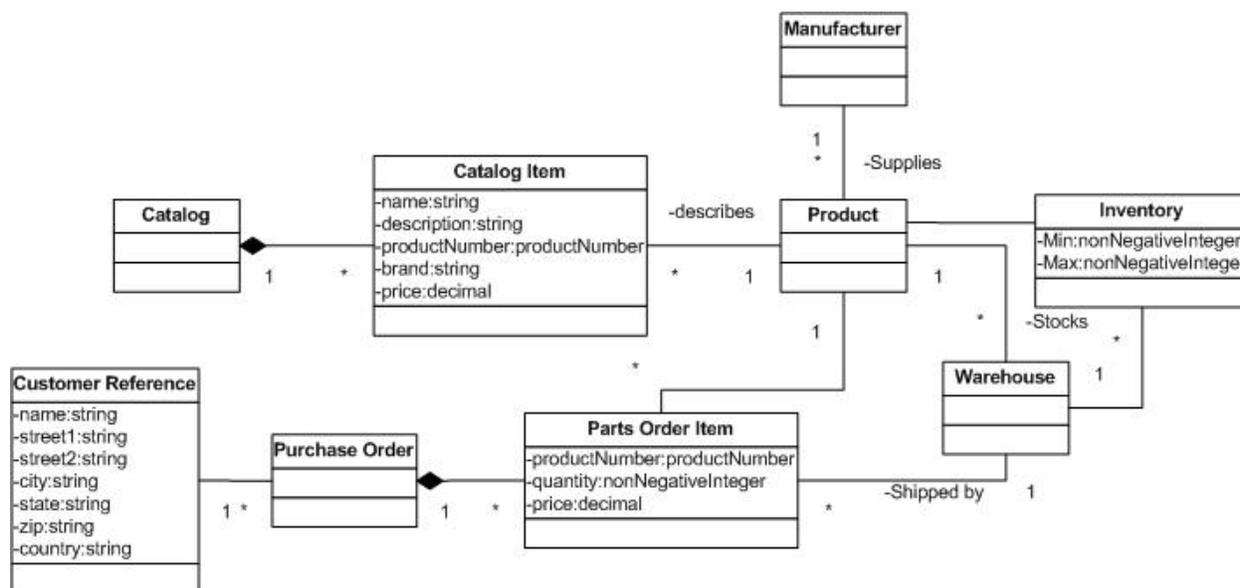


Figure 2: Class Diagram for the Retailer System

3.6 Sequence Diagrams

The sequence diagrams below describe how the groups of objects interact with each other.

3.6.1 UC1: Purchase Goods

Use Case 1 maps to the interactions between the invoker (a retailer provided web page) and the Retailer Service.

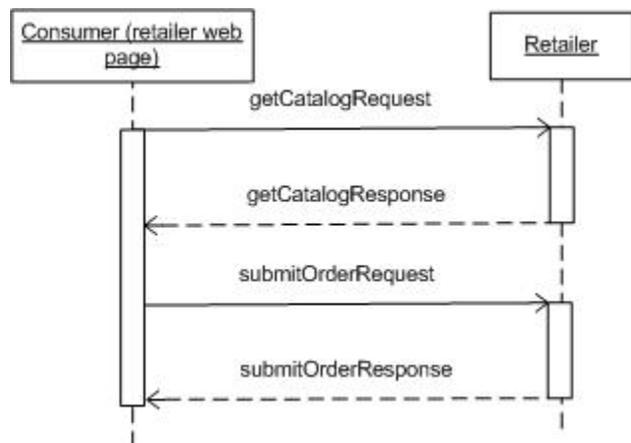


Figure 3: Sequence Diagram for Use Case 1 and the relevant Web services

3.6.2 UC2: Source Goods

Use Case 2 maps to the interactions between the Retailer Service and Warehouse Services A, B, and C.

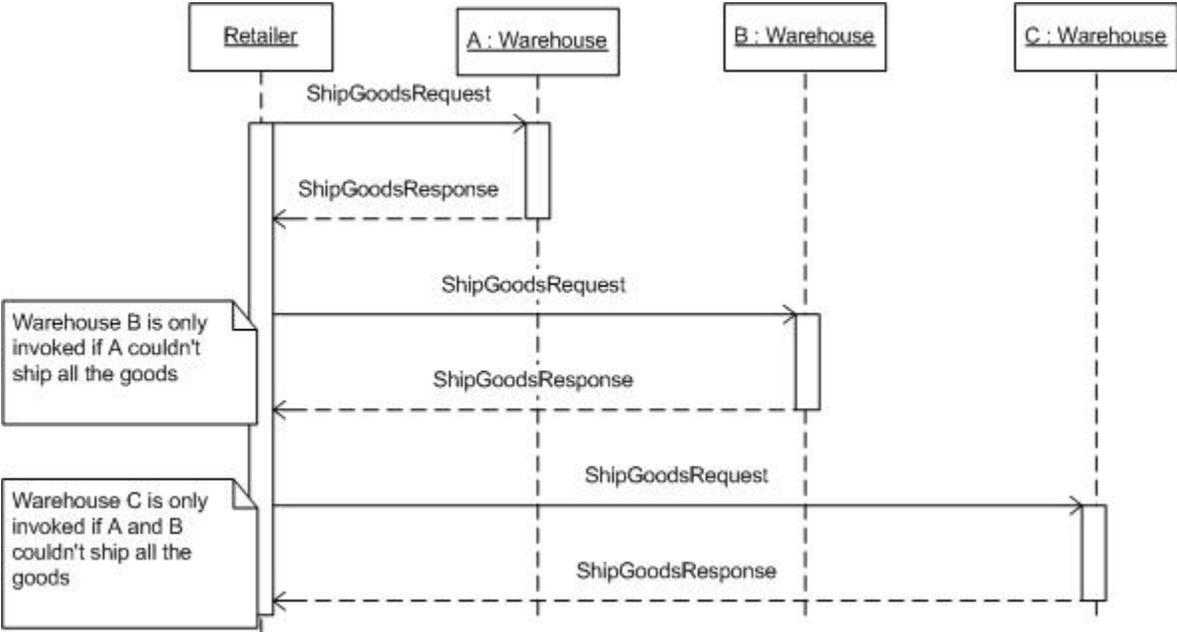


Figure 4: Sequence Diagram for Use Case 2 and the relevant Web services

3.6.3 UC3: Replenish Stock

Use case 3 maps to the interactions between a warehouse and a manufacturer (Figure 5 **Error! Reference source not found.**). Use case 4 describes the manufacturer side of this interaction.

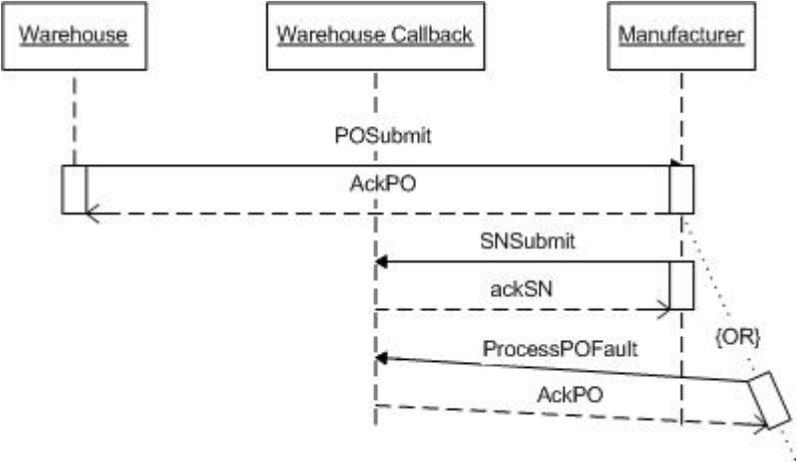


Figure 5: Sequence Diagram for Use Case 3 and the relevant Web services

4 Manufacturing System Architecture

This section pertains to the technical design and implementation of the Manufacturer System of the Basic Profile Sample Application as specified in the *SCM Use Cases v 1* document.

The domain model described in this section relates to the following use cases outlined in the *SCM Use Cases v 1* document, and as such should be read in conjunction with that document:

- UC4: Supply Finished Goods
- UC5: Manufacture Finished Goods

The various types of diagrams (class, sequence, deployment, etc.) included in this section each provide a different view of the application, including its interfaces, roles and responsibilities, business rules, processes as well as the information collected and maintained.

In general this model is implementation independent except where technical constraints are given as part of the requirements.

4.1 Manufacturing System Glossary

Term	Description
Inventory Item	The details of a product as it relates to availability (product code, number in stock)
Line Item	An entry in an order relating to a single product (product code, required quantity)
Manufacturer	A party the supplies finished goods to a purchaser.
Product	A tangible entity that can be sold, finished goods
Purchaser	Party requesting finished goods.
Purchase Order	A request from a purchaser to buy products consisting of one or more line items

4.2 Manufacturing System Overview

The Manufacturing system supplies finished goods to warehouses. Requests for finished goods may be fulfilled by the Manufacturer by supplying from internal stock or, if the required quantity is not available, by scheduling a production run. Since there could be a considerable time delay between receiving the order and informing the warehouse of shipment of goods, an asynchronous processing model is used. This allows a warehouse to proceed on other business, and allows the Manufacturer to callback to the Warehouse once the order has been fulfilled.

4.3 Deployment Diagram

Below is a conceptual view of an implementation.

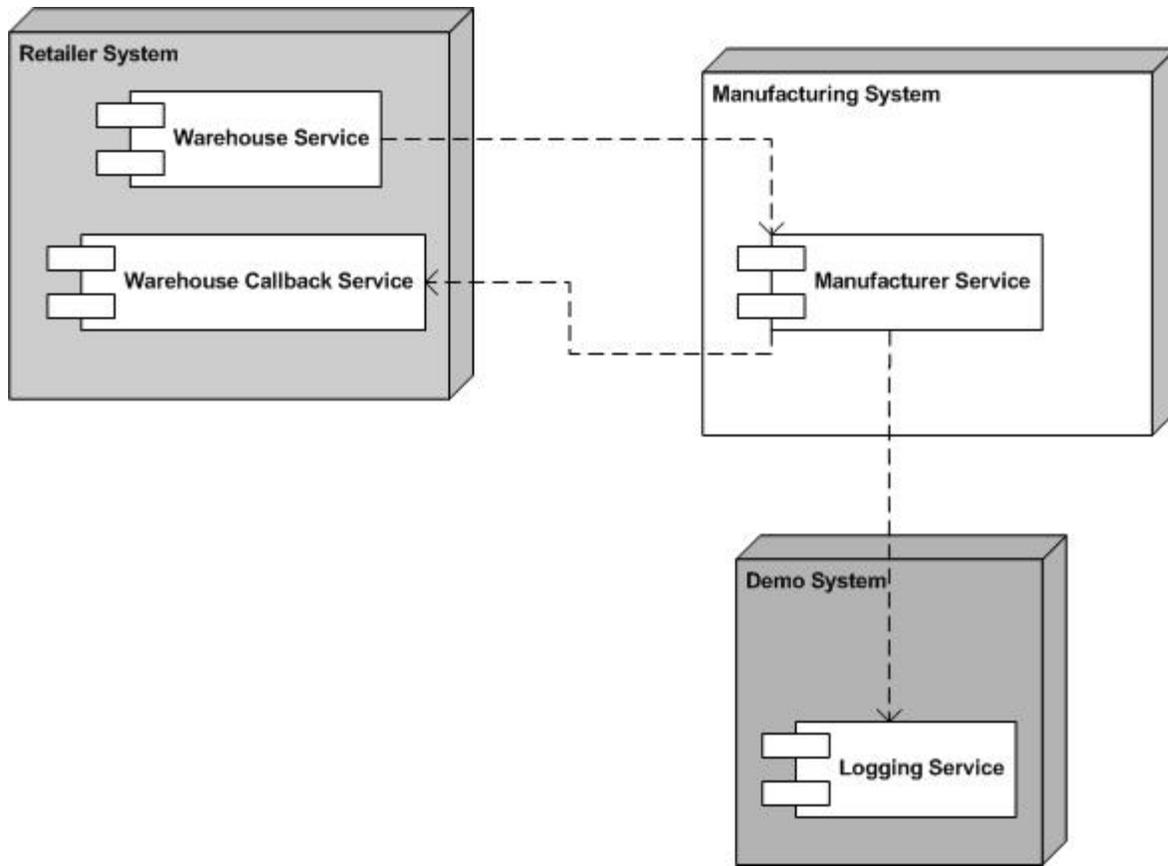


Figure 6: Deployment Diagram for the Manufacturing System

4.4 Manufacturing System Web services

The operations, message types and other relevant information for each Web service are outlined in the sections below. These sections specify key details to be defined in the associated WSDL files. The exact structure of these files is to be resolved as part of the implementation of the sample application.

The Manufacturer System portion of the sample application will contain the following web services:

- Manufacturer Service

Profiles

The web services will be based on the WS-I Basic Profile V1.0.

Usage Scenarios

The web services in the sample application will rely on the following usage scenarios (refer to Usage Scenarios document):

- Synchronous Request/Reply
- Basic Callback

4.4.1 Manufacturer Service

Operations/Message Types

The following operations/message types should be supported:

Operation	Msg. Type	Message	Parameters	Type
submitPO	Input	POSubmit	PurchaseOrder	doc
			ConfigurationHeader	Configuration
			StartHeader	StartHeader
	Output	ackPO	Response	boolean
	Fault	POFault		Client
	Fault	ConfigurationFault		Client

4.4.1.1 submitPO

Description

The purpose of this operation is to place a purchase order with the manufacturer for finished goods. PurchaseOrder is a set of line items describing ordered finished goods ([see class diagram](#)). StartHeader is detailed in the Basic Callback Scenario. This message header contains a callback location and message identifier to be retained by the system for sending the shipping notification in the final request/response. Response is a tacit acknowledgement that the purchase order was received and validated. If the purchase order is invalid for any reason (such as invalid schema, invalid quantity, and invalid product number), a POFault is sent to the client.

Scenario

The scenario used will be the initial request/response portion of the Basic Callback Scenario using SOAP over HTTP.

Message Style

The doc/literal message style will be used.

4.4.2 WSDL

The Manufacturer is defined by a schema and [part of] a WSDL document. The schema is imported into the *types* section of the WSDL. As mentioned above, the Manufacturer WSDL document contains two port types and bindings which together describe a single Web service type. The ManufacturerPortType and associated messages and bindings apply to the Manufacturer; the other applies to the Warehouse.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Manufacturer.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/ManufacturerPO.xsd>

Because the Manufacturer uses and passes showcase configuration information to Warehouses in a Configuration header, the Manufacturer also imports a Configuration WSDL and schema. The Configuration Header Fault is described in the WSDL, and the data types used in the Configuration header and header fault are described in the schema.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configuration.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configuration.xsd>

4.5 Class Diagram

The class diagram below describes the different types of objects and data elements involved in the manufacturing system and the relationships that exist among them. It serves to define the vocabulary of the system and helps to define the schemas. This is a conceptual diagram and is not meant to impose any structure on implementations.

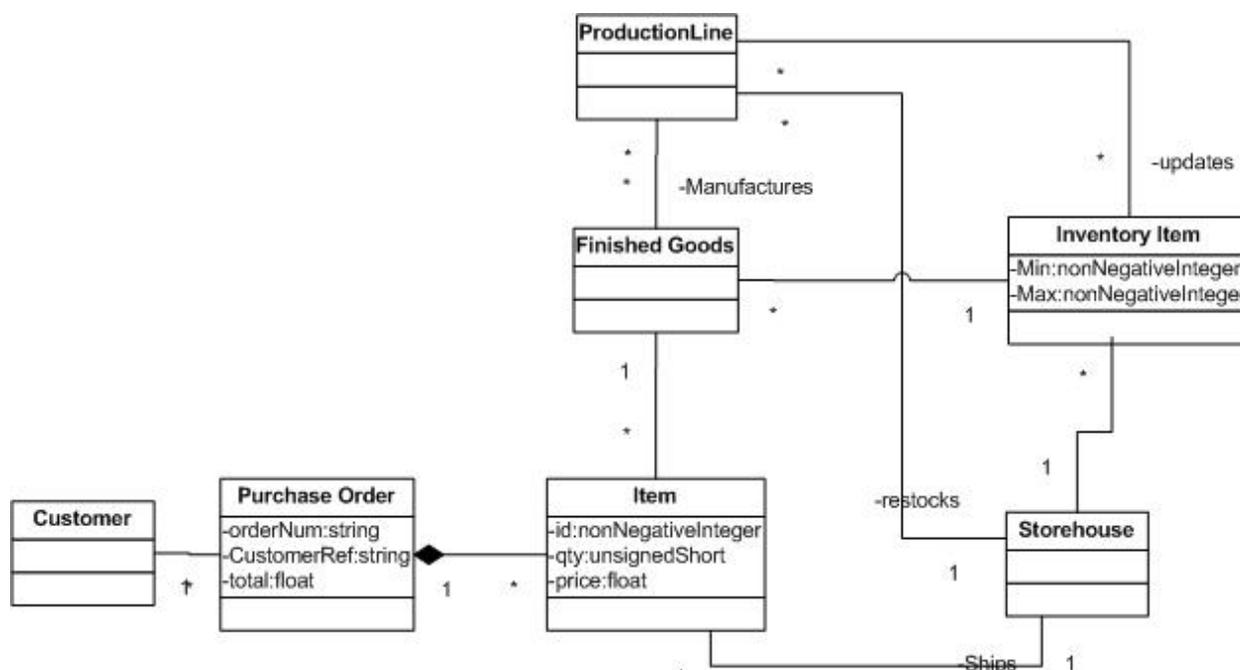


Figure 7: Manufacturer Class Diagram

4.6 Sequence Diagrams

The sequence diagrams below describe how the groups of objects interact with each other. The diagram below shows the behavior of both Use Case 4 and Use Case 5. See also the Retailer System, Section 3.6.3.

5.1 Demo System Glossary

Term	Description
Demo user	Person accessing WS-I web site for the purpose of trying out the sample application.
Configuration	Settings that allow demo user to direct which implementations to use in order to purchase goods, manufacture goods, order parts, etc.
Consumer	Person accessing the Retailer web site for the purpose of purchasing consumer electronics.

5.2 Sample Application Flow

Access to the sample application begins at the WS-I.org web site, which will be referred to as the “WS-I welcome” page. The welcome page will have a link to another web page hosted by the WS-I.org web site. This web page shall be called the “sample app” page. The sample app page will contain a description of the sample application, probably a link for obtaining the source code, and instructions for demonstrating how the sample application works. It will also contain one or more buttons or links for getting to the next web page called the “configuration” page.

The configuration page is where UC6: Configure & Run Demo begins. This page will present the demo user with a number of configuration options. These options select implementations for each of the web services in the sample application¹. Having made his/her selections, the demo user clicks on a “start a new demo” button, which brings the demo user to a web page where he/she can order products. We will call this the “shopping cart” page. This is where UC1: Purchase Goods begins. Before the demo user reaches the shopping cart page, a unique ID is generated to identify the events that are logged as a result of running the demo. This ID is necessary as it is entirely possible that more than one person may be running the demo at the same time. Such concurrent usage would result in log entries that might not make sense when viewed together, but when filtered based on ID they will illustrate the chain of events typical of a Supply Chain Management application.

On the shopping cart page, the demo user selects quantities of products to order, then clicks on a “submit order” button. This causes the demo system to invoke the Retailer web service. Once the Retailer has processed the order, the demo system displays the status of the order (i.e. how many and which products will be shipped). This is referred to as the “order status” web page. From the order status web page, the demo user may optionally select to view the events that occurred in the supply chain as a result of placing an order. This is done on the “track order” web page.

From either the order status page or the track order page, the demo user may return to the configuration page to start a new demo. The previous configuration will be presented as a default, but the demo user is

¹ The implementer(s) of the configuration web page are free to decide if the Configurator web service is to be fixed (i.e. hard-coded), or itself configurable. Note that if the Configurator web service is to be configurable, that selection must be made by the demo user prior to selecting registered implementations of the other web services in the sample application.

free to change the configuration in order to test interoperability. Note that it is not possible for the demo user to return to the shopping cart page from either the order status page or the track order page. In other words, the only way for the demo user to go back and order more products is to return to the configuration page first. Figure 9 below presents a graphical representation of the flow of the sample application.

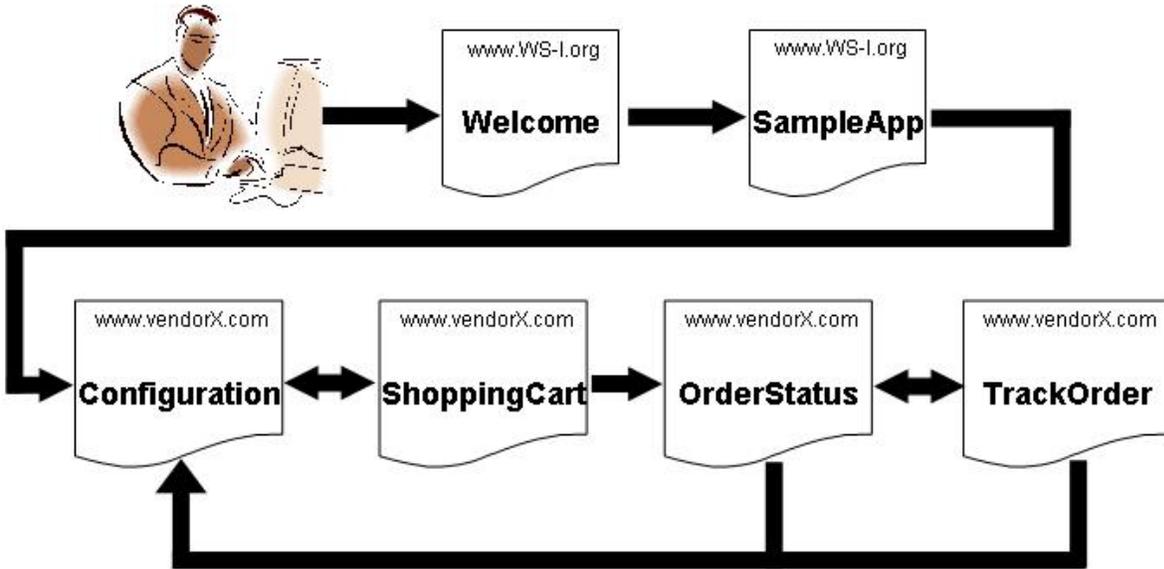


Figure 9: Sample Application Flow

5.3 Deployment Diagram

Figure 10 shows a conceptual view of an implementation.

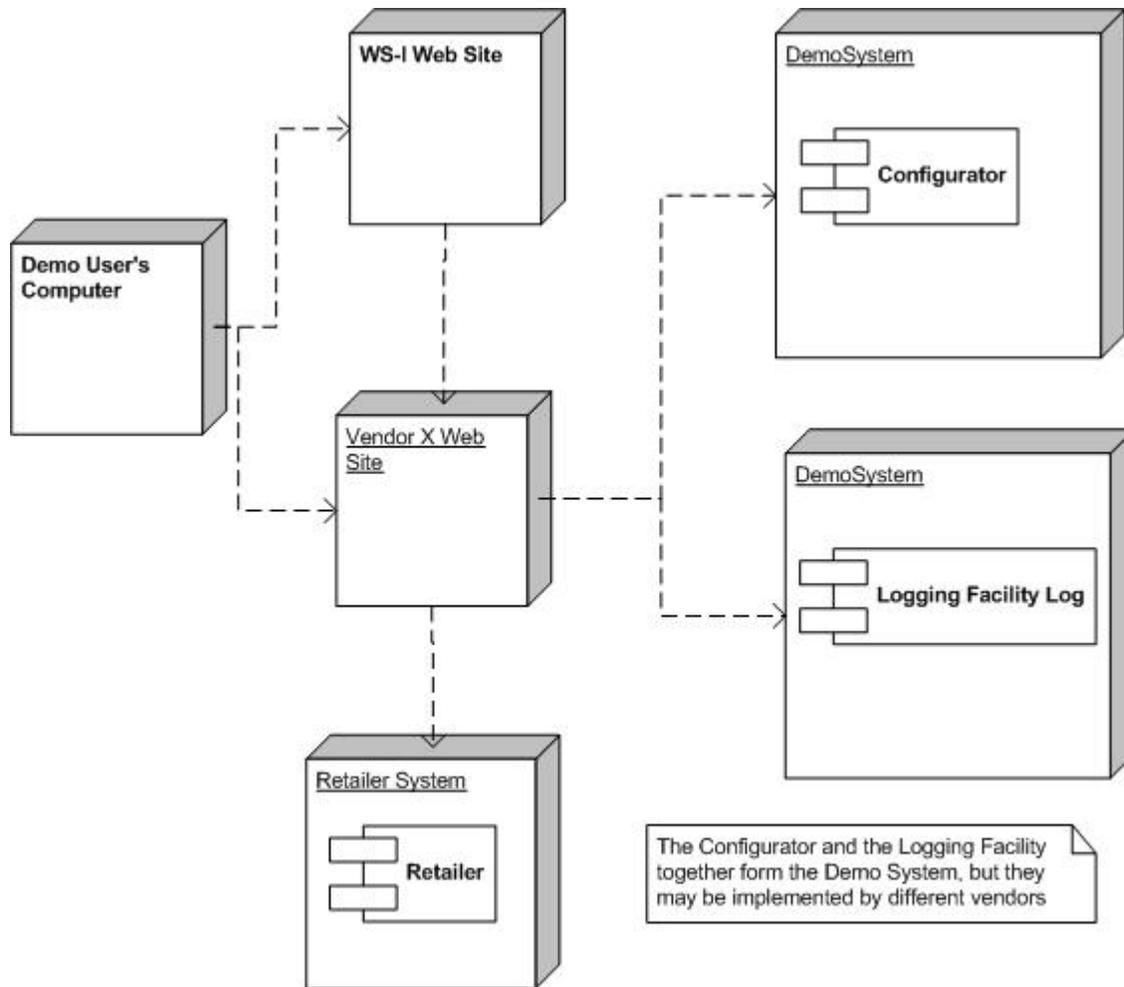


Figure 10: Demo System Deployment Diagram

5.4 Demo System Web services

This section identifies the Web services which will be used in the implementation of the previously described architecture of the sample application. The sample application will be composed of discovered Web services that utilize the usage patterns as captured in the Basic Profile Usage Scenarios document, and that conform to the various aspects of the Basic Profile.

The operations, message types and other relevant information for each Web service are outlined in the sections below. These sections specify key details to be defined in the associated WSDL files. The exact structure of these files is to be resolved as part of the implementation of the sample application.

The Demo System portion of the sample application will contain the following web services:

- Configurator
- Logging Facility

Profiles

The web services will be based on the WS-I Basic Profile V1.0.

Usage Scenarios

The web services in the sample application will rely on the following usage scenarios (refer to Usage Scenarios document):

- Synchronous Request/Response
- One-way

5.4.1 Configurator

Operations/Message Types

The following operations/message types should be supported:

Operation	Msg. Type	Message	Parameters	Type
getConfigurationOptions	Input	getConfigurationOptions	Refresh	Boolean
	Output	getConfigurationOptionsResponse	Response	sequence of configOptions
	Fault	configuratorFailedFault		Server

Operation Descriptions

5.4.1.1 getConfigurationOptions

Description

The purpose of this operation is to retrieve a list of all of the implementations registered in the UDDI registry for each of the web services in the sample application. Note that the implementation of the Configurator web service may choose to cache the results of the UDDI look-ups.

Parameters

Refresh – This is a flag which tells the Configurator web service whether or not the implementations should be looked up in UDDI. True = perform UDDI look-ups; false = perform UDDI lookup or return cached results (in other words false is a hint to implementations).

All implementations – This is what is returned to the caller if there was no error in accessing the UDDI registry or (optional) internal cache. It is a structure with multiple sections, one section for each “role” (i.e. web service type) in the sample application. Each section contains a list of structures, one structure for each implementation, containing the endpoint URL as well as the vendor name, platform and language for the registered implementations of that role.

configuratorFailedFault – This is a fault which is raised if there was an error in accessing the UDDI registry or (optional) internal cache (i.e. no implementations returned).

Scenario

The scenario used will be Synchronous Request/Response using SOAP over HTTP.

Message Style

The doc/literal message style will be used.

5.4.2 Configurator WSDL

The Configurator is defined by a schema and a WSDL document. The schema is imported into the *types* section of the WSDL.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configurator.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configurator.xsd>

The Configurator uses some of the data types defined for the Configuration header. The schema that defines the Configuration header is therefore imported.

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/Configuration.xsd>

5.4.3 Logging Facility

Operations/Message Types

The following operations/message types should be supported:

Operation	Msg. Type	Message	Parameters	Type
logEvent	Input	logEvent	DemoUserID	string
			ServerID	string
			EventDescription	string
			EventId	string
	Output	n/a	n/a	n/a

Operation	Msg. Type	Message	Parameters	Type
getEvents	Input	getEvents	DemoUserID	string
	Output	getEventsResponse	Response	Sequence of LogEntry
	Fault	RepositoryMissingFault		Server

Operation Descriptions

5.4.3.1 logEvent

Description

The purpose of this operation is to log an event that has occurred in one of the other systems in the sample application.

Parameters

DemoUserID – This is a string which identifies a demo user. The getEvents operation will retrieve all events for a specified DemoUserID.

ServerID – This is a string which identifies the server which requested the event to be logged.

EventDescription – This is a string which contains a description of the event being logged (e.g. “5 units of item X shipped from WarehouseB” or “10 units of item Y ordered from ManufacturerZ”).

Note: it is possible to send extra XML elements to be logged, which may be ignored if the “processContents” attribute equals “lax”.

Scenario

The scenario used will be one-way messaging using SOAP over HTTP.

Message Style

The doc/literal message style will be used.

5.4.3.2 getEvents

Description

The purpose of this operation is to retrieve all of the events that have occurred as the result of action taken by the demo user.

Parameters

DemoUserID – This is a string which identifies the demo user for whom events are being retrieved.

Response – This is what is returned to the caller as long as the repository is available. It is a sequence of structures, where each structure contains the following four items: Timestamp, ServerID, EventID and EventDescription. The last three items are exactly the same as those provided as input to the logEvent operation. The DemoUserID is not returned in the response as it was specified in the request.

RepositoryMissingFault – This is a fault which is raised if the repository used to store the log entries is unavailable for whatever reason.

Scenario

The scenario used will be Synchronous Request/Response using SOAP over HTTP.

Message

The message style used will be the doc/literal message style.

5.4.4 Logging Facility WSDL

The LoggingFacility is defined by a schema and a WSDL document. The schema is imported into the *types* section of the WSDL.

WSDL

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/LoggingFacility.wsdl>

Schema

<http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-08/LoggingFacility.xsd>

5.5 Class Diagram

The class diagram below describes the different types of objects and data elements involved in the demo system and the relationships that exist among them. It serves to define the vocabulary of the system and helps to define the schemas. This is a conceptual diagram and is not meant to impose any structure on implementations.

Figure 11 below shows the different types of objects in the Demo system.

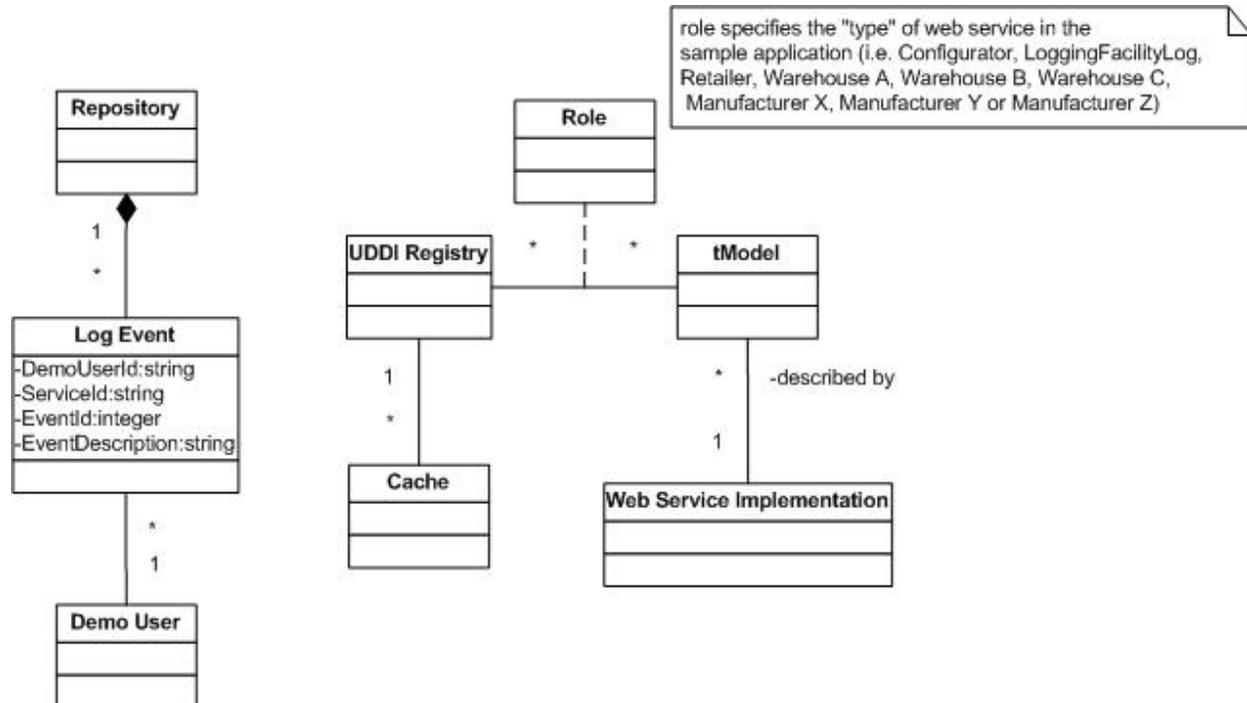


Figure 11: Class Diagram for Demo System

5.6 Sequence Diagrams

The sequence diagrams below describe how the groups of objects interact with each other. Each diagram shows the behavior of a single use case.

5.6.1 UC6: Configure & Run Demo

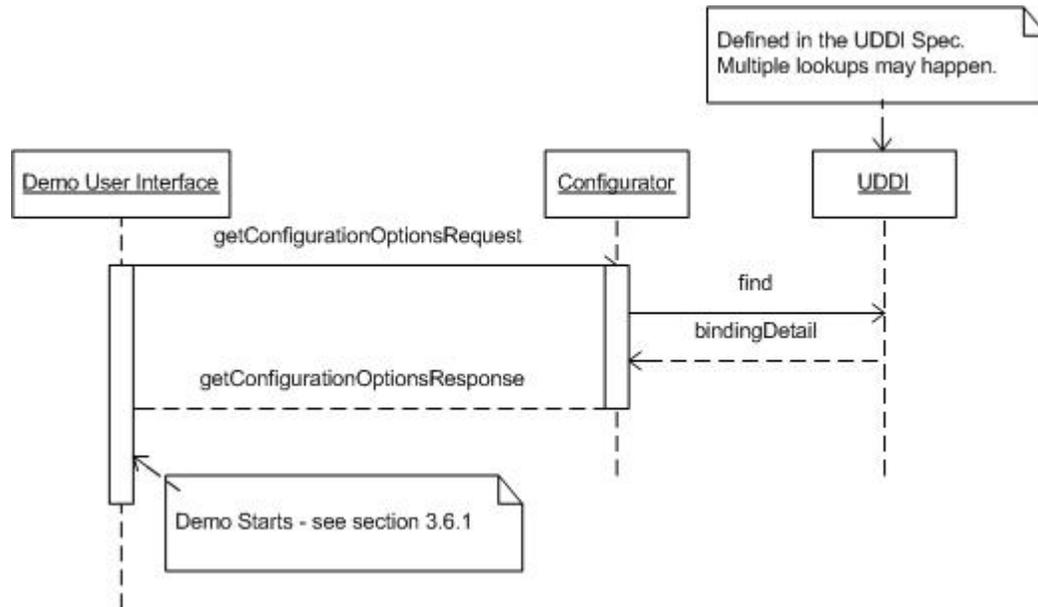


Figure 12: Sequence Diagram for UC6: Configure & Run Demo

When the demo user requests the demo URL, the `DemoUI` class calls the `Configurator` class to get the list of all possible implementations of each and every web service in the sample application. The `Configurator` class in turn calls the UDDI registry to look-up all of the implementations. The `Configurator` class may decide to cache the results of the look-ups.

Having received the list of all possible implementations, the `DemoUI` class then presents the choices to the demo user by displaying the configuration user interface (web page). The demo user then selects implementation options (presumably from drop-down list boxes, though other UI widgets may be used) and submits these selections back to the `DemoUI` class (presumably by pressing a "Submit Choices" button, though other UI widgets may be used).

When the `DemoUI` class receives the demo user's selections, it generates an ID (which will be used for retrieving log events pertaining to the demo user), creates a `Configuration SOAP Header` (which will be passed along to the other systems in the sample application), and then proceeds to display the product order web page.

5.6.2 UC7: Log Events

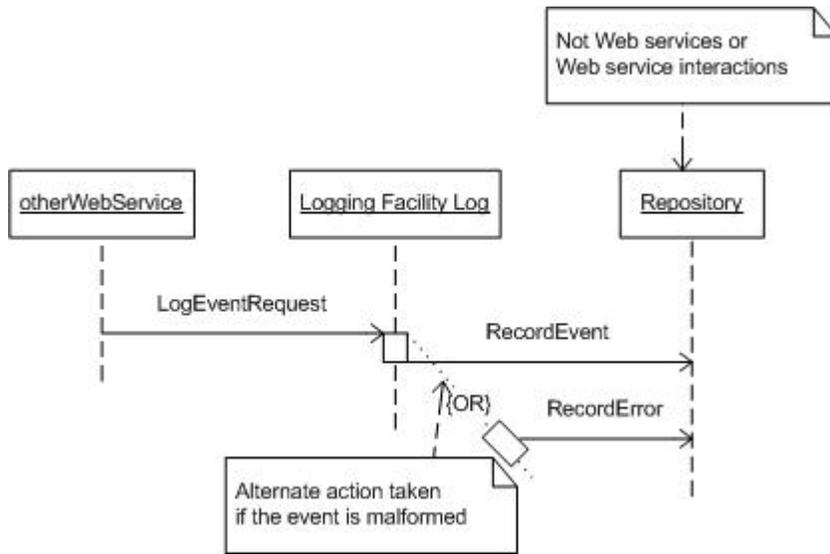


Figure 13: Sequence Diagram for UC7: Log Events

This use case is very simple and straight-forward: at some significant point in the execution of one of the other use cases in the Supply Chain Management sample application, a web service may decide to log the fact that some event has occurred in the system as a result of the demo user interacting with the Retail system. The calling web service collects all the information to be logged, and sends it to the logging facility using a one-way call (which is why the sequence diagram does not show a return from the logging facility back to the calling web service).

When the logging facility receives the request to log an event, it validates the request, and if the request is valid, proceeds to save the information sent to it in the log that it maintains. If the request is invalid, the logging facility will log the reason for the invalid request (e.g. message does not conform to schema). Of course, before saving a new entry in the log, the logging facility should check that the repository which it is using for storing the log entries is available. Different implementations will provide different qualities of service, but it is assumed that log entries will have a minimum life-span of one hour.

5.6.3 UC8: View Events

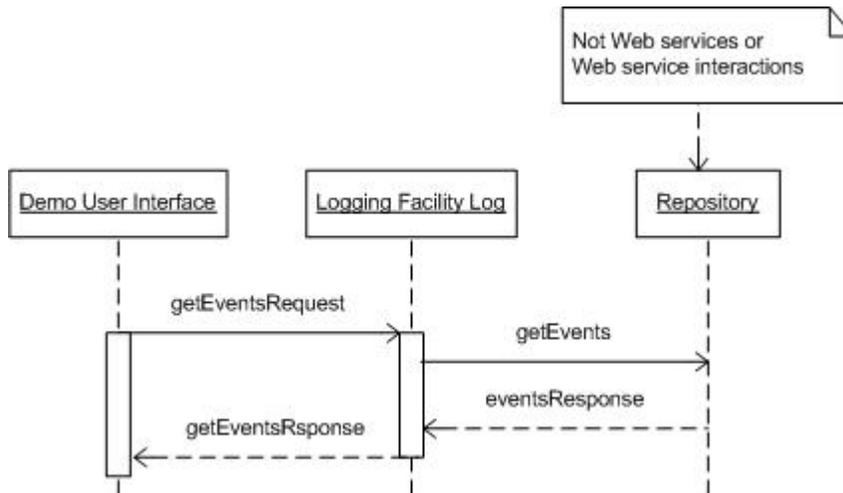


Figure 14: Sequence Diagram for UC8: View Events

The view events use case is initiated by the demo user navigating to the appropriate place in the user interface. This can be either a link or a button. Once the demo user has clicked on the button (or hyper-text), the user interface calls the logging facility to retrieve the log entries associated with the current demo user.

The logging facility accesses its repository of log entries, extracts the appropriate ones, and returns them to the user interface, which then displays them to the demo user. If for some reason the repository of log entries cannot be accessed, then a fault is returned to the user interface, and error message is displayed to the demo user.

6 Design Aspects of the Basic Sample Application

This section describes the technical design aspects of the Basic Sample Application. The technical descriptions of the Web services and their associated schemas are included here, as are the fundamentals of the showcase User Interface, logging of events, fixed sample data, and the advertisement of sample Web services in UDDI.

Implementations of WS-I Basic Sample Application Web services are provided by individual WS-I members. Some members may host live instances of their Web services. WS-I provides access to these hosted instances through a showcase version of the Basic Sample Application that can be launched from the WS-I Web site.

6.1 Basic Sample Application User Interface Fundamentals

One or more front ends to the Basic Sample Application may be implemented by WS-I member companies. These contributors may host live instances of their front ends which can be accessed from the the WS-I interoperability showcase.

The sample Web services are designed around a simple transaction model that the front ends must enforce. The front end assigns a unique id to each user of the demo every time a configuration is chosen. The front end is required to force the user to the configuration selection, and generation of a new unique id, each time a new order is to be made, as this defines a transaction boundary. After the user concludes submission of an order, the events logged for that request can be viewed through the front end. But if when the user wants to try a different order, s/he must start by selecting a configuration, and thus be assigned a new unique ID. It's suggested, but not required, that the previous configuration be retained for the same user so that incremental changes can be made when starting a new transaction.

The front end invokes a Configurator Web service to obtain the list of Web service instance choices. In the WS-I interoperability showcase, this list of choices is obtained from the UDDI business registry. The showcase further offers a choice of Configurator Web service to use. When the user has chosen a configuration and has elected to proceed with constructing an order, the front end retrieves the product catalog from the chosen Retailer Web service. The chosen Retailer Web service is also used to submit the order the user constructs. Finally, the front end uses the chosen LoggingFacility Web service to obtain the log events associated with the transaction's unique ID. These log event provide evidence of progress through the supply chain.

6.2 Basic Sample Application Web Service Descriptions

The Basic Sample Application is composed of a set of Web service implementations with a User Interface front end. The data types used by the sample application are contained in a set of xml schemas, and the Web services are described using WSDL 1.1. All WSDL documents described here for the WS-I Basic Sample Application are common across implementations, containing types, message, portType and binding descriptions. Endpoints for implementations of WS-I Sample Web services are advertised in UDDI, as described below, and the service and port descriptions are thus not specified in the WS-I WSDL documents.

As described in previous sections of this document, an attempt was made to define an application in an easily understandable application domain that has many opportunities for simplification of the business logic so that the sample can focus on interoperability. The main goal of the Basic Sample Application is to demonstrate interoperability among Web services, based on the set of specifications defined by the Basic Profile 1.0. As shown in the table below, the sample schemas and WSDL employ a diverse set of styles, and offer valid alternative techniques for describing the Web services. For example, the WSDL descriptions of the sample Web services employ different styles of specifying SOAP Action, adopt rpc/literal and document/literal styles, use obscure data types in xml schema where possible, specify headers for application meta-data, and use different naming conventions. All of these differences and combinations of differences yield a higher degree of confidence in the interoperability capabilities of different kinds of Web services.

	Retailer	Warehouse	WH Callback	Manufacturer	Logging Facility	Configurator
Usage Scenario	Request/Response	Request/Response	Basic Callback; Request/Response	Basic Callback; Request/Response	One-way; Request/Response	Request/Response
Style	Rpc/literal	Rpc/literal	Doc/literal	Doc/literal	Doc/literal	Doc/literal
Header	Yes	Yes	Yes	Yes	No	No
Data types	nonnegative Integer decimal string integer normalizedString NMTOKEN	normalizedString nonnegative Integer unsignedShort boolean NMTOKEN anyURI	nonnegative Integer unsignedShort float string normalizedString NMTOKEN	string float normalizedString nonnegative Integer unsignedShort NMTOKEN	string dateTime NMTOKEN	boolean string NMTOKEN anyURI

	Retailer	Warehouse	WH Callback	Manufacturer	Logging Facility	Configurator
	anyURI	string	anyURI			
Attribute	Yes	Yes	Yes	Yes	No	Yes
SOAP Action	Empty string	WSDL tns	None	None	Empty string	WSDL tns + operation
Naming	Mixed	Start with upper case	Mixed	Mixed	Start with upper case	Start with lower case

All Basic Sample Application schemas and WSDL documents are accessible from the WS-I Web site. The URLs used are the same as the namespace associated with each document.

6.3 Basic Callback Usage Scenario Design and Implementation

The interaction between the Warehouse and the Manufacturer, whereby the Warehouse submits a purchase order to a Manufacturer to replenish its stock on hand, is implemented via the Basic Callback usage scenario. This usage scenario is an asynchronous message exchange between two Web services using a pair of synchronous request/response message exchanges. The implementation of the Basic Callback usage scenario requires some mechanism for correlating a final request/response with its corresponding initial request/response. It also requires some mechanism for the consumer (i.e. the initiator of the initial request/response) to convey the callback endpoint to the provider (i.e. the recipient of the initial request/response).

This is achieved by the consumer allocating an identifier and passing that identifier in a SOAP header of the initial request, identified as the "StartHeader". The identifier is then passed back in the SOAP header of the callback, identified as the "CallbackHeader". The identifier is not required on the two "acknowledgement" replies, as these are part of the respective synchronous request/response interactions. In order to inform the provider of the callback location, the consumer includes the URL of the callback endpoint in the "StartHeader" of the request.

6.4 UDDI Advertisement of the Basic Sample Application

Basic Sample Application Web services are advertised in the UDDI Business Registry (UBR) to enable discovery of alternative implementations. The advertised descriptions of these web services follow the guidelines set forth in the [Using WSDL in a UDDI Registry, Version 1.08](#) Best Practice document with additional data elements that distinguish the contents of the sample application as a showcase for Web service interoperability.

The UBR is a public UDDI registry that has multiple nodes, offered by IBM, Microsoft, NTT, and SAP. To advertise something in UDDI a publisher must first obtain publishing credentials at one of the nodes. Once publishing credentials have been obtained they are used to advertise Web services at the node granting the credentials. Because registered data is replicated between these nodes, discovery can be performed at any of the registry's nodes.

The nodes in the UBR provide access to the registry programmatically and over the Web. Publishing credentials are requested using the Web interface. WS-I content is advertised using the programmatic interface.

Publishing credentials can be requested at one of the following UBR nodes:

- IBM: <http://uddi.ibm.com/ubr/registry.html>
- Microsoft: <http://uddi.microsoft.com>

- NTT: <http://www.ntt.com/uddi>
- SAP: <http://uddi.sap.com>

UDDI SOAP messages for advertisement may be sent to one of the following URLs:

- IBM: <https://uddi.ibm.com/ubr/publishapi>
- Microsoft: <https://uddi.microsoft.com/publish>
- NTT: <https://www.uddi.ne.jp/ubr/publishapi>
- SAP: <https://uddi.sap.com/UDDI/api/publish>

6.4.1 Advertisement of tModels

Each Basic Sample Application Web service type is captured in a WSDL document that contains the corresponding `wSDL:message`, `wSDL:portType`, and `wSDL:binding` elements but does not contain the `wSDL:service` and `wSDL:port` elements since they are specific to a deployed Web service. These WSDL documents are accessible using HTTP GET at a site provided by WS-I.

A UDDI tModel is published for each of these Web service type descriptions. Each tModel refers to the Web service type WSDL document in its `overviewURL` element. The URL includes the xpointer-based fragment identifier for the applicable named `wSDL:binding`. Each tModel is categorized with the `soapSpec` and `wSDLSpec` types from the `uddi-org:types` category system.

WS-I has a category system named `ws-i-org:conformsTo:2002_12` that is used to self-certify conformance with the WS-I profiles. A tModel for the WS-I Sample Application should be given a category value of `"http://ws-i.org/profiles/basic/1.0"` which indicates compliance with the Basic Profile.

An example `save_tModel` operation containing a tModel element that can be used to convey a description of a conformant Web service type is described below. The tModelKey is a zero length string that is assigned by the UDDI publication service the first time the tModel is published. The assigned tModelKey is contained in the tModelDetail that is returned from the save. Subsequent (re)publishes of the tModel must contain the actual tModelKey. Note that to publish a tModel one is required to obtain a UDDI authentication token using the `get_authToken` UDDI message and insert this into the `authInfo` element in the save message.

```
<save_tModel generic="2.0" xmlns="urn:uddi-org:api">
  <authInfo>Authorization token returned from get_authToken</authToken>
  <tModel tModelKey="key assigned by the registry">
    <name>ws-i-org:SampleApplications:SupplyChainManagement:Name of Web
service type2</name>
    <description>Web service type for ...</description>
    <overviewDoc>
      <description>WSDL for ... Web service type</description>
      <overviewURL>
        URL of the Web service type WSDL3
      </overviewURL>
    </overviewDoc>
    <categoryBag>
      <keyedReference
        tModelKey="UUID:C1ACF26D-9672-4404-9D70-39B756E62AB4"
        keyValue="wSDLSpec" keyName="types:wSDLSpec" />
  </tModel>
</save_tModel>
```

² `ws-i-org:SampleApplications:SupplyChainManagement:Retailer` for example.

³ `http://www.ws-i.org/SampleApplications/SupplyChainManagement/2002-10/Manufacturer.wsd#xpointer(//*[@name='ManufacturerSOAPBinding'])` for example.

```

<keyedReference
  tModelKey="UUID:C1ACF26D-9672-4404-9D70-39B756E62AB4"
  keyValue="soapSpec" keyName="types:soapSpec" />
<keyedReference
  tModelKey="uuid:65719168-72c6-3f29-8c20-62defb0961c0"
  keyValue="http://ws-i.org/profiles/basic/1.0"
  keyName="ws-i-conformance:basicProfile" />
</categoryBag>
</tModel>
</save_tModel>

```

The tModelKeys assigned to the WS-I Basic Sample Application Web service types are:

```

Retailer: UUID:44599540-CC06-11D6-9D4F-000629DC0A53
Warehouse: UUID:79CF57F0-CC06-11D6-9D4F-000629DC0A53
Manufacturer: UUID:AD04EEA0-CC06-11D6-9D4F-000629DC0A53
LoggingFacility: UUID:FE462140-CC05-11D6-9D4F-000629DC0A53
Configurator: UUID:C5FE2BC0-CC05-11D6-9D4F-000629DC0A53

```

6.4.2 Advertisement of Web Service Implementations

A UDDI businessService and bindingTemplate pair is published for each Web service instance that implements a Web service type described by a tModel. The bindingTemplate corresponds to a wsdl:port element. UDDI businessService elements and their contained bindingTemplates are published within a businessEntity. You are required to have publishing credentials, as described above, to publish any of these entities.

Each bindingTemplate contains an accessPoint element. The end point where the Web service instance can be reached is placed in this element. Information about the sample Web service implementation is captured in name/value pairs in the bindingTemplate's instanceParms to assist the demo user in choosing implementations to demonstrate. Such information is irrelevant for Web services that are not part of the WS-I Basic Sample Application. The bindingTemplate references a tModel for one of the conformant Basic Sample Application's Web service types in its tModelInstanceDetails, indicating that the Web service instance implements the Web service type.

Some of the Basic Sample Application Web services apply to a certain role in the Basic Sample Application. These roles are captured in the *categoryBag* of the businessService using the UDDI General Keywords category system, as shown in the example below.

An example save_service operation for a showcase Web service implementation described with the UDDI businessService and bindingTemplate elements is shown below. Note that to publish any of these entities one is required to obtain an authentication token using the get_authToken UDDI operation and use this in the save message. The serviceKey and bindingKey are zero length strings the first time these entities are saved. A serviceKey is assigned to the new businessService and a bindingKey is assigned to the new bindingTemplate. These are both contained in the serviceDetail returned from the save. Subsequent (re)publishing of the businessService and/or bindingTemplate must contain the assigned keys.

```

<save_service generic="2.0" xmlns="urn:uddi-org:api">
  <authInfo>Authorization token returned from get_authToken</authToken>
  <businessService
    businessKey="businessKey for the outer businessEntity">

```

```

<name>Name of business & name of the Web service4</name>
<bindingTemplates>
  <bindingTemplate bindingKey="">
    <accessPoint>
      end point URL for the Web service implementation5
    </accessPoint>
    <tModelInstanceDetails>
      <!--The tModelKey(s) captured in the tModelInstanceInfo
      elements establish the technical fingerprint of the Web
      service -->
      <tModelInstanceInfo
        tModelKey="key assigned to the Web service type tModel">
        <instanceDetails>
          <instanceParms>
            implPlatform=WebSphereV4;implOS=AIX;implLanguage=Java
          </instanceParms>
        </instanceDetails>
      </tModelInstanceInfo>
    </tModelInstanceDetails>
  </bindingTemplate>
</bindingTemplates>
<categoryBag>
  <keyedReference
    tModelKey="uuid:A035A07C-F362-44dd-8F95-E2B134BF43B4"
    keyValue="asia" keyName="ws-i:sampleRole:warehouse" />
</categoryBag>
</businessService>
</save_service>

```

6.4.3 Participation in the WS-I Interoperability Showcase

Implementations of Basic Sample Application Web services will only appear in the WS-I Interoperability Showcase if their owning businessEntities have reciprocal business relationships with WS-I. Both WS-I and each publisher of the Web service implementations must save identical peer-to-peer publisherAssertions in UDDI for the relationships to form. This is accomplished using the set_publisherAssertion API as demonstrated below.

```

<set_publisherAssertion generic="2.0" xmlns="urn:uddi-org:api">
  <authInfo>Authorization token returned from get_authToken</authToken>
  <publisherAssertion>
    <fromKey>EE7A7A30-F67C-11D6-B618-00629DC0A53</fromKey>
    <toKey>Business key of the implementation's businessEntity</toKey>
    <keyedReference keyName="peer-peer" keyValue="peer-peer"
      tModelKey="uuid:807A2C6A-EE22-470D-ADC7-E0424A337C03"/>
  </publisherAssertion>
</setPublisherAssertion>

```

⁴ IBM WS-I Retailer for example.

⁵ <http://www.ibm.com/ws-i/sample/Retailer> for example.

6.4.4 businessService Categorizations To Differentiate Roles

The WS-I Basic Sample Application has two Web service types that are reused for different roles in the Sample Application. There can be 3 distinct Warehouses and 3 distinct Manufacturers. To be able to determine the role that the Web service instance is adopting, businessServices for these Sample Web service instances are categorized with specific values, using the UDDI general keywords category system (UUID:A035A07C-F362-44DD-8F95-E2B134BF43B4). Both the keyName and the keyValue are significant in any keyedReference associated with the general keywords category system.

Warehouses are assigned a categorization that designates a geographical area.

Warehouse A: keyValue=**NorthAmerica** keyName=ws-i:sampleRole:**warehouse**

Warehouse B: keyValue=**Europe** keyName=ws-i:sampleRole:**warehouse**

Warehouse C: keyValue=**Asia** keyName=ws-i:sampleRole:**warehouse**

Manufacturers are assigned a categorization that designates a brand.

Manufacturer A: keyValue=**BrandA** keyName=ws-i:sampleRole:**manufacturer**

Manufacturer B: keyValue=**BrandB** keyName=ws-i:sampleRole:**manufacturer**

Manufacturer C: keyValue=**BrandC** keyName=ws-i:sampleRole:**manufacturer**

Any other categorizations on other sample app Web services will be ignored.

6.5 Event Logging in the Basic Sample Application

Interactions with Web services involved in the supply chain are recorded using events in the Sample Application Logging Facility where they can be retrieved and used to chart progress through the supply chain. These events provide evidence of invocations of Sample Application web services. Events are recorded at the start of each web service operation, and at each exit point.

Use cases for the Sample Application are used to denote the points at which an event is logged. Service IDs record the Web service role that is processing the operation and the name of the operation. EventIDs refer to the Use Case step to indicate where in the Sample Application Use Cases the event originates from. The event descriptions provide functional context for the events.

EventID	ServiceID	EventDescription	What it means
UC1-5	Retailer.submitOrder	Order placed by <customer id> for <product number 1>, <product number n>.	Start of the Retailer submitOrder operation.
UC1-9	Retailer.submitOrder	Processing of the order from <customer id> has finished normally.	Completion of the Retailer submitOrder operation.
UC1-ALT1-1	Retailer.submitOrder	Order placed by <customer id> is rejected as <product n> is not a valid product and processing has terminated.	Invalid product encountered in the Retailer submitOrder operation.
UC1-ALT2-1	Retailer.submitOrder	There is no availability for any products in the order placed by <customer id> and processing is terminated.	Unable to fulfill any of the order in Retailer submitOrder operation.

EventID	ServiceID	EventDescription	What it means
UC2-2-1	Warehouse<n>.ShipGoods	Warehouse<n> will determine its ability to ship <product number 1>, ... <product number n>	Start of the Warehouse ShipGoods operation.
UC2-2-2	Warehouse<n>.ShipGoods	Warehouse<n> is able to ship <product number 1>, ... <product number n> and is unable to ship <product number 1x>, ... <product number nx>	Completion of the Warehouse ShipGoods operation.
UC3-3	Manufacturer<n>.submitPO	Manufacturer<n> is replenishing stock for <product number>	Start of the Manufacturer submitPO operation.
UC3-7-1	Warehouse<n>.submitSN	Warehouse<n> has received notice that <product number> has been shipped by Manufacturer<n>	Start of the Warehouse submitSN operation indicating the manufacturer has shipped stock to the warehouse.
UC3-7-3	Warehouse<n>submitSN	Warehouse<n> is unable to correlate the shipment of <product number> with a pending replenishment request.	Correlation error encountered attempting to match the shipment with a pending replenishment request.
UC3-7-4	Warehouse<n>errorPO	Warehouse<n> is unable to correlate the notification of a shipping error with a pending replenishment request.	Correlation error encountered attempting to match the manufacturing error with a pending replenishment request.
UC3-ALT1-1	Manufacturer<n>.submitPO	Invalid replenishment request received by Manufacturer<n> for <product number>	Manufacturer is unable to process the purchase order due to invalid or insufficient data.
UC3-7-2	Warehouse<n>.submitSN	Warehouse<n> has replenished stock for product <product number>	Completion of the submitSN operation by a Warehouse indicating stock is replenished.
UC4-1	Manufacturer<n>.submitPO	Manufacturer<n> is shipping product <product number> from existing inventory	Completion of asynchronous submitPO operation by the Manufacturer indicating the replenishment request was satisfied from existing stock.
UC5-5	Manufacturer<n>.submitPO	Manufacturer<n> has produced additional units of <product number> and is shipping <n> units.	Completion of asynchronous submitPO operation by the Manufacturer indicating more product was manufactured before the replenishment request could be satisfied.

6.6 State Data Used by the Basic Sample Application

Demonstrating interoperability in an application such as the sample Supply Chain Application requires that each identical request results in an identical response, both from a data, and an execution sequence point of view. To accomplish this, the Sample Retailer, Warehouse, and Manufacturer Web services operate with a fixed set of data that is reset for each new order request.

The Retailer keeps track of the Product Catalog. The Product Catalog contains a fixed set of products, with identifying information about them. The Product Catalog is defined in the table below.

Product Number	Name	Brand	Description	Category	Price
605001	TV, BrandA	BrandA	24", color, advanced velocity scan modulated	TV	299.95
605002	TV, BrandB	BrandB	32", super slim flat panel plasma	TV	1499.99
605003	TV, BrandC	BrandC	50", plasma display	TV	5725.98
605004	VCR, BrandA	BrandA	S-VHS	VCR	199.95
605005	VCR, BrandB	BrandB	HiFi, S—VHS	VCR	400.00
605006	VCR, BrandC	BrandC	S-VHS, MINDY	VCR	949.99
605007	DVD, BrandA	BrandA	DVD-Player w/built-in Dolby Digital decoder	DVD	100.00
605008	DVD, BrandB	BrandB	Plays DVD-Video discs, CDs, stereo and music	DVD	200.00
605009	DVD, BrandC	BrandC	DVD Player with SmoothSlow forward/reverse; Digital Video Enhancer; DVD/CD test; Custom parental control (20-disc); Digital cinema sound modes	DVD	250.00
605010	TV, Brand4	Brand4	Designated invalid product code that is allowed to appear in the catalog, but is unable to be ordered	TV	149.99

The fixed data used by Warehouses and Manufacturers is described in the table below.

	WH A	WH B	WH C	Mfg A	Mfg B	Mfg C
Product 605001						
Stock	10	30	45	10		
Minimum	5	5	5	5		
Maximum	25	55	55	25		
Product 605002						
Stock	7	10	20		5	
Minimum	4	4	4		5	
Maximum	20	20	20		10	
Product 605003						
Stock	15	15	15			15
Minimum	10	10	10			10
Maximum	50	50	50			50
Product 605004						
Stock	55	70	11	70		
Minimum	10	10	10	5		
Maximum	70	70	70	100		
Product 605005						
Stock	10	10	10		10	
Minimum	5	5	5		5	
Maximum	10	10	10		10	
Product 605006						
Stock	20	20	20			20
Minimum	5	5	5			5
Maximum	20	20	20			20

	WH A	WH B	WH C	Mfg A	Mfg B	Mfg C
Product 605007						
Stock	70	30	85	70		
Minimum	30	30	30	30		
Maximum	100	100	100	100		
Product 605008						
Stock	25	35	45		35	
Minimum	10	10	10		10	
Maximum	50	50	50		50	
Product 605009						
Stock	20	30	40			40
Minimum	20	20	20			20
Maximum	50	50	50			50