



# D3.6v01 WSMO Use Case "STREAM Flows! System"

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## Abstract

This document presents a concrete use for specifying Semantic Web Service descriptions in WSMO for a frequent flyer programme called "Stream Flows! System" (SFS). This system serves as a meeting point for customers who want to book flights, train tickets, hotels, shuttle transfers and for the providers of such services. Customers can create, or use predefined packages which specify what services are needed by the customers. Providers can create, edit and publish their services on SFS in order to make them available for customers. The main objective of this document is to provide a modeling of the WSMO elements based on the SFS scenario.

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## 1. Introduction

This use case is defined in the area of e-Tourism, particularly, it addresses a frequent flyer programme called Stream Flows! System (SFS for short). This system will be available online and it can be accessed both from customers and service providers. We will specify the required semantic descriptions in this system basing ourselves on the WSMO conceptual model, that is, by specifying the Ontologies, Web Services, Goals and Mediators.

Customers will be able to group and specify the services needed in terms of packages. A package is a collection of services which are to be purchased by the user. A package may be either pre-defined by the SFS Administrator or customized by the customer. Service providers can publish their services with SFS in order to make them available for customers. It is up to the SFS to update the stored packages once a service has changed. Our use case shall take the following path:

- The Service Providers will have published some services: a flight, a hotel reservation, and a car rental service
- The customer searches for a package of desired services
- The SFS program access to the catalogue and search for the best services that fulfill the customer requirements

## 2. Use Case Overview

In this section we will provide an overview of the Use Case. Particularly, a description of the scenario depicted will be given and we will also specify the actors, roles and goals involved in the use case.

### 2.1 Description

STREAM Airlines is the airline company of the STREAM Group, which works in Europe and South America . The STREAM Group has a FPP called STREAM Flows! System (SFS). The customers of the SFS (by means of a membership) can obtain points from purchasing services of the STREAM group. These services might be an airline ticket, a hotel booking, a car rental and many others. There are several companies affiliated to SFS. Each service of the program has its counterpart in points and these points can be consolidated and exchanged by one or more services. The customer purchases services from many companies (engaged with the SFS program). These companies collect the information of the customer and send the information to the SFS program, adding the counterpart of the service in points of the SFS program. The SFS program collects all the information and stores them into its own databases.

The customers of SFS program will be able to exchange their SFS points for eTourism services, provided by companies affiliated to SFS. These services will support booking of flights, booking of hotel's rooms, booking of rental cars and booking of shuttles online. The services must have been published in the SFS Catalogue by the service providers as WSMO web services, and can be purchased by the customers directly or by an established package. The SFS program will advise the customer which services are the best that fulfill the customer requirements. Once the customer has selected the services, SFS will act as an intermediary between the customer and the service provider.

### 2.2 Scope

The STREAM Group wants to offer the ability to book complete vacation packages: airplane tickets, hotels, car rental, shuttle, etc. The service providers (airlines, car rental companies, hotel chains, etc) will provide web services to query their offerings and perform reservations. So, the SFS program will allow the customer to contract these services using his or her points.

### 2.3 Actors, Roles and Goals

The Stream Flows! System is comprised of three main entities, namely, customers, service providers and the system itself. The roles and goals of each entity are described in this section.

#### 2.3.1 Customer

The end user that request a service or a package of services.

- *Goal*: Automated resolutions of the request.
- *Role*: End-user. Interacts with the SFS portal.

### 2.3.2 Service Providers

The commercial companies affiliated to the SFS program that provides the specific tourism services.

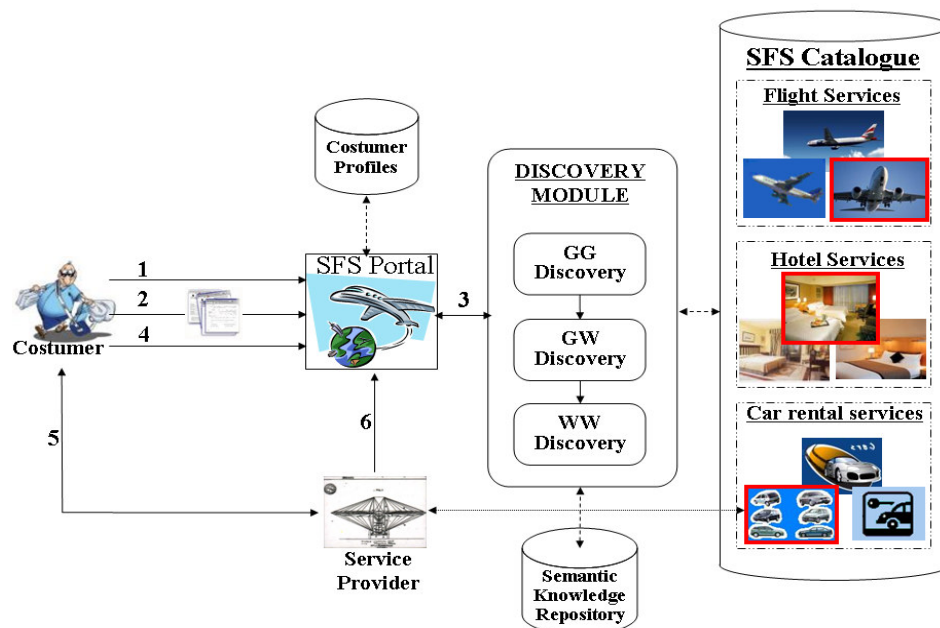
- *Goal* : Publish their services in the SFS catalogue.
- *Role* : Provides tourism services as Web services.

### 2.3.3 STREAM Flows! System (SFS)

The intermediary between the Customer and the Service providers.

- *Goal* : Manage the customer's record of services and manage the catalogue of services and packages contacting customers and service providers for performing its tasks.
- *Role* : Interacts with customer and service providers.

## 2.4 Story Board



**Figure 1: Story Board Overview**

### Step 1

The customer logs in the SFS portal and, once authenticated, he consults his accumulated points. The SFS will access to the customer's profile database and will show the customer his accumulated points.

The customer management is not important at this stage of the project. However, we will say that a customer profile database is maintained in order to know the previous services contracted to the companies affiliated with SFS and the points that the customer has gathered until this moment. For the sake of clarification, we will define a scenario in which a

customer “Perico Palotes”, having 2500 points, wants to go to Madrid from Brussels, rent a car in Madrid Airport (Barajas) to go to Toledo and book a room in a 4-star hotel in Toledo (Toledo is 70 km from Madrid and it's well known for being a melting pot of cultures in the Middle Age where Muslims, Christians and Jews lived in peace). When Perico logs in, he sees its current amount of points and the historical record of his last travel services contracted to companies affiliated.

## Step 2

The customer clicks on the “ **Voyage Planner** ” button. Within the planner, Perico can choose a stored package (flight + hotel + rent-a-car with standard restrictions) or **create** a new one. Perico is one of these persons who likes to control everything and wants to create his own package. A box will appear and he will drag & drop icons from the left (one for the flight, one for the hotel and one for the rent-a-car). Each **slot in the box represents an abstract service** (abstract in terms of desired behaviour but not fully specified [[Priest, 2004](#)]). The definition of the constraints may be based in time, distance, accumulated amount of points and whatever other property with an ordinal and quantitative metric. Any of these properties can be graphically defined as connections between the slots (the richness of the graphical interface is subject to a further study of the graphical interface of the tools delivered by the Developer's partners of the project). For his own package he defines the *following set of constraints* :

- The location parking of the rent-a-car service can be at maximum 3km far away from the airport
- The rent-a-car service must be open (or operative) at the scheduled landing time.
- The check-in date for the hotel can not be before the scheduled time for landing.
- The accumulated amount of points for the three services can not be higher of 2200 points.

Once he has defined the overall constraints for the package, he may want to define *specific constraints for each service* . The customer will have a form in which he can detail which **specific features for each service he wants to obtain and impose constraints on these features** . These constraints can be seen (from a WSMO perspective) as part of the postcondition of the goal and can be easily translated into logical expressions. Some of *these constraints* can be summarised here:

- For the hotel, for example, he knows that he wants (at least) a 4-star hotel.
- The location of the hotel will be Toledo (or some place not 10 km from afar Toledo ).
- The flight destination will be Madrid .
- He wants a car with air conditioning system.

## Step 3

Once he has the package with the three slots filled (each slot represents an abstract service with constraints that must be met. The abstract service is defined by a goal template in which part of the logical expressions are identified with variables. The values for these variables will be substituted by the input from the customer), **a goal** (in terms of WSMO goals) is created using the **templates and the values obtained from the customer interaction with the interface** . These goals are sent to the Discovery Component which searches into the SFS Catalogue for services that are available for each slot.

## Step 4

The **selection phase** is complicated, because it not only performs selection task but also the compatibility between the services chosen for the slots have to be checked (the services chosen, have to fulfil as a whole the constraints imposed by the customer). The process for the selection is as follows:

- The user receives a list of **possible results** for each slot (these services have been discovered taking in account only the constraints for this slot, not the overall constraints). He can *manually select one service or he can be advised by the system* (using QoS metrics or other customer preferences defined previously).
- The **selected service is asked for final offers** which can fulfil the customer preferences and constraints (the service may have more than one possible realisation of the service for a concrete goal). If an offer is finally accepted by the customer, the **concrete endpoint of the service is stored** until all the services are chosen.
- Once a concrete offer is chosen, the set of possible results for each slot *may be reduced*, taking into account the overall constraints. If the set of results for a slot is not empty, then the customer may repeat the steps 'a' and 'b' for each slot. If the set is empty, then the constraints have to be relaxed or the customer may choose another offer, or another service.
- When all the slots are concretized with final offers, then the package is ready to be contracted. Since all the services have agreed with the overall constraints, the order for the enactment is not an issue and they can be contracted in whatsoever order and time (even in parallel).

### Step 5

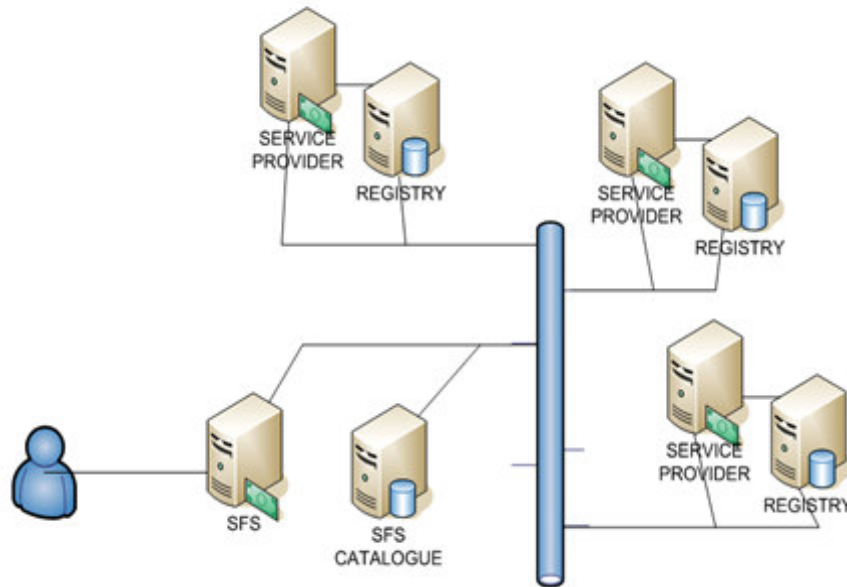
The service provider of each chosen service will try to confirm the terms of acceptance and conditions, and details of the service. Once both parties have accepted the terms of the contract, a booking request is placed. The customer (using the SFS Portal) invokes the services which fulfil his package and the service provider has to send to the customer all the information and any coupon or ticket need for the use of the service.

### Step 6

Finally, the service provider will communicate with the SFS to provide him the information needed for performing the update of the customer record (the payment, from the customer perspective is made with points, but from the Service Provider perspective is made by the SFS). This arrangement between SFS and Service Providers is out of the scope of this use case.

## 2.5 System Architecture

The conceptual architecture shown in Figure 2 represents the network in which all the partners will be engaged. Whereas the user has to connect using some agent on his behalf, the SFS and the rest of the Providers (SFS is also a Service Provider) join the architecture in a peer-to-peer approach.



**Figure 2: Conceptual Architecture of the Stream Flows! System**

### 2.5.1 Catalogue Nature

The Catalogue is a centralised mirror of all the Registries subscribed to the SFS program. An Entry in the SFS Catalogue should be a subset (it could be a copy) of an entry in a Service Provider Registry. This mechanism will allow the SFS Catalogue to act as a mirror of the Distributed Registries (as shown in Figure 2 ).

Due to the fact that the Service provider is not willing to have many versions of the same service it will publish its service with the desired Domain Ontologies (it is not expected that a Service Provider will have several versions of the same service description even if they publish the same service in different repositories).

The mechanism of publication in SFS will follow a "push" paradigm (from the provider point of view). The SFS Catalogue will have an API that accepts entries in form of a triple (serviceProviderID, serviceID, version) and will store only one Service Description for each Service of the Service Provider.

If some Service is discovered (during a Discovery-Selection phase), each Service will be asked for offers that would be matched against the Service Request. Then if suitable, an offer (which can be seen as an special instantiation / concretization of the Service) will be selected and the Service will be invoked with some inputs from the Requester.

### 2.5.2 Catalogue Content

The Catalogue will store **Web Service Descriptions** (as are described in WSMO). Other content will be available for SFS members but these contents have not to be mixed up with Service Descriptions and they can be logically and/or physically stored in different databases. Among these contents, there are templates and package descriptions. Now we describe, briefly, the information we expect to have for each element of the Catalogue:

- Service Description
  - WSML text file containing the WSMO Web Service Description (the inclusion of the interface for each Web Service is subject to further description between WP10 and WP4) .

- Template
  - A WSMO Ontology containing the minimum vocabulary used to build a goal. Is created to hide logic expressions to the customer. The template contains a name, a category (which can be mapped against taxonomies), a set of keywords which can be related with the template and a file which contains the Goal Template.
  - The customer will select a category (there are many possible ways to do this: extracting keywords from a text-free description of his request, selecting the category from a taxonomy-like tree or even following a wizard in a more rich GUI interface. The final realisation of this selection is up to the WP10 Use Case Scenario team choice ) and a set of keywords related to this service Category will be asked to the customer. The system will create a goal instance using the goal file template, the keywords related and the values the user has filled in.
- Package
  - A package is a non-empty set of templates and a set of constraints that all the logical expressions of the template have to fulfil. The constraints are relative to one or more slots and implies constraints that one service possesses over the other (e.g. the check-in property of a bookingHotelService can not have a value which is “before” the scheduled flight landing time).

Logically, the template and the package template are stored in the SFS as instances of these concepts. Each instance will have a file (for a template) or many (for a package) which represent the abstract capability that the requester wants to achieve. The system will build the goal (for a service or for “many” services) using these templates and the inputs from the customer (using natural language or a more rich interface). The details of these concepts are shown in Listing 1

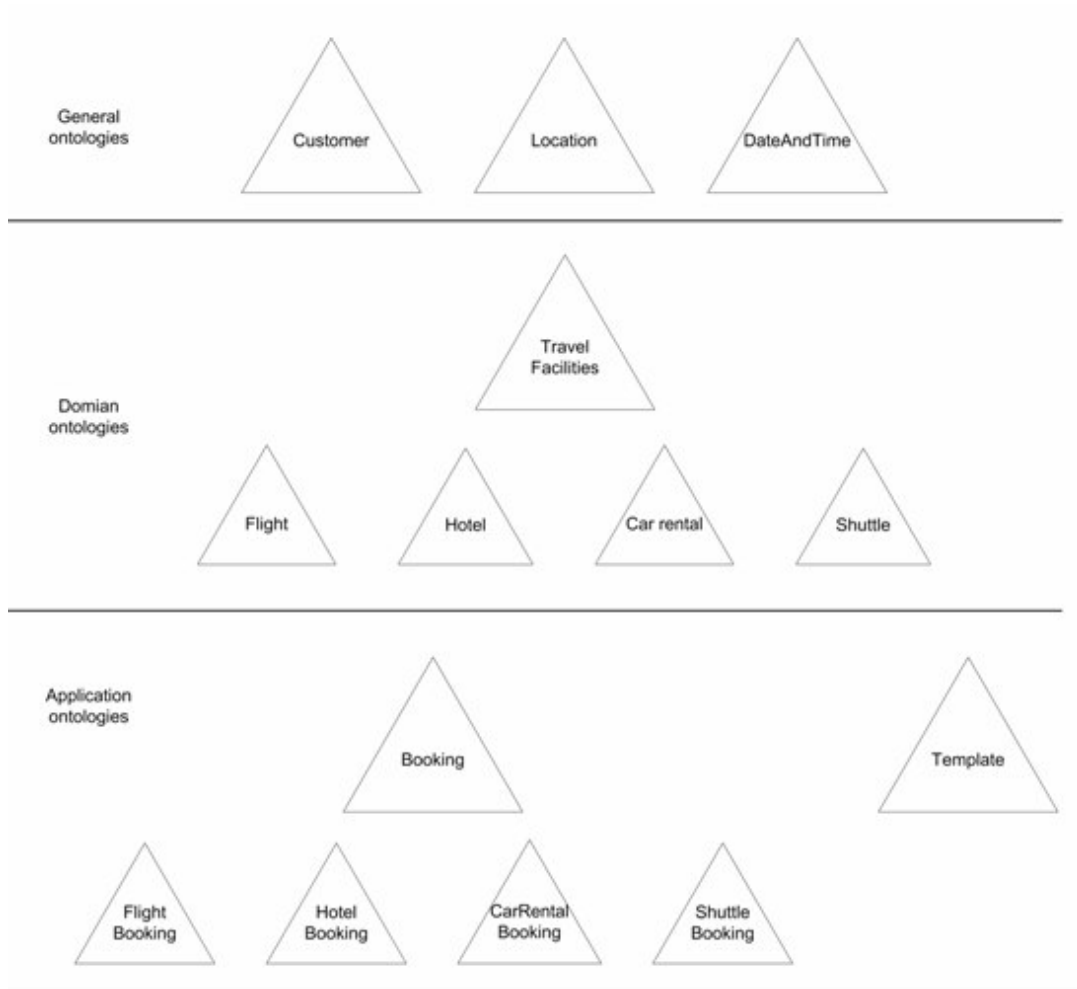
## 3. WSMO Use Case Modelling

This section exemplifies the specification of this use case within the Web Service Modeling Ontology WSMO. The listings provided use the conceptual model and syntax presented in WSMO [[Roman et. al., 2005](#)] and WSML [[De Bruijn et. al., 2005](#)]. They have been validated with the [WSML Online Validation Service](#).

### 3.1 Ontologies

In this section we describe briefly the SFS ontologies that model the domain presented in our scenario, and which will be used by the Semantic Web services developed for it and described in section 3.3 . These ontologies have been implemented in WSML. A graphical outline of the main relationships between these ontologies is presented in Figure 2. According to the classifications of [[Heijst et. al., 1997](#)] and of [[Mizoguchi et. al., 1995](#)] we can distinguish the following types of ontologies:

- *General ontologies* , which represent common sense knowledge reusable across domains. In this group we can include our ontologies about users and notifications, which include basic concepts related to persons and their contact information, and our ontology about estimation parameters, which is based on statistical concepts.
- *Domain ontologies* , which represent reusable knowledge in a specific domain. In this group we can include our ontologies about tourism services, such as flight, hotel room, car rental and shuttle
- *Application ontologies* , which represent the application-dependent knowledge needed. In this group we can include our ontologies.



**Figure 2: SFS Ontologies**

The ontologies specified are intended to be "real ontologies" in the sense that they describe the specific domain as a shared conceptualization in a sufficient manner. This allows to reuse this ontologies in different settings and use cases - for example, general booking ontology are needed in a lot of other possible scenarios. However, we do not claim the defined below to be such generic ontologies, but they will be enhanced and completed within cooperations with other use cases, projects, and initiatives.

For reader's convenience, the relevant instances for this use case will be gathered in the SFS Use Case Knowledge Base, a separate ontology that will be created in a future version. The inclusion of links to large set of instances will be considered in future versions of WSMO.

### 3.1.1 Template Ontology

This ontology describes the template and package concepts.

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/template#",
  dc _ "http://purl.org/dc/elements/1.1#",
  xsd _ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/template "
  nonFunctionalProperties
    dc#title hasValue "Template ontology"
    dc#creator hasValue "ATOS ORIGIN S.A."
    dc#description hasValue "Ontology to describe the template and package concepts"
    dc#publisher hasValue "ATOS ORIGIN S.A."
    dc#contributor hasValue {"Alejandro López","Ozelin López", "Clara Pezuela"}
    dc#date hasValue "2005-02-11"
    dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
    dc#format hasValue "text/html"
    dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/ template "
    dc#language hasValue "en-US"
    dc#coverage hasValue "ID:7029392 Name:World"
  endNonFunctionalProperties

concept packageTemplate
  nonFunctionalProperties
    dc#description hasValue "A template for a package"
    dc#slots hasValue "The slots which represents the templates that composes the package.
      The services chosen for fulfil each slot has to"
  endNonFunctionalProperties
  slots impliesType (1 *) template
  constraints impliesType packageConstraints

concept template
  nonFunctionalProperties
    dc#description hasValue "A template description for a requested Service "
    dc#templateIdentifier hasValue "An unique ID for this template"
    dc#templateCategory hasValue "The category of the template"
    dc#templateKeywords hasValue "The template keywords used for building the form"
    dc#fileTemplate hasValue "The URI which contains the WSML code for building the goal"
  endNonFunctionalProperties
  templateName ofType (1) xsd:string
  templateCategory impliesType (1) serviceCategory
  templateKeywords ofType xsd:string
  fileTemplate impliesType (1) fileTemplate

concept serviceCategory
  nonFunctionalProperties
    dc#description hasValue "A pair {id, value} which represents some node in a taxonomy. A
      serviceCategory may have a father and may have multiple sons. The keywords related ca
      to identify the Service Category"
  endNonFunctionalProperties
  idCategory ofType (1) xsd:string
  valueServiceCategory ofType (1) xsd:string
  keywordsRelated ofType xsd:string
  sonOfCategory impliesType (0 1) serviceCategory
  fatherOfCategories impliesType serviceCategory

concept packageConstraints
  nonFunctionalProperties
    dc#description hasValue "A logical expression which is built relating the concepts of the packag
      (e.g. The parkingLocation of a Rent-a-Car Service has to be near than 20 km from the airp
      landing location.)"
  endNonFunctionalProperties

concept fileTemplate

```

**nonFunctionalProperties**  
dc:description **hasValue** "An URI representing the location of a file "  
**endNonFunctionalProperties**

/\* Definition of the Relations of the Ontology \*/

**relation** hasAncestor  
**nonFunctionalProperties**  
dc:description **hasValue** "(X,Y) is a tuple of the binary relation iff X is ancestor of Y"  
**endNonFunctionalProperties**  
ancestor **impliesType** serviceCategory  
descendant **impliesType** serviceCategory

/\* Description of the **axioms** of the Ontology \*/

**axiom** fatherIsAnAncestor  
**nonFunctionalProperties**  
dc:description **hasValue** "A Father is an ancestor for a ServiceCategory"  
**endNonFunctionalProperties**  
**definedBy**  
hasAncestor(?S1,?S2)  
**impliedBy**  
?S1 memberOf serviceCategory **and** ?S2 memberOf serviceCategory  
**and** ?S2[sonOfCategory ?S1].

**axiom** transitivityOfAncestor  
**nonFunctionalProperties**  
dc:description **hasValue** "The Ancestor relation is transitive"  
**endNonFunctionalProperties**  
**definedBy**  
hasAncestor(?S1, ?S3)  
**impliedBy**  
hasAncestor(?S1, ?S2) **and** hasAncestor(?S2, ?S3) **and**  
?S1 memberOf serviceCategory **and**  
?S2 memberOf serviceCategory **and**  
?S3 memberOf serviceCategory.

**axiom** serviceCategoryLackOfCycles  
**nonFunctionalProperties**  
dc:description **hasValue** "One serviceCategory can not be ancestor of itself"  
**endNonFunctionalProperties**  
**definedBy**  
false  
**impliedBy**  
hasAncestor(?S1, ?S2) **and** ?S1 = ?S2 **and**  
?S1 memberOf serviceCategory **and**  
?S2 memberOf serviceCategory.

**axiom** serviceCategoryLukelmYourFather  
**nonFunctionalProperties**  
dc:description **hasValue** "If one serviceCategory S1 has a son S2, then the father of S2 is S1."  
**endNonFunctionalProperties**  
**definedBy**  
**constraint**  
?S2[sonOfCategory **hasValue** ?S1] memberOf serviceCategory  
**impliedBy**  
?S1[fatherOfTaxons **hasValue** ?S2] memberOf serviceCategory.

**axiom** serviceCategoryHolyGhost  
**nonFunctionalProperties**  
dc:description **hasValue** "A serviceCategory can not be son of itself"  
**endNonFunctionalProperties**  
**definedBy**  
**constraint**

**false**  
**impliedBy**  
?S1 memberOf serviceCategory **and**  
?S2 memberOf serviceCategory **and**  
?S1 = ?S2 **and**  
?S2[sonOfCategory **hasValue** ?S1].

---

### 3.1.2 Tourism Service Provider Ontology

This ontology describes the superconcept *tourism service provider* , who will be the seller who offers an specific tourism service.

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider#",
  dc _ "http://purl.org/dc/elements/1.1#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  xsd _ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/ tourismServiceProvider "
nonFunctionalProperties
  dc#title hasValue "tourismServiceProvider ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"tourismServiceProvider"}
  dc#description hasValue "Tourism service provider ontology"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López","Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/location"}

concept tourismServiceProvider
nonFunctionalProperties
  dc#description hasValue "The tourismServiceProvider information"
  dc#companyID hasValue "The tourismServiceProvider code"
  dc#contactInformation hasValue "The tourismServiceProvider contactInformation"
  dc#website hasValue "The tourismServiceProvider website"
endNonFunctionalProperties
  companyID ofType xsd:string
  contactInformation impliesType contactInformation
  website ofType xsd:string

concept contactInformation
nonFunctionalProperties
  dc#description hasValue "The collection of business properties that
  provide communication and address information for
  contacting a person, organization or business."
  dc#name hasValue "The tourismServiceProvider name"
  dc#address hasValue "The tourismServiceProvider adress"
  dc#phone hasValue "The tourismServiceProvider phone"
  dc#faxnumber hasValue "The tourismServiceProvider faxnumber"
  dc#emailaddress hasValue "The tourismServiceProvider email"
  dc#relation hasValues {<>}
endNonFunctionalProperties
  name ofType xsd:string
  emailaddress ofType xsd:string
  faxnumber ofType xsd:string
  telephonenumber ofType xsd:string
  physicalAddress ofType loc#address

```

### 3.1.3 Flight domain ontology

This ontology describes the flight domain. The flight service provider will offer flights, that have to fulfill a set of axioms, and it will have stored the flight reservations already made, in

order to be able to make future reservations.

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/flight#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  tsp _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider#",
  fb _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  xsd _ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/flight"
  nonFunctionalProperties
    dc#title hasValue "Flight Ontology"
    dc#creator hasValue "ATOS ORIGIN S.A."
    dc#subject hasValue {"Flight", "Airport", "Aircraft"}
    dc#description hasValue "Flight Booking Ontology"
    dc#publisher hasValue "ATOS ORIGIN S.A."
    dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
    dc#date hasValue "2005-02-11"
    dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
    dc#format hasValue "text/html"
    dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/flight"
    dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
    dc#language hasValue "en-US"
    dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
      _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider",
      _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
      _ "http://www.wsmo.org/ontologies/dateTime#",
      _ "http://www.wsmo.org/ontologies/location#",
      _ "http://www.daml.org/2001/02/geofile/geofile-ont"}
    dc#coverage hasValue "ID:7029392 Name:World"
  endNonFunctionalProperties

  importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location",
    _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
    _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider"}

  usesMediator
    _ "http://www.wsmo.org/2004/d3/d3.3/v0.1/20041008/resources/owlGeoMediator.wsm!"

  concept airport subConceptOf geo#geographicLocation
    nonFunctionalProperties
      dc#description hasValue "An airport with his code"
      dc#code hasValue "The code of the airport"
    endNonFunctionalProperties
    code ofType xsd#string

  concept flightServiceProvider subConceptOf tsp#tourismServiceProvider
    nonFunctionalProperties
      dc#description hasValue "An air tourismServiceProvider"
      dc#flightsProgrammed hasValue "The flights programmed by the tourismServiceProvider"
      dc#flightReservations hasValue "The reservations made that the flight tourismServiceProv
        store in order to have all the reserves information and to allow available booking
    endNonFunctionalProperties
    flightReservations impliesType fb#flightBooking
    flights impliesType flight
    originCities impliesType loc#city
    allowKidsAloneService ofType xsd#boolean

  concept flight
    nonFunctionalProperties
      dc#description hasValue "A flight"
      dc#flightNumber hasValue "The identificator of the flight"
      dc#aircraft hasValue "The assigned aircraft"

```

dc#scheduledDepartureDateAndTime **hasValue** "Scheduled departure date of the flight"  
dc#scheduledArrivalDateAndTime **hasValue** "Scheduled arrival date of the flight"  
dc#currentDepartureDateAndTime **hasValue** "Current departure date of the flight"  
dc#currentArrivalDateAndTime **hasValue** "Current arrival date of the flight"  
dc#originAirport **hasValue** "The origin airport"  
dc#destinationAirport **hasValue** "The destination airport"  
dc#duration **hasValue** "The duration of the flight"  
dc#distance **hasValue** "The distance of the flight"

**endNonFunctionalProperties**

flightNumber **ofType** xsd#integer  
aircraft **impliesType** aircraft  
scheduledDepartureDateAndTime **ofType** dt#dateAndTime  
scheduledArrivalDateAndTime **ofType** dt#dateAndTime  
currentDepartureDateAndTime **ofType** dt#dateAndTime  
currentArrivalDateAndTime **ofType** dt#dateAndTime  
originAirport **impliesType** airport  
destinationAirport **impliesType** airport  
duration **impliesType** dt#interval  
distance **impliesType** loc#distance  
seats **impliesType** seat

**concept** seat

**nonFunctionalProperties**

dc#description **hasValue** "A seat of a flight"  
dc#seatNumber **hasValue** "Indicates the seat number"  
dc#seatLetter **hasValue** "Indicates the seat letter"  
dc#seatClass **hasValue** "Indicates the seat class"  
dc#available **hasValue** "Indicates if the seat is available or not"

**endNonFunctionalProperties**

seatNumber **ofType** xsd#string  
seatLetter **ofType** xsd#string  
seatClass **ofType** xsd#string  
available **ofType** xsd#boolean

**concept** aircraft

**nonFunctionalProperties**

dc#description **hasValue** "An aircraft"  
dc#idAircraft **hasValue** "A unique number of aircraft"  
dc#numberSeatEconomy **hasValue** "Indicates the number of economy seats"  
dc#numberSeatBusiness **hasValue** "Indicates the number of bussiness seats"  
dc#numberSeatFirstClass **hasValue** "Indicates the number of first class seats"

**endNonFunctionalProperties**

idAircraft **ofType** xsd#string  
numberSeatEconomy **ofType** xsd#integer  
numberSeatBusiness **ofType** xsd#integer  
numberSeatFirstClass **ofType** xsd#integer

**axiom** airportCountry

**nonFunctionalProperties**

dc#description **hasValue** "Integrity constraint# if a airport is located in a place  
which is located in a given country, the country of the airport is the same"

**endNonFunctionalProperties**

**definedBy**

?A memberOf airport[  
    locatedIn **hasValue** ?L,  
    country **hasValue** ?C  
]  
**and** neg  
(?L memberOf loc#location[  
    country **hasValue** ?C  
]).

**axiom** departureBeforeArrival

**nonFunctionalProperties**

```

    dc:description hasValue "Integrity Constraint departure has to be before arrival"
endNonFunctionalProperties
definedBy
    ?F memberOf flight[
        scheduledDepartureDateAndTime hasValue ?D,
        scheduledArrivalDateAndTime hasValue ?A
    ]
and
    ?A =< ?D.

```

```

axiom DifferentOriginAndDestination
nonFunctionalProperties
    dc:description hasValue "Integrity Constraint origin airport has to be different"
endNonFunctionalProperties
definedBy
    ?F memberOf flight[
        originAirport hasValue ?O,
        destinationAirport hasValue ?D
    ]
and
    ?O != ?D.

```

```

function fulfillFlightPreferences
nonFunctionalProperties
    dc:description hasValue "(airTripInfo, flightBookingPreferences, result) is a triple
    of the ternary relation corresponding to this function: if airTripInfo fulfills the
    the customer flightBookingPreferences the result is true."
endNonFunctionalProperties
    airTripInfo impliesType airTripInfo
    flightBookingPreferences impliesType flightBookingPreferences
    range ofType xsd#boolean

```

### 3.1.4 Hotel domain ontology

This ontology describes the hotel domain. The hotel service provider will offer different hotels and rooms, and it will have stored the hotel rooms reservations already made, in order to be able to make future bookings. The ontology also includes the hotel room's taxonomy.

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/hotel#",
  dc _ "http://purl.org/dc/elements/1.1#",
  tsp _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider#",
  hb _ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  xsd _ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/hotel"

nonFunctionalProperties
  dc#title hasValue "Hotel Room Ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Hotel", "Hotel chain", "Room"}
  dc#description hasValue "Hotel reservation"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/hotel"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
  _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider",
  _ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.daml.org/2001/02/geofile/geofile-ont"}
  dc#coverage hasValue "ID:7029392 Name:World"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider"}

concept hotelServiceProvider subConceptOf tsp#tourismServiceProvider
  nonFunctionalProperties
    dc#description hasValue "A hotel tourismServiceProvider"
    dc#hotels hasValue "The hotels of the tourismServiceProvider"
    dc#hotelRoomReservations hasValue "The reservations made that the hotel
      tourismServiceProvider store in order to have all the reserves information and to
      allow available bookings"
  endNonFunctionalProperties
  hotelRoomReservations impliesType hb#hotelRoomBooking
  hotels impliesType hotel
  availableCities impliesType loc#city
  allowPets ofType xsd#boolean
  allowGroupsReservation ofType xsd#boolean

concept hotel
  nonFunctionalProperties
    dc#description hasValue "A hotel"
    dc#name hasValue "The hotel name"
    dc#hotelID hasValue "The hotel identifier"
    dc#stars hasValue "The hotel stars"
    dc#city hasValue "The city where the hotel is located"
    dc#address hasValue "The hotel address"
    dc#builtDate hasValue "The date when the hotel was built"
    dc#lastUpdateDate hasValue "The date when the hotel had a reform"
    dc#hasRestaurant hasValue "Indicates if the hotel has Restaurant"
    dc#email hasValue "The hotel email"
    dc#phone hasValue "The hotel phone"
    dc#room hasValue "The rooms of the hotel"
  endNonFunctionalProperties

```

name **ofType** xsd:string  
hotelID **ofType** xsd:string  
stars **ofType** xsd:integer  
city **ofType** loc#city  
address **ofType** loc#address  
builtDate **ofType** dt#Date  
lastUpdateDate **ofType** dt#Date  
hasRestaurant **ofType** xsd:boolean  
email **ofType** xsd:string  
phone **ofType** xsd:integer  
room **impliesType** room

**concept** room

**nonFunctionalProperties**

dc:description **hasValue** "A room of a hotel"  
dc#roomNumber **hasValue** "The number of the room"  
dc#area **hasValue** "The rooms area measured in m2"  
dc#phone **hasValue** "The room phone number"  
dc#hasAirConditioning **hasValue** "Indicates if the room has air conditioning"  
dc#fare **hasValue** "Indicates the fare of the room"  
dc#addBedFare **hasValue** "Indicates the fare of an adding bed in the room"

**endNonFunctionalProperties**

roomNumber **ofType** xsd:integer  
area **ofType** xsd:integer  
phone **ofType** xsd:integer  
hasAirConditioning **ofType** xsd:boolean  
numberOfBeds **ofType** xsd:integer  
smoking **ofType** xsd:boolean  
fare **ofType** xsd:float  
addBedFare **ofType** xsd:float

**concept** suite **subConceptOf** room

**nonFunctionalProperties**

dc:description **hasValue** "A suite of a hotel"

**endNonFunctionalProperties**

**concept** singleRoom **subConceptOf** room

**nonFunctionalProperties**

dc:description **hasValue** "A single room of a hotel"

**endNonFunctionalProperties**

**concept** doubleRoom **subConceptOf** room

**nonFunctionalProperties**

dc:description **hasValue** "A double room of a hotel"

**endNonFunctionalProperties**

**concept** meetingRoom **subConceptOf** room

**nonFunctionalProperties**

dc:description **hasValue** "A meeting room of a hotel"

**endNonFunctionalProperties**

seatingCapacity **ofType** xsd:integer

**function** fulfillHotelPreferences

**nonFunctionalProperties**

dc:description **hasValue** "(hotelStay, hotelRoomBookingPreferences, result) is a triple of the ternary relation corresponding to this function: if hotelStay fulfills the the customer hotelBookingPreferences the result is true."

**endNonFunctionalProperties**

hotelStay **impliesType** hotelStay

hotelBookingPreferences **impliesType** hotelRoomBookingPreferences

range **ofType** xsd:boolean

### 3.1.5 Rent-a-car domain ontology

This ontology describes the car rental ontology. The car rental service provider will offer car rental in different locations, and it will have stored the car rentals reservations already made, in order to be able to make future reservations.

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/carRental#",
  dc _ "http://purl.org/dc/elements/1.1#",
  tsp _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider#",
  crb _ "http://www.wsmo.org/ontologies/sfs/carRentalBooking#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  xsd _ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/carRental"

nonFunctionalProperties
  dc#title hasValue "Car rental ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Car tourismServiceProvider", "Car"}
  dc#description hasValue "Rent a car booking"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/carRental"
dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
  _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider",
  _ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/sfs/carRentalBooking"}
  dc#coverage hasValue "ID:7029392 Name:World"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider",
  _ "http://www.wsmo.org/ontologies/sfs/carRentalBooking"}

concept carRentalServiceProvider subConceptOf tsp#tourismServiceProvider
  nonFunctionalProperties
    dc#description hasValue "The car rental tourismServiceProvider information"
    dc#cars hasValue "The cars of the car rental tourismServiceProvider"
    dc#carReservations hasValue "The reservations made that the car rental
      tourismServiceProvider store in order to have all the reserves information and
      available bookings"
    dc#availableCities hasValue "The cities where there is this a rent-a-car office"
    dc#parkingLocations hasValue "The parking locations where pickup the car"
    dc#allowSendToHome hasValue "Indicates if it is possible that the car is sent to your hom
    dc#allowOutlineReturn hasValue "Indicates if it is possible to return the car "
    dc#officeOpeningTime hasValue "Indicates the opening time of the office"
    dc#officeClosingTime hasValue "Indicates the closing time of the office"
  endNonFunctionalProperties
  carReservations impliesType crb#carRentalBooking
  availableCities impliesType loc#city
  parkingLocations impliesType loc#city
  officeOpeningTime impliesType date#time
  officeClosingTime impliesType date#time
  allowSendToHome ofType xsd#boolean
  allowOutlineReturn ofType xsd#boolean
  cars ofType car

concept car
  nonFunctionalProperties
    dc#description hasValue "Describes a car"
    dc#carIdentiicator hasValue "A car"
    dc#rentalRate hasValue "Indicates the one day rate of the car"
    dc#doorCount hasValue "The number of doors of the car"

```

```
dc#carSize hasValue "Indicates the number of persons that can be in the car"  
dc#miliageLimited hasValue "Indicates if the car has miliageLimited"  
dc#hasChildSeat hasValue "Indicates if the car has child seat"  
dc#hasAirConditioning hasValue "Indicates if the car has air conditioning"
```

**endNonFunctionalProperties**

```
carIdentiicator ofType xsd:string  
rentalRate ofType xsd#float  
doorCount ofType xsd#integer  
carSize ofType xsd#integer  
miliageLimited ofType xsd#boolean  
hasChildSeat ofType xsd#boolean  
hasAirConditioning ofType xsd#boolean
```

**function** fulfillCarRentalPreferences

**nonFunctionalProperties**

```
dc#description hasValue "(carRentalInfo, carRentalBookingPreferences, result) is a triple  
of the ternary relation corresponding to this function: if carRentalInfo fulfills the  
the customer carRentalBookingPreferences the result is true."
```

**endNonFunctionalProperties**

```
carRentalInfo impliesType carRentalBookingInfo  
carRentalBookingPreferences impliesType carRentalBookingPreferences  
range ofType xsd#boolean
```

### 3.1.6 Shuttle domain ontology

This ontology describes the shuttle ontology. The shuttle service provider will offer shuttles in different airports, and it will have stored the shuttle reservations already made, in order to be able to make future reservations.

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/shuttle#",
  dc_ "http://purl.org/dc/elements/1.1#",
  tsp_ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider#",
  sb_ "http://www.wsmo.org/ontologies/sfs/shuttleBooking#",
  fl_ "http://www.wsmo.org/ontologies/sfs/flight#",
  dt_ "http://www.wsmo.org/ontologies/dateTime#",
  loc_ "http://www.wsmo.org/ontologies/location#",
  xsd_ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/shuttle"

nonFunctionalProperties
  dc#title hasValue "Shuttle ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Shuttle tourismServiceProvider", "shuttle"}
  dc#description hasValue "Rent a car booking"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/shuttle"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
  _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider",
  _ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.daml.org/2001/02/geofile/geofile-ont"}
  dc#coverage hasValue "ID:7029392 Name:World"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/sfs/tourismServiceProvider"}

concept shuttleServiceProvider subConceptOf tsp#tourismServiceProvider
  nonFunctionalProperties
    dc#description hasValue "The shuttle tourismServiceProvider information"
    dc#shuttleReservations hasValue "The reservations made that the shuttle
      tourismServiceProvider store in order to have all the reserves information and to all
      available bookings"
    dc#officeOpeningTime hasValue "Indicates the opening time of the office"
    dc#officeClosingTime hasValue "Indicates the closing time of the office"
    dc#availableOriginAirports hasValue "Indicates the list of airports where the shuttles can be taken"
    dc#allowKidsAloneService hasValue "Indicates if a kid is allowed to travel alone"
    dc#hasVans hasValue "Indicates if the service provider offers vans as shuttles"
    dc#shuttles hasValue "The shuttles that this tourismServiceProvider offers"
  endNonFunctionalProperties
  shuttleReservations impliesType sb#shuttleBooking
  officeOpeningTime impliesType date#time
  officeClosingTime impliesType date#time
  availableOriginAirports impliesType fl#airport
  allowKidsAloneService ofType xsd#boolean
  hasVans ofType xsd#boolean
  shuttles impliesType shuttle

concept shuttle
  nonFunctionalProperties
    dc#description hasValue "A shuttle"
    dc#shuttleIdenticator hasValue "An unique code for a shuttle"
    dc#rentalRate hasValue "The shuttle rate"
    dc#doorCount hasValue "Indicates the number of doors of the shuttle"
    dc#shuttleSize hasValue "Indicates the number of places of the shuttle"

```

dc#miliageLimited **hasValue** "Indicates if the miliage is limited"  
dc#hasChildSeat **hasValue** "Indicates if the miliage is limited"  
dc#hasAirConditioning **hasValue** "Indicates if the shuttle has air conditioning"

**endNonFunctionalProperties**

shuttleIdentificator **ofType** xsd:string  
rentalRate **ofType** xsd:float  
doorCount **ofType** xsd:integer  
shuttleSize **ofType** xsd:integer  
miliageLimited **ofType** xsd:boolean  
hasChildSeat **ofType** xsd:boolean  
hasAirConditioning **ofType** xsd:boolean

**function** fulfillShuttlePreferences

**nonFunctionalProperties**

dc#description **hasValue** "(shuttleBookingInfo, shuttleBookingPreferences, result) is a tripl  
of the ternary relation corresponding to this function: if shuttleBookingInfo fulfills the  
the customer shuttleBookingPreferences the result is true."

**endNonFunctionalProperties**

shuttleBookingInfo **impliesType** shuttleBookingInfo  
shuttleBookingPreferences **impliesType** shuttleBookingPreferences  
range **ofType** xsd:boolean .

### 3.1.7 Booking Ontology

The booking ontology describes the domain of booking within a B2C scenario.

The main constructs of the Purchase Ontology are:

- **Booking:** the overall construct that holds all aspects for a booking where a buyer reserves a service from a seller
- **Booking Partners:** the parties involved in a booking, i.e. buyer and seller
- **Payment:** specifies notions of payment
- **Delivery:** specifies delivery methods for delivering a booking ticket from the seller to the buyer

```

namespace { _"http://www.wsmo.org/ontologies/sfs/booking#",
  dc _"http://purl.org/dc/elements/1.1#",
  dt _"http://www.wsmo.org/ontologies/dateTime#",
  loc _"http://www.wsmo.org/ontologies/location#",
  tsp _"http://www.wsmo.org/ontologies/sfs/tourismServiceProvider#",
  cu _"http://www.wsmo.org/ontologies/sfs/customer#",
  xsd _"http://www.w3.org/2001/XMLSchema#"
}

ontology _"http://www.wsmo.org/ontologies/sfs/booking"

nonFunctionalProperties
  dc#title hasValue "Booking ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Booking request", "Buyer", "Seller", "Booking ticket", "Payment method"}
  dc#description hasValue "General description of a booking request"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-15"
  dc#type hasValue _"http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/plain"
  dc#identifier hasValue _"http://www.wsmo.org/ontologies/sfs/booking"
  dc#language hasValue "en-US"
  dc#relation hasValue { _"http://www.wsmo.org/ontologies/location",
    _"http://www.wsmo.org/ontologies/dateTime",
    _"http://www.wsmo.org/ontologies/sfs/customer",
    _"http://www.wsmo.org/ontologies/sfs/tourismServiceProvider"}
  dc#coverage hasValue "ID:7029392 Name:World"
  dc#rights hasValue _"http://deri.at/privacy.html"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology { _"http://www.wsmo.org/ontologies/dateTime.wsml",
  _"http://www.wsmo.org/ontologies/location.wsml",
  _"http://www.wsmo.org/ontologies/sfs/tourismServiceProvider",
  _"http://www.wsmo.org/ontologies/sfs/customer"}

concept booking
  nonFunctionalProperties
    dc#description hasValue "A general booking"
  endNonFunctionalProperties
  bookingIdentifier ofType xsd:string
  buyer impliesType buyer
  seller impliesType tsp#tourismServiceProvider
  paymentMethod impliesType paymentMethod
  contractDate impliesType dt:date
  bookingTicket impliesType bookingTicket

concept bookingTicket
  nonFunctionalProperties
    dc#description hasValue "A ticket for a booking."
  endNonFunctionalProperties
  bookingTicketIdentifier ofType xsd:string
  buyerName ofType xsd:string
  sellerName ofType xsd:string

concept buyer subConceptOf cu#customer
  nonFunctionalProperties
    dc#description hasValue "the partner that makes a booking"
    dc#relation hasValue { _"http://wsmo.org/ontologies/rosettanet#buyer"}
  endNonFunctionalProperties
  bookingPreferences impliesType bookingPreferences

concept bookinaPreferences

```

```
nonFunctionalProperties
  dc:description hasValue "The preferences of the buyer in a booking"
endNonFunctionalProperties
```

```
concept paymentMethod
  nonFunctionalProperties
    dc:description hasValue "The superconcept of payment methods"
  endNonFunctionalProperties
```

```
concept pointsPaymentMethod subConceptOf paymentMethod
  nonFunctionalProperties
    dc:description hasValue "payment Method POINTS"
  endNonFunctionalProperties
  numberOfPoints ofType xsd#integer
```

```
concept onlineDelivery
  nonFunctionalProperties
    dc:description hasValue "a reservationTicket is delivery online as a piece of information"
  endNonFunctionalProperties
  onlineDeliveryMethod ofType xsd#string
  deliveryItem impliesType reservationTicket
  sender impliesType tsp#tourismServiceProvider
  receiver impliesType buyer
```

### 3.1.8 Flight Booking Ontology

This ontology describes a flight booking. The booking will include:

- a booking ticket
- an air trip info, which will include start and end location, departure and arrival date, and the sections that compose the trip
- buyer information
- seller information

Listing 8. Flight Booking Ontology.

```
namespace {_ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  fl _ "http://www.wsmo.org/ontologies/sfs/flight#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  xsd _ "http://www.w3.org/2001/XMLSchema#"}

ontology _ "http://www.wsmo.org/ontologies/sfs/flightBooking"
  nonFunctionalProperties
    dc:title hasValue "Flight Booking Ontology"
    dc:creator hasValue "ATOS ORIGIN S.A."
    dc:subject hasValue {"Flight", "Flight Booking", "Airport", "AirTrip"}
    dc:description hasValue "Flight Booking Ontology"
    dc:publisher hasValue "ATOS ORIGIN S.A."
    dc:contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
    dc:date hasValue "2005-02-11"
    dc:type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
    dc:format hasValue "text/html"
    dc:identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/flightBooking"
    dc:language hasValue "en-US"
    dc:relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
      _ "http://www.wsmo.org/ontologies/sfs/booking",
```

```

_ "http://www.wsmo.org/ontologies/dateTime",
_ "http://www.wsmo.org/ontologies/location",
_ "http://www.daml.org/2001/02/geofile/geofile-ont"}
dc#coverage hasValue "ID:7029392 Name:World"
version hasValue "$Revision: 1.1 $"

```

**endNonFunctionalProperties**

```

importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
_ "http://www.wsmo.org/ontologies/location",
_ "http://www.wsmo.org/ontologies/sfs/booking",
_ "http://www.wsmo.org/ontologies/sfs/flight"}

```

**usesMediator**

```

_ "http://www.wsmo.org/2004/d3/d3.3/v0.1/20041008/resources/owlGeoMediator.wsmi"

```

**concept** flightBooking **subConceptOf** bo#booking

**nonFunctionalProperties**

```

dc#description hasValue "a description of a flight booking"

```

**endNonFunctionalProperties**

```

seller impliesType fl#flightServiceProvider

```

```

airTripInfo impliesType airTripInfo

```

**concept** flightBookingTicket **subConceptOf** bo#bookingTicket

**nonFunctionalProperties**

```

dc#description hasValue "A ticket for flight booking"

```

**endNonFunctionalProperties**

```

airTripInfo impliesType airTripInfo

```

**concept** trip

**nonFunctionalProperties**

```

dc#description hasValue "A concept that describes a trip by plane"

```

```

dc#start hasValue "The origin location"

```

```

dc#end hasValue "The destination location"

```

```

dc#departure hasValue "The departure date"

```

```

dc#arrival hasValue "The arrival date"

```

```

dc#duration hasValue "The duration of the trip"

```

**endNonFunctionalProperties**

```

startLocation impliesType loc#location

```

```

endLocation impliesType loc#location

```

```

departureDate impliesType dt#dateAndTime

```

```

arrivalDate impliesType dt#dateAndTime

```

```

duration impliesType dt#interval

```

**concept** airTripInfo **subConceptOf** trip

**nonFunctionalProperties**

```

dc#description hasValue "An air trip between two airports"

```

```

dc#airTripIdentifier hasValue "An unique identifier for the air trip"

```

```

dc#start hasValue "The start airport"

```

```

dc#end hasValue "The end airport"

```

```

dc#sections hasValue "The sections of the trip. "

```

**endNonFunctionalProperties**

```

airTripIdentifier ofType xsd:string

```

```

startLocation ofType airport

```

```

endLocation ofType airport

```

```

sections ofType section

```

**concept** section

**nonFunctionalProperties**

```

dc#description hasValue "A section of an air trip"

```

```

dc#originAirport hasValue "The origin airport of the section"

```

```

dc#destinationAirport hasValue "The destination airport of the section"

```

```

dc#flightTicket hasValue "A ticket for the section"

```

**endNonFunctionalProperties**

```

originAirport impliesType fl#airport

```

destinationAirport **impliesType** fl#airport  
flightTicket **impliesType** flightTicket

**concept** flightTicket

**nonFunctionalProperties**

dc#description **hasValue** "A ticket for a flight"  
dc#ticketNumber **hasValue** "The unique number for a ticket"  
dc#personName **hasValue** "The name of the tickets person"  
dc#dateOfIssue **hasValue** "Date when the ticket has been created"  
dc#seatNumber **hasValue** "The seat number "  
dc#seatClass **hasValue** "The seat class"  
dc#smokingSeat **hasValue** "Indicates if it is a smoking seat"  
dc#flight **hasValue** "The flight associated for the ticket"

**endNonFunctionalProperties**

ticketNumber **ofType** xsd#integer  
personName **ofType** xsd#string  
dateOfIssue **impliesType** dt#date  
seatNumber **ofType** xsd#integer  
seatClass **ofType** xsd#string  
smokingSeat **ofType** xsd#boolean  
flight **impliesType** fl#flight

**concept** flightBookingPreferences **subConceptOf** bookingPreferences

**nonFunctionalProperties**

dc#description **hasValue** "The airTrip preferences that must be fulfilled by the booking"  
dc#start **hasValue** "The start airport"  
dc#end **hasValue** "The end airport"  
dc#departure **hasValue** "The departure date"  
dc#arrival **hasValue** "The arrival date"  
dc#class **hasValue** "The seat class"  
dc#numMaxConnections **hasValue** "The maximum connections that the buyer allows"

**endNonFunctionalProperties**

start **impliesType** airport  
end **impliesType** airport  
departure **impliesType** dt#dateAndTime  
arrival **impliesType** dt#dateAndTime  
class **ofType** xsd#string  
numMaxConnections **ofType** xsd#integer

**axiom** departureBeforeArrival

**nonFunctionalProperties**

dc#description **hasValue** "Integrity Constraint departure has to be before arrival"

**endNonFunctionalProperties**

definedBy

?T memberOf trip[  
    departure **hasValue** ?D,  
    arrival **hasValue** ?A  
] **and** ?A =< ?D.

**axiom** startNotEqualEnd

**nonFunctionalProperties**

dc#description **hasValue** "Integrity Constraint the start and end of a trip have to be different"

**endNonFunctionalProperties**

definedBy

?T memberOf trip[  
    start **hasValue** ?Start,  
    end **hasValue** ?End  
] **and** ?Start = ?End.

This ontology describes a hotel room booking. The booking will include:

- a booking ticket
- an hotelStay, which will include the stay in a hotel info such as: check-in and check-out date, the hotel and room assigned
- buyer information
- seller information

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking#",
  dc _"http://purl.org/dc/elements/1.1#",
  dt _"http://www.wsmo.org/ontologies/dateTime#",
  bo _"http://www.wsmo.org/ontologies/sfs/booking#",
  ho _"http://www.wsmo.org/ontologies/sfs/hotel#",
  loc _"http://www.wsmo.org/ontologies/location#",
  xsd _"http://www.w3.org/2001/XMLSchema#"
}

ontology _"http://www.wsmo.org/ontologies/sfs/hotelRoomBooking"

nonFunctionalProperties
  dc#title hasValue "Hotel Room Booking Ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Hotel", "Hotel room booking", "Room", "hotelStay"}
  dc#description hasValue "Hotel reservation"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _"http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#identifier hasValue _"http://www.wsmo.org/ontologies/sfs/hotelRoomBooking"
  dc#source hasValue _"http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
  _"http://www.wsmo.org/ontologies/sfs/booking",
  _"http://www.wsmo.org/ontologies/sfs/hotel",
  _"http://www.wsmo.org/ontologies/dateTime",
  _"http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
  _"http://www.wsmo.org/ontologies/location",
  _"http://www.wsmo.org/ontologies/sfs/booking",
  _"http://www.wsmo.org/ontologies/sfs/hotel"}

concept hotelRoomBooking subConceptOf bo#booking
  nonFunctionalProperties
    dc#description hasValue "A hotel room booking"
    dc#hotelStay hasValue "The info of the stay in a hotel"
  endNonFunctionalProperties
  seller impliesType ho#hotelServiceProvider
  hotelStay impliesType hotelStay

concept hotelRoomBookingTicket subConceptOf bo#hotelRoomBookingTicket
  nonFunctionalProperties
    dc#description hasValue "A ticket of a hotel romm booking"
    dc#hotelStay hasValue "The info of the stay in a hotel"
  endNonFunctionalProperties
  hotelStay impliesType hotelStay

concept hotelStay
  nonFunctionalProperties
    dc#description hasValue "A stay in a hotel"
    dc#stayId hasValue "The unique code for a stay in a hotel"
    dc#checkIn hasValue "The date of check-in of the stay in a hotel"
    dc#checkOut hasValue "The date of check-out of the stay in a hotel"
    dc#hotel hasValue "The hotel of the stay in a hotel"
    dc#room hasValue "The room of the stay in a hotel"
  endNonFunctionalProperties
  stayId ofType xsd#string
  checkIn impliesType dt#date

```

```
checkOut impliesType dt#date
hotel impliesType ho#hotel
room impliesType ho#room
```

```
concept hotelRoomBookingPreferences subConceptOf bookingPreferences
```

```
nonFunctionalProperties
```

```
dc#description hasValue "The hotel room preferences that must be fulfilled by the booking"
dc#checkIn hasValue "The date of check-in of the stay "
dc#checkOut hasValue "The date of check-out of the stay "
dc#numberOfPersons hasValue "The number of persons that the customer wants to make
the reserve"
dc#hotelStars hasValue "The hotel stars that must be fulfilled by the booking"
dc#numberOfBeds hasValue "Number of beds. "
dc#smoking hasValue "Indicates if its a smoking room or not"
```

```
endNonFunctionalProperties
```

```
checkIn impliesType dt#date
checkOut impliesType dt#date
numberOfPersons ofType xsd#integer
hotelStars ofType xsd#integer
numberOfBeds ofType xsd#integer
smoking ofType xsd#boolean
```

```
axiom checkInBeforeCheckOut
```

```
nonFunctionalProperties
```

```
dc#description hasValue "Integrity Constraint: checkIn has to be before checkOut"
```

```
endNonFunctionalProperties
```

```
definedBy
```

```
?S memberOf hotelStay[
    checkIn hasValue ?CI,
    checkOut hasValue ?CO
```

```
]
```

```
and
```

```
?CI =< ?CO.
```

### 3.1.10 Car rental booking ontology

This ontology describes a car rental booking. The booking will include:

- a booking ticket
- the car rental info which will include the pickup and return date, the pickup location and the assigned car.
- buyer information
- seller information

Listing 10. Rent a Car Booking Ontology.

```
namespace{ _"http://www.wsmo.org/ontologies/sfs/carRentalBooking#",
dc _"http://purl.org/dc/elements/1.1#",
dt _"http://www.wsmo.org/ontologies/dateTime#",
bo _"http://www.wsmo.org/ontologies/sfs/booking#",
cr _"http://www.wsmo.org/ontologies/sfs/carRental#",
loc _"http://www.wsmo.org/ontologies/location#",
xsd _"http://www.w3.org/2001/XMLSchema#"
}
```

```
ontology _"http://www.wsmo.org/ontologies/sfs/carRentalBooking"
```

```
nonFunctionalProperties
```

```
dc#title hasValue "Car rental booking ontology"
```

dc#creator **hasValue** "ATOS ORIGIN S.A."  
 dc#subject **hasValue** {"Rent a car", "Car rental booking", "Car"}  
 dc#description **hasValue** "Rent a car booking"  
 dc#publisher **hasValue** "ATOS ORIGIN S.A."  
 dc#contributor **hasValue** {"Alejandro López", "Ozelin López", "Clara Pezuela"}  
 dc#date **hasValue** "2005-02-11"  
 dc#type **hasValue** "\_http://www.wsmo.org/2004/d2#ontologies"  
 dc#format **hasValue** "text/html"  
 dc#identifier **hasValue** "\_http://www.wsmo.org/ontologies/sfs/carRentalBooking"  
 dc#language **hasValue** "en-US"  
 dc#relation **hasValue** { "\_http://keg.cs.tsinghua.edu.cn/ontology/travel",  
 "\_http://www.wsmo.org/ontologies/sfs/booking",  
 "\_http://www.wsmo.org/ontologies/sfs/carRental",  
 "\_http://www.wsmo.org/ontologies/dateTime",  
 "\_http://www.wsmo.org/ontologies/location"}  
 dc#coverage **hasValue** "ID:7029392 Name:World"  
 version **hasValue** "\$Revision: 1.1 \$"

**endNonFunctionalProperties**

**importsOntology** { "\_http://www.wsmo.org/ontologies/dateTime",  
 "\_http://www.wsmo.org/ontologies/sfs/booking",  
 "\_http://www.wsmo.org/ontologies/sfs/carRental",  
 "\_http://www.wsmo.org/ontologies/location"  
 }

**concept** carRentalBooking **subConceptOf** bo#booking  
**nonFunctionalProperties**  
 dc#description **hasValue** "A booking of a car rental"  
**endNonFunctionalProperties**  
 seller **impliesType** cr#carRentalServiceProvider  
 carRentalBookingInfo **impliesType** carRentalBookingInfo

**concept** carRentalBookingTicket **subConceptOf** bo#bookingTicket  
**nonFunctionalProperties**  
 dc#description **hasValue** "A bookingTicket of a car rental booking"  
**endNonFunctionalProperties**  
 carRentalBookingInfo **impliesType** carRentalBookingInfo

**concept** carRentalBookingInfo  
**nonFunctionalProperties**  
 dc#description **hasValue** "The car rental information"  
 dc#driversName **hasValue** "The driver or drivers that can drive the car"  
 dc#pickupLocation **hasValue** "The location where the car will be pickuped"  
 dc#returnLocation **hasValue** "The location where the car will be returned"  
 dc#pickupDateAndTime **hasValue** "The date when the car will be pickuped"  
 dc#returnDateAndTime **hasValue** "The date when the car will be returned"  
 dc#car **hasValue** "The car that has been rented"  
**endNonFunctionalProperties**  
 driversName **ofType** xsd#string  
 pickupLocation **impliesType** loc#address  
 returnLocation **impliesType** loc#address  
 pickupDateAndTime **impliesType** dt#dateAndTime  
 returnDateAndTime **impliesType** dt#dateAndTime  
 car **impliesType** cr#car

**concept** carRentalBookingPreferences **subConceptOf** bookingPreferences  
**nonFunctionalProperties**  
 dc#description **hasValue** "The car rental preferences that must be fulfilled by the booking"  
 dc#pickupLocation **hasValue** "The location where the car will be pickuped"  
 dc#returnLocation **hasValue** "The location where the car will be returned"  
 dc#pickupDateAndTime **hasValue** "The date when the car will be pickuped"  
 dc#returnDateAndTime **hasValue** "The date when the car will be returned"  
 dc#doorCount **hasValue** "The number of doors of the car"

```

dc#carSize hasValue "Indicates tue number of persons that can be in the car"
dc#miliageLimited hasValue "Indicates if the car has miliageLimited"
dc#hasChildSeat hasValue "Indicates if the car has child seat"
dc#hasAirConditioning hasValue "Indicates if the car has air conditioning"

```

**endNonFunctionalProperties**

```

pickupLocation impliesType loc#address
returnLocation impliesType loc#address
pickupDateAndTime impliesType dt#dateAndTime
returnDateAndTime impliesType dt#dateAndTime
doorCount ofType xsd#integer
carSize ofType xsd#integer
miliageLimited ofType xsd#boolean
hasChildSeat ofType xsd#boolean
hasAirConditioning ofType xsd#boolean

```

**axiom** pickupBeforeReturn

**nonFunctionalProperties**

```

dc#description hasValue "Integrity Constraint# pickupDate has to be before returnDate"

```

**endNonFunctionalProperties**

```

definedBy
    ?B memberOf carRentalBooking[
        carRentalBookingInfo hasValue ?C
    ]
and
    ?C memberOf carRentalBookingInfo[
        pickupDateAndTime hasValue ?P,
        returnDateAndTime hasValue ?R
    ]
and
    ?P =< ?R.

```

### 3.1.11 Shuttle booking Ontology

This ontology describes a shuttle booking. The booking will include:

- a booking ticket
- the shuttle booking info, which will include the pickup date, the pickup airport and the assigned shuttle.
- buyer information
- seller information

Listing 11.Shuttle Booking Ontology.

```

namespace{ _"http://www.wsmo.org/ontologies/sfs/shuttleBooking#",
  dc_"http://purl.org/dc/elements/1.1#",
  dt_"http://www.wsmo.org/ontologies/dateTime#",
  bo_"http://www.wsmo.org/ontologies/sfs/booking#",
  sh_"http://www.wsmo.org/ontologies/sfs/shuttle#",
  loc_"http://www.wsmo.org/ontologies/location#",
  fb_"http://www.wsmo.org/ontologies/sfs/flightBooking#",
  xsd_"http://www.w3.org/2001/XMLSchema#"
}

ontology _"http://www.wsmo.org/ontologies/sfs/shuttleBooking"

nonFunctionalProperties
  dc#title hasValue "Shuttle booking ontology"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Taxi shuttle", "Shuttle booking", "Taxi"}
  dc#description hasValue "The ontology for booking a shuttle"

```

```
dc#publisher hasValue "ATOS ORIGIN S.A."
dc#contributor hasValue {"Alejandro López","Ozelin López", "Clara Pezuela"}
dc#date hasValue "2005-02-11"
dc#type hasValue _"http://www.wsmo.org/2004/d2#ontologies"
dc#format hasValue "text/html"
dc#identifier hasValue _"http://www.wsmo.org/ontologies/sfs/shuttleBooking"
dc#language hasValue "en-US"
dc#relation hasValue {_"http://keg.cs.tsinghua.edu.cn/ontology/travel",
_"http://www.wsmo.org/ontologies/sfs/booking",
_"http://www.wsmo.org/ontologies/sfs/shuttle#",
_"http://www.wsmo.org/ontologies/sfs/flightBooking",
_"http://www.wsmo.org/ontologies/dateTime",
_"http://www.wsmo.org/ontologies/location"}
dc#coverage hasValue "ID:7029392 Name:World"
version hasValue "$Revision: 1.1 $"
```

**endNonFunctionalProperties**

```
importsOntology {_"http://www.wsmo.org/ontologies/dateTime",
_"http://www.wsmo.org/ontologies/sfs/shuttle#",
_"http://www.wsmo.org/ontologies/sfs/booking",
_"http://www.wsmo.org/ontologies/sfs/flightBooking",
_"http://www.wsmo.org/ontologies/location"
}
```

```
concept shuttleBooking subConceptOf bo#booking
nonFunctionalProperties
  dc#description hasValue "A booking of a shuttle"
  dc#shuttleBookingInfo hasValue "The shuttle booking info"
endNonFunctionalProperties
seller impliesType sh#shuttleServiceProvider
shuttleBookingInfo impliesType shuttleBookingInfo
```

```
concept shuttleBookingTicket subConceptOf bo#bookingTicket
nonFunctionalProperties
  dc#description hasValue "A bookingTicket of a shuttle booking"
  dc#shuttleBookingInfo hasValue "The shuttle booking info"
endNonFunctionalProperties
shuttleBookingInfo impliesType shuttleBookingInfo
```

```
concept shuttleBookingInfo
nonFunctionalProperties
  dc#description hasValue "The shuttle booking information"
  dc#pickupLocation hasValue "The pickup location of the shuttle service"
  dc#pickupDateAndTime hasValue "The date and time of the shuttle service"
  dc#destination hasValue "The destination of the shuttle"
  dc#shuttle hasValue "The shuttle for this booking"
endNonFunctionalProperties
pickupLocation impliesType fb#airport
pickupDateAndTime impliesType dt#dateAndTime
destination impliesType loc#location
shuttle impliesType sh#shuttle
```

```
concept shuttleBookingPreferences subConceptOf bo#bookingPreferences
nonFunctionalProperties
  dc#description hasValue "The shuttle booking preferences"
  dc#pickupLocation hasValue "The pickup location of the shuttle service"
  dc#pickupDateAndTime hasValue "The pickup date and time of the shuttle service"
  dc#destination hasValue "The destination"
endNonFunctionalProperties
pickupLocation impliesType fb#airport
pickupDateAndTime impliesType dt#dateAndTime
destination impliesType loc#location
```

## 3.2 Goal Templates

The following specifies a set of pre-defined SFS Goal Templates whereof SFS Goal Instances will be created by marketplace participants and assigned to their distinct Freds. We define the Goal Templates in order to support the general desires a SFS customer can have; when creating a Goal Instance, the notions defined in the Goal Template can be arbitrarily refined.

Goals denote what a user wants as the result of the Web Service. For modeling the goal, WSMO describes the information elements that the user wants to get from the service (the postcondition) together with the state of the world desired after the service execution (the effect).

### 3.2.1 Flight Booking Goal

- **Desire:** A flight booking and get the booking ticket to the buyer email.
- **Postcondition:** a flight booking for a buyer (the SFS customer), payment by points.
- **Effect:** delivery of the flight booking ticket via email.

```

namespace {_ "http://www.wsmo.org/goals/sfs/flightBookingGoalTemplate#",
  dc _ "http://purl.org/dc/elements/1.1#",
  fb _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
  fl _ "http://www.wsmo.org/ontologies/sfs/flight#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#"
}

goal _ "http://www.wsmo.org/goals/sfs/flightBookingGoalTemplate"

nonFunctionalProperties
  dc#title hasValue "Goal for booking an airTrip"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Flight", "Flight Booking template", "Airport", "AirTrip"}
  dc#description hasValue "Goal for booking an airTrip"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/flightBookingGoalTemplate"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://daml.umbc.edu/ontologies/ittalks/person",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/flight#",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability flightBookingGoalTemplateCapability

  postcondition
    nonFunctionalProperties
      dc#description hasValue "the output of the service is a flight booking."
    endNonFunctionalProperties
    definedBy
      exists {?BookingIdentifier, ?FlightBookingTicket, ?BookingTicketIdentifier,
        ?AirTripInfo, ?Start, ?End, ?Departure, ?Arrival, ?Buyer, ?BuyerContactInform,
        ?FlightBookingPreferences, ?BuyerEmail, ?Class, ?NumMaxConnections}
      (
        ?BookingIdentifier memberOf bo#bookingIdentifier and
        ?FlightBookingTicket memberOf fb#flightBookingTicket
        [
          bookingTicketIdentifier hasValue ?BookingTicketIdentifier,
          airTripInfo hasValue ?AirTripInfo
        ] and
        ?BookingTicketIdentifier memberOf bo#bookingTicketIdentifier and
        ?AirTripInfo memberOf fb#airTripInfo
        [
          start hasValue ?Start,
          end hasValue ?End,
          departure hasValue ?Departure,

```

```

        arrival hasValue ?Arrival,
        sections hasValue ?Section
    ] and
    ?Section memberOf fb#section[
        originAirport hasValue ?OriginAirport,
        destinationAirport hasValue ?DepartureAirport,
        flightTicket hasValue ?FlightTicket
    ] and
    ?FlightTicket memberOf bo#flightTicket [
        flight hasValue ?Flight
    ] and
    ?Flight memberOf fl#flight and
    ?FlightBookingTicket memberOf fb#flightBookingTicket
    [
        bookingTicketIdentifier hasValue ?BookingTicketIdentifier,
        airTripInfo hasValue ?AirTripInfo
    ] and
    ?Buyer memberOf bo#buyer[
        contactInformation hasValue ?BuyerContactInformation,
        flightBookingPreferences hasValue ?FlightBookingPreferences
    ] and
    ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?BuyerEmail
    ] and
    ?BuyerEmail memberOf xsd#string and
    ?FlightBookingPreferences memberOf fb#flightBookingPreferences
    [
        start hasValue ?Start,
        end hasValue ?End,
        departure hasValue ?Departure,
        arrival hasValue ?Arrival,
        class hasValue ?Class,
        numMaxConnections hasValue ?NumMaxConnections
    ] and
    ?Start memberOf fl#airport and
    ?End memberOf fl#airport and
    ?Departure memberOf dt#dateAndTime and
    ?Arrival memberOf dt#dateAndTime and
    ?Class memberOf xsd#string and
    ?NumMaxConnections memberOf xsd#integer and
    ?Seller memberOf fl#flightServiceProvider[
        flights hasValue {?Flight}
    ]
) and
?X memberOf fb#flightBooking[
    bookingIdentifier hasValue ?BookingIdentifier,
    airTripInfo hasValue ?AirTripInfo,
    buyer hasValue ?Buyer,
    seller hasValue ?Seller,
    bookingTicket hasValue ?FlightBookingTicket
].

```

### 3.2.2 Hotel Room Booking Goal Template

- **Desire:** A hotel room booking and get the booking ticket to the buyer email.
- **Postcondition:** a hotel room booking for a buyer (the SFS customer), payment by points.
- **Effect:** delivery of the hotel room booking ticket via email.

```

namespace {_ "http://www.wsmo.org/goals/sfs/hotelRoomBookingGoalTemplate#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  hb _ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking#",
  ho _ "http://www.wsmo.org/ontologies/sfs/hotel#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

goal _ "http://www.wsmo.org/goals/sfs/hotelRoomBookingGoalTemplate"

nonFunctionalProperties
  dc#title hasValue "Goal for booking a hotel room"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Hotel", "Hotel room booking", "Room", "hotelStay"}
  dc#description hasValue "Goal for booking a hotel room"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/hotelRoomBookingGoalTemplate"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/booking",
    _ "http://www.wsmo.org/ontologies/hotelRoomBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"

  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/hotel",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability hotelRoomBookingGoalTemplateCapability

  postcondition
    nonFunctionalProperties
      dc#description hasValue "This goal template is used to find a
        hotel booking web service. It will be fill in by the
        customer"
    endNonFunctionalProperties
    definedBy
      exists {?BookingIdentifier, ?HotelRoomBookingTicket, ?BookingTicketIdentifier,
        ?HotelStay, ?DateAndTime, ?CheckIn, ?CheckOut, ?Room, ?Hotel, ?
        ?BuyerEmail, ?BuyerContactInformation, ?HotelRoomBookingPreferer
        ?numberOfPersons, ?hotelStars}

      (
        ?BookingIdentifier memberOf bo#bookingIdentifier and
        ?HotelRoomBookingTicket memberOf hb#hotelRoomBookingTicket
        [
          bookingTicketIdentifier hasValue ?BookingTicketIdentifier,
          hotelStay hasValue ?HotelStay
        ] and
        ?BookingTicketIdentifier memberOf bo#bookingTicketIdentifier and
        ?HotelStay memberOf hb#hotelStay [
          checkIn hasValue ?CheckIn,

```

```

        checkOut hasValue ?CheckOut,
        room hasValue ?Room,
        hotel hasValue ?Hotel
    ] and
    ?CheckIn memberOf dt#date and
    ?CheckOut memberOf dt#date and
    ?Room memberOf ho#room and
    ?Hotel memberOf ho#hotel and
    ?Buyer memberOf bo#buyer[
        contactInformation hasValue ?ContactInformation,
        bookingPreferences hasValue ?HotelRoomBookingPreferences
    ] and
    ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?BuyerEmail
    ] and
    ?BuyerEmail memberOf xsd#string and
    ?HotelRoomBookingPreferences memberOf hb#hotelRoomBookingPreferences:
    [
        checkIn hasValue ?CheckInPre,
        checkOut hasValue ?CheckOutPre,
        numberOfPersons hasValue ?NumberOfPersonsPre,
        hotelStars hasValue ?HotelStarsPre
    ] and
    ?CheckInPre memberOf dt#date and
    ?CheckOutPre memberOf dt#date and
    ?NumberOfPersonsPre memberOf xsd#integer and
    ?HotelStarsPre memberOf xsd#integer and
    ?HotelServiceProvider memberOf ho#hotelServiceProvider
    [
        hotels hasValue {?Hotel}
    ]
    )
and
    ?X memberOf hb#hotelRoomBooking[
        bookingIdentifier hasValue ?BookingIdentifier,
        hotelStay hasValue ?HotelStay,
        buyer hasValue ?Buyer,
        seller hasValue ?HotelServiceProvider,
        bookingTicket hasValue ?HotelRoomBookingTicket
    ].

```

### 3.2.3 Car Rental Booking Goal Template

- **Desire:** A car rental booking and get the booking ticket to the buyer email.
- **Postcondition:** a car rental booking for a buyer (the SFS customer), payment by points.
- **Effect:** delivery of the car rental booking ticket via email.

Listing 14. Car Rental Booking Goal Template.

```

namespace {_"http://www.wsmo.org/goals/sfs/carRentalBookingGoalTemplate#",
    dc_"http://purl.org/dc/elements/1.1#",
    dt_"http://www.wsmo.org/ontologies/dateTime#",
    bo_"http://www.wsmo.org/ontologies/sfs/booking#",
    loc_"http://www.wsmo.org/ontologies/location#"
}

goal _"http://www.wsmo.org/goals/sfs/carRentalBookingGoalTemplate"

nonFunctionalProperties
    dc#title hasValue "Package Goal"
    dc#creator hasValue "ATOS ORIGIN S.A."

```

```

dc#subject hasValue {"Package goal", "constraint", ""}
dc#description hasValue "Goal for booking online carRental"
dc#publisher hasValue "ATOS ORIGIN S.A."
dc#contributor hasValue {"Alejandro López","Jose López", "Clara Pezuela"}
dc#date hasValue "2005-02-11"
dc#type hasValue _"http://www.wsmo.org/2004/d2#goals"
dc#format hasValue "text/html"
dc#identifier hasValue _"http://www.wsmo.org/goals/sfs/carRentalBookingGoalTemplate"
dc#source hasValue _"http://keg.cs.tsinghua.edu.cn/ontology/travel"
dc#language hasValue "en-US"
dc#relation hasValue {_"http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _"http://www.wsmo.org/ontologies/sfs/booking",
    _"http://www.wsmo.org/ontologies/sfs/carBooking",
    _"http://www.wsmo.org/ontologies/dateTime",
    _"http://www.wsmo.org/ontologies/location"}
dc#coverage hasValue "ID:7029392 Name:World"
version hasValue "$Revision: 1.1 $"

```

**endNonFunctionalProperties**

```

importsOntology {_"http://www.wsmo.org/ontologies/sfs/carRentalBooking",
    _"http://www.wsmo.org/ontologies/sfs/booking",
    _"http://www.wsmo.org/ontologies/sfs/carRental",
    _"http://www.wsmo.org/ontologies/location",
    _"http://www.wsmo.org/ontologies/dateTime"
}

```

**capability**

**postcondition**

**nonFunctionalProperties**

```

dc#description hasValue "This goal is used to build the package"

```

**endNonFunctionalProperties**

**definedBy**

```

exists {?BookingIdentifier, ?CarRentalBookingTicket, ?BookingTicketIdentifier,
    ?CarRentalBookingInfo, ?PickupLocation, ?ReturnLocation, ?PickupDateAndTime,
    ?ReturnDateAndTime, ?Car, ?Buyer, ?BuyerContactInformation, ?DoorCount,
    ?CarSize, ?MiliageLimited, ?HasChildSeat, ?HasAirConditioning}

```

(

```

?BookingIdentifier memberOf xsd:string and
?CarRentalBookingInfo memberOf cb#carRentalBookingInfo

```

[

```

pickupLocation hasValue ?PickupLocation,
returnLocation hasValue ?ReturnLocation,
pickupDateAndTime hasValue ?PickupDateAndTime,
returnDateAndTime hasValue ?ReturnDateAndTime,
car hasValue ?Car

```

] **and**

```

?PickupLocation memberOf loc#location and
?ReturnLocation memberOf loc#location and
?PickupDateAndTime memberOf dt#dateAndTime and
?ReturnDateAndTime memberOf dt#dateAndTime and
?Car memberOf car#car

```

[

```

doorCount hasValue ?DoorCount,
carSize hasValue ?CarSize,
miliageLimited hasValue ?MiliageLimited,
hasChildSeat hasValue ?HasChildSeat,
hasAirConditioning hasValue ?HasAirConditioning

```

] **and**

```

?CarRentalBookingTicket memberOf cb#carRentalBookingTicket

```

[

```

bookingTicketIdentifier hasValue ?BookingTicketIdentifier,
carRentalBookingInfo hasValue ?CarRentalBookingInfo

```

] **and**

```

?BookingTicketIdentifier memberOf xsd:string and

```

```

?Buyer memberOf bo#buyer[
    contactInformation hasValue ?BuyerContactInformation,
    bookingPreferences hasValue ?CarRentalBookingPreferences
] and
?BuyerContactInformation memberOf bo#contactInformation [
    emailAddress hasValue ?Emailaddress
] and
?Emailaddress memberOf xsd#string and
?CarRentalBookingPreferences memberOf cb#carRentalBookingPreferences
[
    pickupLocation hasValue ?PickupLocationPre,
    returnLocation hasValue ?ReturnLocationPre,
    pickupDateAndTime hasValue ?PickupDateAndTimePre,
    returnDateAndTime hasValue ?ReturnDateAndTimePre,
    doorCount hasValue ?DoorCountPre,
    carSize hasValue ?CarSizePre,
    miliageLimited hasValue ?MiliageLimitedPre,
    hasChildSeat hasValue ?HasChildSeatPre,
    hasAirConditioning hasValue ?HasAirConditioningPre
] and
?PickupLocationPre memberOf loc#location and
?ReturnLocationPre memberOf loc#location and
?PickupDateAndTimePre memberOf dt#dateAndTime and
?ReturnDateAndTimePre memberOf dt#dateAndTime and
?DoorCountPre memberOf xsd#integer and
?CarSizePre memberOf xsd#integer and
?MiliageLimitedPre memberOf xsd#boolean and
?HasChildSeatPre memberOf xsd#boolean and
?HasAirConditioningPre memberOf xsd#boolean and
?CarRentalServiceProvider memberOf cr#carRentalServiceProvider and
[
    cars hasValue {?Car}
]
) and
?X memberOf cb#carRentalBooking[
    bookingIdentifier hasValue ?BookingIdentifier,
    carRentalBookingInfo hasValue ?CarRentalBookingInfo,
    buyer hasValue ?Buyer,
    seller hasValue ?CarRentalServiceProvider,
    bookingTicket hasValue ?CarRentalBookingTicket,
    paymentMethod hasValue ?Points
].

```

### 3.2.4 Shuttle Booking Goal Template

- **Desire:** A shuttle booking and get the booking ticket to the buyer email.
- **Postcondition:** a shuttle booking for a buyer (the SFS customer), payment by points.
- **Effect:** delivery of the shuttle booking ticket via email.

```

namespace {_ "http://www.wsmo.org/goals/sfs/shuttleBookingGoalTemplate#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  sh _ "http://www.wsmo.org/ontologies/sfs/shuttle#",
  cb _ "http://www.wsmo.org/ontologies/sfs/shuttleBooking#",
  bo _ "http://www.wsmo.org/ontologies/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

goal _ "http://www.wsmo.org/goals/sfs/shuttleBookingGoalTemplate"

nonFunctionalProperties
  dc#title hasValue "Goal for booking online a shuttle"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Taxi shuttle", "Shuttle booking", "Taxi"}
  dc#description hasValue "Goal for booking online a shuttle"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/shuttleBookingGoalTemplate"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/booking",
    _ "http://www.wsmo.org/ontologies/shuttleBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  dc#rights hasValue _ "http://www.deri.org/privacy.html"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/shuttleBooking",
  _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/shuttle",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability shuttleBookingGoalTemplateCapability

  postcondition
    nonFunctionalProperties
      dc#description hasValue "This goal template is used to find a
        shuttle booking web service. It will be fill in by the
        customer"
    endNonFunctionalProperties
    definedBy
      exists {?BookingIdentifier, ?ShuttleBookingTicket, ?BookingTicketIdentifier,
        ?ShuttleBookingInfo, ?PickupAirport, ?PickupDateAndTime, ?Destination,
        ?Buyer, ?BuyerContactInformation, ?ShuttleBookingTicket}
      (
        ?BookingIdentifier memberOf xsd:string and
        ?ShuttleBookingInfo memberOf sb#shuttleBookingInfo [
          pickupAirport hasValue ?PickupAirport,
          pickupDateAndTime hasValue ?PickupDateAndTime,
          destination hasValue ?Destination,
          shuttle hasValue ?Shuttle
        ] and
        ?PickupAirport memberOf fb#airport and
        ?PickupDateAndTime memberOf dt#dateAndTime and

```

```

?Destination memberOf loc#location and
?Shuttle memberOf sh#shuttle and
?ShuttleBookingTicket memberOf sb#shuttleBookingTicket [
    bookingTicketIdentifier hasValue ?BookingTicketIdentifier,
    shuttleBookingInfo hasValue ?ShuttleBookingInfo
] and
?BookingTicketIdentifier memberOf xsd#string and
?Buyer memberOf bo#buyer[
    contactInformation hasValue ?BuyerContactInformation,
    bookingPreferences hasValue ?ShuttleBookingPreferences
] and
?BuyerContactInformation memberOf bo#contactInformation [
    emailAddress hasValue ?EmailAddress
] and
?EmailAddress memberOf xsd#string and
?ShuttleBookingPreferences memberOf sb#shuttleBookingPreferences[
    pickupAirport hasValue ?PickupLocation,
    pickupDateAndTime hasValue ?PickupDateAndTime,
    destination hasValue ?Destination
] and
?ShuttleServiceProvider memberOf sh#shuttleServiceProvider
    [shuttles hasValue {?Shuttle}]
) and
?X memberOf sb#shuttleBooking [
    bookingIdentifier hasValue ?BookingIdentifier,
    shuttleBookingInfo hasValue ?ShuttleBookingInfo,
    buyer hasValue ?Buyer,
    seller hasValue ?ShuttleServiceProvider,
    bookingTicket hasValue ?ShuttleBookingTicket
].

```

**effect**

**nonFunctionalProperties**

dc#description **hasValue** "The booking ticket is delivered to the buyer via email"

**endNonFunctionalProperties**

**definedBy**

**exists** {?ShuttleBooking ,?BookingIdentifier, ?ShuttleBookingTicket,
?BookingTicketIdentifier, ?ShuttleBookingInfo, ?PickupAirport ,
?PickupDateAndTime, ?Destination, ?Buyer, ?BuyerContactInformation,
?ShuttleBookingTicket}

(

```

?ShuttleBooking memberOf sb#shuttleBooking [
    bookingIdentifier hasValue ?BookingIdentifier,
    shuttleBookingInfo hasValue ?ShuttleBookingInfo,
    buyer hasValue ?Buyer,
    bookingTicket hasValue ?ShuttleBookingTicket

```

**] and**

```

?BookingIdentifier memberOf xsd#string and
?ShuttleBookingInfo memberOf sb#shuttleBookingInfo [
    pickupAirport hasValue ?PickupAirport,
    pickupDateAndTime hasValue ?PickupDateAndTime,
    destination hasValue ?Destination,
    shuttle hasValue ?Shuttle

```

**] and**

```

?PickupAirport memberOf fb#airport and
?PickupDateAndTime memberOf dt#dateAndTime and
?Destination memberOf loc#location and
?Shuttle memberOf sh#shuttle and
?ShuttleBookingTicket memberOf sb#shuttleBookingTicket [
    bookingTicketIdentifier hasValue ?BookingTicketIdentifier,
    shuttleBookingInfo hasValue ?ShuttleBookingInfo

```

**] and**

```

?BookingTicketIdentifier memberOf xsd#string and
?Buyer memberOf bo#buyer[

```

```

        contactInformation hasValue ?BuyerContactInformation,
        bookingPreferences hasValue ?ShuttleBookingPreferences
    ] and
    ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?Emailaddress
    ] and
    ?ShuttleBookingPreferences memberOf sb#shuttleBookingPreferences[
        pickupAirport hasValue ?PickupLocation,
        pickupDateAndTime hasValue ?PickupDateAndTime,
        destination hasValue ?Destination ]
) and
?X memberOf bo#onlineDelivery[
    deliveryItem hasValue {?ShuttleBookingTicket},
    receiver hasValue ?Buyer,
    onlineDeliveryMethod hasValue "email"
].

```

### 3.2.5 Find Air Trip Information Goal Template

Listing 16 below defines the findAirTripInfoGoal which is linked by the findAirTripInfoMediator. This goal will provide an available airTripInfo for the flight booking, that will satisfy the customer flight booking preferences.

```

namespace { _ "http://www.wsmo.org/goals/sfs/findAirTripInfoGoal#",
  dc _ "http://purl.org/dc/elements/1.1#",
  fb _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
  fl _ "http://www.wsmo.org/ontologies/sfs/flight#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#"
}

goal _ "http://www.wsmo.org/goals/sfs/findAirTripInfoGoal"

nonFunctionalProperties
  dc#title hasValue "Goal for booking an airTrip"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Flight", "Airport", "AirTrip info"}
  dc#description hasValue "Goal for booking an airTrip"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/findAirTripInfoGoal"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue { _ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://daml.umbc.edu/ontologies/ittalks/person",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology { _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/flight#",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability
  sharedVariables ?airTripInfo
  postcondition
    nonFunctionalProperties
      dc#description hasValue "This is a goal template. The "
    endNonFunctionalProperties
    definedBy
      exists {
        ?Buyer, ?BuyerContactInformation, ?FlightBookingPreferences, ?BuyerEmail ,
        ?Start, ?End , ?Departure, ?Arrival , ?Class, ?NumMaxConnections}
      (
        ?Buyer memberOf bo#buyer[
          contactInformation hasValue ?BuyerContactInformation,
          flightBookingPreferences hasValue ?FlightBookingPreferences
        ] and
        ?BuyerContactInformation memberOf bo#contactInformation [
          emailAddress hasValue ?BuyerEmail
        ] and
        ?BuyerEmail memberOf xsd#string and
        ?FlightBookingPreferences memberOf fb#flightBookingPreferences
        [
          start hasValue ?Start,
          end hasValue ?End,

```

```

    departure hasValue ?Departure,
    arrival hasValue ?Arrival,
    class hasValue ?Class,
    numMaxConnections hasValue ?NumMaxConnections
] and
?Start memberOf fl#airport and
?End memberOf fl#airport and
?Departure memberOf dt#dateAndTime and
?Arrival memberOf dt#dateAndTime and
?Class memberOf xsd#string and
?NumMaxConnections memberOf xsd#integer
and
) and
?AirTripInfo memberOf fb#airTripInfo
[
    start hasValue ?Start,
    end hasValue ?End,
    departure hasValue ?Departure,
    arrival hasValue ?Arrival,
    sections hasValue ?Section
] and
?Section memberOf fb#section[
    originAirport hasValue ?Origin,
    destinationAirport hasValue ?Departure,
    flightTicket hasValue ?FlightTicket
] and
?FlightTicket memberOf bo#flightTicket [
    flight hasValue ?Flight
] and
?Flight memberOf fl#flight.

```

### 3.2.6 Find Hotel Stay Goal Template

Listing 17 belows defines the findHotelStayGoal which is linked by the findHotelStayMediator. This goal will provide an available hotelStay for the hotel booking, that will satisfy the customer hotel booking preferences.

```

namespace {
  _ "http://www.wsmo.org/goals/sfs/findHotelStayGoal#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  hb _ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking#",
  ho _ "http://www.wsmo.org/ontologies/sfs/hotel#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

goal _ "http://www.wsmo.org/goals/sfs/findHotelStayGoal#"

nonFunctionalProperties
  dc#title hasValue "Goal to find a hotel stay"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Hotel", "Room", "hotelStay", "available room"}
  dc#description hasValue "Goal to find a hotel stay"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/findHotelStayGoal"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue { _ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/booking",
    _ "http://www.wsmo.org/ontologies/hotelRoomBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location" }
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology { _ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/hotel",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability

  sharedVariables ?hotelStay

  postcondition
    nonFunctionalProperties
      dc#description hasValue "A hotelStay instance has been created
        according to the buyer preferences"
    endNonFunctionalProperties
    definedBy
      exists {
        ?Buyer, ?BuyerEmail, ?BuyerContactInformation,
        ?HotelRoomBookingPreferences, ?NumberOfPersons, ?HotelStars}
      (
        ?Buyer memberOf bo#buyer[
          contactInformation hasValue ?ContactInformation,
          bookingPreferences hasValue ?HotelRoomBookingPreferences
        ] and
        ?BuyerContactInformation memberOf bo#contactInformation [
          emailAddress hasValue ?BuyerEmail
        ] and
        ?BuyerEmail memberOf xsd#string and
        ?HotelRoomBookingPreferences memberOf hb#hotelRoomBookingPreferences:
      [

```

```

        checkIn hasValue ?CheckIn,
        checkOut hasValue ?CheckOut,
        numberOfPersons hasValue ?NumberOfPersons,
        hotelStars hasValue ?HotelStars
    ] and
    ?CheckIn memberOf dt#date and
    ?CheckOut memberOf dt#date and
    ?NumberOfPersons memberOf xsd#integer and
    ?HotelStars memberOf xsd#integer and
    ?Room memberOf ho#room and
    ?Hotel memberOf ho#hotel
)
and
?hotelStay memberOf hb#hotelStay [
    checkIn hasValue ?CheckIn,
    checkOut hasValue ?CheckOut,
    room hasValue ?Room,
    hotel hasValue ?Hotel
] and
hb#fulfillHotelPreferences(?hotelStay,?HotelRoomBookingPreferences).

```

### 3.2.7 Find Car Rental Information Goal Template

Listing 18 belows defines the findCarRentalInfoGoal which is linked by the findCarRentalInfoMediator. This goal will provide an available carRentalInfo for the car rental booking, that will satisfy the customer car rental booking preferences.

```

namespace { _ "http://www.wsmo.org/goals/sfs/findCarRentalInfoGoal#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  car _ "http://www.wsmo.org/ontologies/sfs/carRental#",
  cb _ "http://www.wsmo.org/ontologies/sfs/carRentalBooking#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

goal _ "http://www.wsmo.org/goals/sfs/findCarRentalInfoGoal"
nonFunctionalProperties
  dc#title hasValue "Goal for booking online carRental"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Car rental", "Car booking info", "Car"}
  dc#description hasValue "Goal for booking online carRental"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/findCarRentalInfoGoal"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue { _ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/carBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology { _ "http://www.wsmo.org/ontologies/sfs/carRentalBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/carRental",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability
  postcondition
    nonFunctionalProperties
      dc#description hasValue "A car Rental Booking Info instance
        has been created according to the buyer preferences"
    endNonFunctionalProperties
    definedBy
      exists {?BookingIdentifier, ?CarRentalBookingTicket, ?BookingTicketIdentifier,
        ?CarRentalBookingInfo, ?PickupLocation, ?ReturnLocation, ?PickupDateAndTime,
        ?ReturnDateAndTime, ?Car, ?Buyer, ?BuyerContactInformation, ?DoorCount,
        ?CarSize, ?MiliageLimited, ?HasChildSeat, ?HasAirConditioning}
      (
        ?PickupLocation memberOf loc#location and
        ?ReturnLocation memberOf loc#location and
        ?PickupDateAndTime memberOf dt#dateAndTime and
        ?ReturnDateAndTime memberOf dt#dateAndTime and
        ?Car memberOf car#car
      [
        doorCount hasValue ?DoorCount,
        carSize hasValue ?CarSize,
        miliageLimited hasValue ?MiliageLimited,
        hasChildSeat hasValue ?HasChildSeat,
        hasAirConditioning hasValue ?HasAirConditioning
      ] and
        ?Buyer memberOf bo#buyer[
          contactInformation hasValue ?BuyerContactInformation,

```

```

        bookingPreferences hasValue ?CarRentalBookingPreferences
    ] and
    ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?Emailaddress
    ] and
    ?Emailaddress memberOf xsd#string and
    ?CarRentalBookingPreferences memberOf cb#carRentalBookingPreferences
    [
        pickupLocation hasValue ?PickupLocation,
        returnLocation hasValue ?ReturnLocation,
        pickupDateAndTime hasValue ?PickupDateAndTime,
        returnDateAndTime hasValue ?ReturnDateAndTime,
        doorCount hasValue ?DoorCount,
        carSize hasValue ?CarSize,
        miliageLimited hasValue ?MiliageLimited,
        hasChildSeat hasValue ?HasChildSeat,
        hasAirConditioning hasValue ?HasAirConditioning
    ] and
    ?DoorCount memberOf xsd#integer and
    ?CarSize memberOf xsd#integer and
    ?MiliageLimited memberOf xsd#boolean and
    ?HasChildSeat memberOf xsd#boolean and
    ?HasAirConditioning memberOf xsd#boolean
) and
?carRentalBookingInfo memberOf cb#carRentalBookingInfo
[
    pickupLocation hasValue ?PickupLocation,
    returnLocation hasValue ?ReturnLocation,
    pickupDateAndTime hasValue ?PickupDateAndTime,
    returnDateAndTime hasValue ?ReturnDateAndTime,
    car hasValue ?Car
] and
cb#fulfillCarRentalPreferences(?carRentalBookingInfo,?CarRentalBookingPreference

```

### 3.2.8 Find Shuttle Information Goal Template

Listing 19 belows defines the findShuttleInfois linked by the findShuttleInfoMediator. This goal will provide an available shuttleInfo for the shuttle booking, that will satisfy the customer shuttle booking preferences.

```

namespace { _ "http://www.wsmo.org/goals/sfs/findShuttleBookingInfoGoal#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  sh _ "http://www.wsmo.org/ontologies/sfs/shuttle#",
  cb _ "http://www.wsmo.org/ontologies/sfs/shuttleBooking#",
  bo _ "http://www.wsmo.org/ontologies/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

goal _ "http://www.wsmo.org/goals/sfs/findShuttleBookingInfoGoal"

nonFunctionalProperties
  dc#title hasValue "Goal to fin a available shuttle booking info"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Taxi", "shuttle", "Shuttle booking", "Available shuttle"}
  dc#description hasValue "Goal to fin a available shuttle booking info"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#goals"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/goals/sfs/findShuttleBookingInfoGoal"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue { _ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/booking",
    _ "http://www.wsmo.org/ontologies/shuttleBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology { _ "http://www.wsmo.org/ontologies/sfs/shuttleBooking",
  _ "http://www.wsmo.org/ontologies/sfs/flight",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/shuttle",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability

  sharedVariables ?shuttleBookingInfo

  postcondition
    nonFunctionalProperties
      dc#description hasValue "A shuttle booking info instance
        has been created according to the buyer preferences"
    endNonFunctionalProperties
    definedBy
      exists {?Buyer, ?BuyerContactInformation,
        ?ShuttleBookingInfo, ?PickupAirport, ?PickupDateAndTime, ?Destination,
        ?Buyer, ?BuyerContactInformation, ?ShuttleBookingTicket}
      (
        ?PickupAirport memberOf fb#airport and
        ?PickupDateAndTime memberOf dt#dateAndTime and
        ?Destination memberOf loc#location and
        ?Shuttle memberOf sh#shuttle and
        ?Buyer memberOf bo#buyer[
          contactInformation hasValue ?BuyerContactInformation,
          bookingPreferences hasValue ?ShuttleBookingPreferences
        ] and

```

```

?BuyerContactInformation memberOf bo#contactInformation [
  emailAddress hasValue ?Emailaddress
]and
?Emailaddress memberOf xsd#string and
?ShuttleBookingPreferences memberOf sb#shuttleBookingPreferences[
  pickupAirport hasValue ?PickupLocation,
  pickupDateAndTime hasValue ?PickupDateAndTime,
  destination hasValue ?Destination
]
) and
?shuttleBookingInfo memberOf sb#shuttleBookingInfo [
  pickupAirport hasValue ?PickupAirport,
  pickupDateAndTime hasValue ?PickupDateAndTime,
  destination hasValue ?Destination,
  shuttle hasValue ?Shuttle
] and
sb#fulfillShuttlePreferences(?shuttleBookingInfo,?ShuttleBookingPrefe

```

## 3.3 Web Services

We define the Web Services in this use case: end-user services (means that the user interacts with this services) for booking a flight, a hotel room and a car rental. These Web Services can be composed of other Web Services. This setting allows modeling all notions of a WSMO Web Service description: a Capability of the end-user service and its Choreography for user-service interaction, as well as the orchestration which incorporates the aggregated Web Services. A Web Service Capability in WSMO is described by pre- and post-conditions, assumptions and effects, as defined in [[Roman et al., 2005](#)], and the Web service interface, including choreography and orchestration, is defined in [[Roman et al., 2005b](#)].

### 3.3.1 Flight Booking Web service

This web service is provided by IB flight service provider. It offers flights with the origin airport in Spain and destination Europe .

- **Functionality:** A flight booking will be created and the booking ticket will be send to the buyer email.
- **Capability**
  - **Precondition:** required input is: (1) the buyer contact information, including the email address and (2) the buyer flight booking preferences, where it is told that the origin airport must be in Spain and destination must be in Europe
  - **Assumption:** the payment method is by points
  - **Postcondition:** a flight booking for a buyer, payment by points and the seller is the IB Flight service provider.
  - **Effect:** delivery of the flight booking ticket to the buyer via email.
- **Interface**
  - **Choreography:**
    - when a airTripInfoInstance is received, a partial carRentalBookingInstance is created
    - if a partial flightBooking exists and if the booking identificator instance and the flightBookingTicketInstance are received, then the partial booking is complete with all the attributes filled in

- **Orchestration:**
  - when a `airTripInfoInstance` is received, the service must make use of another service which provide the `hotelStay`

Listing 20. IB Flight Booking Web Service.

```

namespace {_ "http://www.wsmo.org/webservices/sfs/IBFlightBookingWS#",
  dc _ "http://purl.org/dc/elements/1.1#",
  fb _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
  fl _ "http://www.wsmo.org/ontologies/sfs/flight#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
}

webService _ "http://www.wsmo.org/webservices/sfs/IBFlightBookingWS"

nonFunctionalProperties
  dc#title hasValue "Online Flight Booking Web Service"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Flight", "Flight Booking", "Airport", "AirTrip"}
  dc#description hasValue "Web service for booking an airTrip"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López","Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#webservice"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/webservices/sfs/IBFlightBookingWS"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://daml.umbc.edu/ontologies/ittalks/person",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/flight#",
  _ "http://www.wsmo.org/ontologies/sfs/flightBookingWSChoreography",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability IBFlightBookingWSCapability
  precondition
    nonFunctionalProperties
      dc#description hasValue "Required input is:
        [1] buyer information
        [2] flight booking preferences
        As precondition the buyer must have an existin email address
        and he has to indicate his preferences of a flight booking,
        such as:the departure and arrival date, start and end location
        maximun number of conexions and desired seat class.
        The departure must be from Madrid and
        the arrival must be toEurope"
    endNonFunctionalProperties
  definedBy
    ?Buyer memberOf bo#buyer[
      contactInformation hasValue ?BuyerContactInformation,
      flightBookingPreferences hasValue ?FlightBookingPreferences

```

] and  
 ?BuyerContactInformation **memberOf** bo#contactInformation [  
   emailaddress **hasValue** ?InputBuyerEmail  
 ] and  
 ?FlightBookingPreferences **memberOf** fb#flightBookingPreferences  
 .

postcondition

**nonFunctionalProperties**

dc#description **hasValue** "The output of the service is a flight booking.  
 An instance of a flight booking have been created.  
 This booking has an identificator, a ticket, **and** the air trip info  
 has been obtained from the service providers data base  
**and** satisfy the booking buyer preferences.

The air trip info has:

  departure **and** arrival date,  
   start **and** end airports,  
   the sections of the air trip

This sections will have a flight ticket with the flight associated"

**endNonFunctionalProperties**

**definedBy**

**exists** {?BookingIdentifier, ?FlightBookingTicket, ?bookingTicketIdentifier, ?AirTripInf  
   ?Start, ?End, ?Departure, ?Arrival, ?Buyer, ?BuyerContactInformatic  
   ?FlightBookingPreferences, ?BuyerEmail}

(

  ?Buyer **memberOf** bo#buyer[  
     contactInformation **hasValue** ?BuyerContactInformation,  
     flightBookingPreferences **hasValue** ?FlightBookingPreferences

  ] and

  ?BuyerContactInformation **memberOf** bo#contactInformation [  
     emailaddress **hasValue** ?BuyerEmail

  ] and

  ?FlightBookingPreferences **memberOf** fb#flightBookingPreferences **and**  
   ?AirTriplInfo **memberOf** fb#airTriplInfo

  [

    start.inCountry **hasValue** SPAIN,  
 end.locatedIn **hasValue** EUROPE  
 departure **hasValue** ?Departure,  
 arrival **hasValue** ?Arrival  
 sections **hasValue** ?Sections

  ] and

  fb#fulfillFlightPreferences(?AirTriplInfo, ?FlightBookingPreferences) **and**

  ?Section **memberOf** fb#section[  
     flightTicket **hasValue** {?FlightTicket}

  ] and

  ?FlightTicket **memberOf** bo#flightTicket [  
     flight **hasValue** ?Flight

  ] and

  ?Flight **memberOf** fl#flight **and**  
   IBFlightServiceProvider **memberOf** fl#flightServiceProvider[  
     flights **hasValue** {?Flight}

  ]

) and

?X **memberOf** fb#flightBooking[  
   bookingIdentifier **hasValue** ?BookingIdentifier,  
   bookingTicket **hasValue** ?FlightBookingTicket,  
   airTriplInfo **hasValue** ?AirTriplInfo,  
   buyer **hasValue** ?Buyer,  
   seller **hasValue** IBFlightServiceProvider,  
   paymentMethod **hasValue** ?Points

].

**effect**

**nonFunctionalProperties**

dc#description **hasValue** "The booking ticket is delivered to the buyer via email from the service provider to the buyer emailAddress.  
The booking ticket will include the air trip info **and** the buyer info"

**endNonFunctionalProperties**

**definedBy**

**exists** {?FlightBooking, ?BookingIdentifier, ?FlightBookingTicket,  
?bookingTicketIdentifier, ?AirTripInfo, ?Buyer,  
?BuyerContactInformation, ?BuyerEmail}  
(  
  ?Buyer **memberOf** bo#buyer[  
    contactInformation **hasValue** ?BuyerContactInformation,  
  ] **and**  
  ?BuyerContactInformation **memberOf** bo#contactInformation [  
    emailAddress **hasValue** ?BuyerEmail  
  ] **and**  
  ?FlightBooking **memberOf** fb#flightBooking  
  [  
    bookingIdentifier **hasValue** ?BookingIdentifier,  
    airTripInfo **hasValue** ?AirTripInfo,  
    buyer **hasValue** ?Buyer,  
    seller **hasValue**  
    bookingTicket **hasValue** ?FlightBookingTicket,  
    paymentMethod **hasValue** ?Points  
  ] **and**  
  ?BookingIdentifier **memberOf** xsd#String **and**  
  ?AirTripInfo **memberOf** fb#airTripInfo **and**  
  ?FlightBookingTicket **memberOf** fb#flightBookingTicket  
  [  
    bookingTicketIdentifier **hasValue** ?bookingTicketIdentifier,  
    airTripInfo **hasValue** ?AirTripInfo  
  ] **and**  
  ?bookingTicketIdentifier **memberOf** xsd#string **and**  
  IBFlightServiceProvider **memberOf** fl#flightServiceProvider  
) **and**  
  ?X **memberOf** bo#onlineDelivery[  
    deliveryItem **hasValue** {?FlightBookingTicket},  
    receiver **hasValue** ?Buyer,  
    sender **hasValue** IBFlightServiceProvider,  
    onlineDeliveryMethod **hasValue** "email"  
  ].

**interface** IBFlightBookingWSInterface

**nonFunctionalProperties**

dc#description **hasValue** "describes the Interface of the Web Service"

**endNonFunctionalProperties**

**choreography**

**state** \_ "http://www.wsmo.org/ontologies/sfs/carFlightWSChoreography#"

**guardedTransitions**

/\* rule 1:

when a airTripInfoInstance is received, a partial  
airTripInfoInstance is created\*/

**if** (airTripInfoInstance **memberOf** fb#airTripInfo

[  
  start **hasValue** ?Start,  
  end **hasValue** ?End,  
  departure **hasValue** ?Departure,  
  arrival **hasValue** ?Arrival  
])

**then**

flightBookingInstance **memberOf** fb#flightBooking[  
  airTripInfo **hasValue** airTripInfoInstance].

```

/* rule 2:
   if a partial shuttle booking exists and if the booking identifier
   instance and the shuttleBookingTicketInstance are received,
   then the partial booking is complete with all the attributes filled in.
*/
if ((flightBookingInstance memberOf fb#flightBooking) and
    (bookingIdInstance memberOf bo#bookingIdentifier) and
    (flightBookingTicketInstance memberOf sb#shuttleBookingTicket[
        bookingTicketIdentifier hasValue bookingTicketIdInstance,
        shuttleBookingInfo hasValue shuttleBookingInfoInstance]))
then
    (flightBookingInstance memberOf fb#flightBooking[
        bookingIdentifier hasValue bookingIdInstance,
        bookingTicket hasValue flightBookingTicketInstance,
        airTripInfo hasValue airTripInfoInstance,
        buyer hasValue ?Buyer,
        seller hasValue IBFlightServiceProvider,
        paymentMethod hasValue ?Points
    ]).

```

### orchestration

#### guardedTransitions

```

/* rule 1:
   when a airTripInfoInstance is received, the service
   must make use of another service which provide the
   airTripInfo*/
if (airTripInfoInstance memberOf fb#airTripInfo
    [
        start hasValue ?Start,
        end hasValue ?End,
        departure hasValue ?Departure,
        arrival hasValue ?Arrival
    ])
then
    findAirTripInfoMediator.

```

### 3.3.2 Hotel Room Booking Web service

This web service is provided by MH hotel service provider. It offers 4 stars hotels in Spain .

- **Functionality:** A hotel booking will be created and the booking ticket will be send to the buyer email.
- **Capability**
  - **Precondition:** required input is: (1) the buyer contact information, including the email address and (2) the buyer hotel room booking preferences, where it is told that the hotel must be in Spain and 4 stars at least.
  - **Assumption:** the payment method is by points
  - **Postcondition:** a hotel room booking for a buyer, payment by points and the seller is the MH Hotel service provider.
  - **Effect:** delivery of the hotel room booking ticket to the buyer via email.
- **Interface**
  - **Choreography:**
    - when a hotelStayInstance is received, a partial hotelRoomBookingInstance is created
    - if a partial hotelRoomBookingInstance exists and if the booking identifier instance and the flightBookingTicketInstance are received, then the partial booking is complete with all the attributes filled in

- **Orchestration:**
  - when a hotelStayInstance is received, the service must make use of another service which provide the hotelStay

Listing 14. MH Hotel Room Booking Web Service.

```

namespace {_ "http://www.wsmo.org/webservices/sfs/MHHotelRoomBookingWS#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  hb _ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking#",
  ho _ "http://www.wsmo.org/ontologies/sfs/hotel#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#",
}

webService _ "http://www.wsmo.org/webservices/sfs/MHHotelRoomBookingWS"

nonFunctionalProperties
  dc#title hasValue "Online NH Hotel Room Booking Web Service"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Hotel", "Hotel room booking", "Room", "hotelStay"}
  dc#description hasValue "Online MH Hotel Room Booking Web Service
    for Spain 4* MH Hotels"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López","Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#webservice"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/webservices/sfs/MHHotelRoomBookingWS"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/booking",
    _ "http://www.wsmo.org/ontologies/hotelRoomBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/hotel",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability MHHotelRoomBookingWSCapability

  precondition
    nonFunctionalProperties
      dc#description hasValue "Required input is:
        [1] buyer information
        [2] hotel room booking preferences
        As precondition the buyer must have an existin email address
        and he has to indicate his preferences of a hotel room booking,
        such as:the check-in and check-out date, desired city,
        desired number of room and beds and if he needs an smoking
        room or not, and the minimun hotel stars.
        The hotel must be in Spain and it must have 4 stars"
    endNonFunctionalProperties
    definedBy
      ?Buyer memberOf bo#buyer[
        contactInformation hasValue ?ContactInformation,
        bookingPreferences hasValue ?HotelRoomBookingPreferences

```

] **and**  
?BuyerContactInformation **memberOf** bo#contactInformation [  
    emailaddress **hasValue** ?InputBuyerEmail  
] **and**  
?HotelRoomBookingPreferences **memberOf** hb#hotelRoomBookingPreferences.

**postcondition**

**nonFunctionalProperties**

dc#description **hasValue** "The output of the service is a NH hotel room booking.  
An instance of a MH hotel room booking have been created.  
This booking has an identificator, a ticket, **and** the hotel stay info  
has been obtained from the service providers data base  
**and** satisfy the booking buyer preferences.  
The hotel stay info has:  
    checkin **and** checkout date,  
    room or rooms,  
    the hotel."

**endNonFunctionalProperties**

**definedBy**

**exists** {?Buyer, ?BuyerContactInformation, ?HotelStay,  
    ?CheckIn, ?CheckOut, ?Room, ?Hotel, ?HotelRoomBookingPreferences,  
    NHHotelServiceProvider}  
(  
    ?Buyer **memberOf** bo#buyer[  
        contactInformation **hasValue** ?ContactInformation,  
        bookingPreferences **hasValue** ?HotelRoomBookingPreferences  
    ] **and**  
    ?BuyerContactInformation **memberOf** bo#contactInformation [  
        emailaddress **hasValue** ?InputBuyerEmail  
    ] **and**  
    ?HotelRoomBookingPreferences **memberOf** hb#hotelRoomBookingPreferences  
    **and**  
    ?HotelStay **memberOf** hb#hotelStay [  
        checkIn **hasValue** ?CheckIn,  
        checkOut **hasValue** ?CheckOut,  
        room **hasValue** ?Room,  
        hotel **hasValue** ?Hotel  
    ] **and**  
    hb#fulfillHotelPreferences(?HotelStay,?HotelRoomBookingPreferences) **and**  
    ?Room **memberOf** ho#room **and**  
    ?Hotel **memberOf** ho#hotel  
    [  
        stars **hasValue** 4,  
        city **hasValue** ?City  
    ] **and**  
    ?City.inCountry **hasValue** SPAIN **and**  
    NHHotelServiceProvider **memberOf** ho#hotelServiceProvider  
    [  
        hotels **hasValue** {?Hotel}  
    ] **and**  
    )  
    **and**  
    ?X **memberOf** hb#hotelRoomBooking[  
        bookingIdentifier **hasValue** ?BookingIdentifier,  
        bookingTicket **hasValue** ?HotelRoomBookingTicket,  
        hotelStay **hasValue** ?HotelStay,  
        buyer **hasValue** ?Buyer,  
        seller **hasValue** NHHotelServiceProvider,  
        paymentMethod **hasValue** ?Points  
    ].

**effect**

**nonFunctionalProperties**

dc#description **hasValue** "The booking ticket is delivered to the buyer via email

from the service provider to the buyer emailAddress.

The booking ticket will include the hotel stay info **and** the buyer info"

**endNonFunctionalProperties**

**definedBy**

**exists** {?HotelRoomBooking, ?BookingIdentifier, ?HotelRoomBookingTicket,  
?bookingTicketIdentifier, ?HotelStay, ?Buyer,  
?BuyerContactInformation, ?HotelRoomBookingPreferences,  
NHHotelServiceProvider}

(  
?Buyer **memberOf** bo#buyer [  
contactInformation **hasValue** ?BuyerContactInformation  
] **and**  
?BuyerContactInformation **memberOf** bo#contactInformation [  
emailAddress **hasValue** ?Emailaddress  
] **and**  
?HotelRoomBooking **memberOf** hb#hotelRoomBooking [  
bookingIdentifier **hasValue** ?BookingIdentifier,  
bookingTicket **hasValue** ?HotelRoomBookingTicket,  
hotelStay **hasValue** ?HotelStay,  
buyer **hasValue** ?Buyer,  
seller **hasValue** NHHotelServiceProvider,  
paymentMethod **hasValue** ?Points,  
] **and**  
?BookingIdentifier **memberOf** bo#bookingIdentifier **and**  
?HotelRoomBookingTicket **memberOf** hb#hotelRoomBookingTicket  
 [  
 bookingTicketIdentifier **hasValue** ?bookingTicketIdentifier,  
 hotelStay **hasValue** ?HotelStay  
 ] **and**  
 ?bookingTicketIdentifier **memberOf** bo#bookingTicketIdentifier **and**  
 ?HotelStay **memberOf** hb#hotelStay **and**  
 NHHotelServiceProvider **memberOf** ho#hotelServiceProvider  
 )  
 **and**  
 ?X **memberOf** bo#onlineDelivery [  
 deliveryItem **hasValue** {?HotelRoomBookingTicket},  
 sender **hasValue** NHHotelServiceProvider,  
 receiver **hasValue** ?Buyer,  
 onlineDeliveryMethod **hasValue** "email"  
 ].

**interface** MHHotelRoomBookingWSInterface

**nonFunctionalProperties**

dc#description **hasValue** "describes the Interface of Web Service"

**endNonFunctionalProperties**

**choreography**

**state** \_ "http://www.wsmo.org/ontologies/sfs/hotelRoomWSChoreography#"

/\* rule 1:

when a hotelStayInstance is received, a partial  
hotelRoomBookingInstance is created \*/

**if** (hotelStayInstance impliesType hb#hotelStay [  
 checkIn **hasValue** ?CheckIn,  
 checkOut **hasValue** ?CheckOut,  
 hotel **hasValue** ?Hotel,  
 room has Value ?Room  
 ] **and**  
 ?CheckIn **memberOf** dt#date **and**  
 ?CheckOut **memberOf** dt#date)

**then**

hotelRoomBookingInstance **memberOf** cb#hotelRoomBooking [  
 hotelStay **hasValue** hotelStayInstance

```

    ].
/* rule 2:
   if a partial hotel room booking exists and if the booking identifier
   instance and the hotelRoomBookingTicketInstance are received,
   then the partial booking is complete with all the attributes fill in.*/
if ((hotelRoomBookingInstance memberOf hb#hotelRoomBooking) and
      (bookingIdInstance memberOf bo#bookingIdentifier) and
      (hotelRoomBookingTicketInstance memberOf hb#hotelRoomBookingTicket[
        bookingTicketIdentifier hasValue bookingTicketIdInstance,
        hotelStay hasValue hotelStayInstance]))
then
  hotelRoomBookingInstance memberOf cb#hotelRoomBooking[
    bookingIdentifier hasValue bookingIdInstance,
    bookingTicket hasValue hotelRoomBookingTicketInstance,
    hotelStay hasValue hotelStayInstance,
    buyer hasValue ?Buyer,
    seller hasValue NHHotelServiceProvider,
    paymentMethod hasValue ?Points
  ]
orchestration

guardedTransitions
/* rule 1:
   when a hotelStayInstance is received, the service
   must make use of another service which provide the
   hotelStay */
if (hotelStayInstance memberOf hb#hotelStay [
  checkIn hasValue ?CheckIn,
  checkOut hasValue ?CheckOut,
  hotel hasValue ?Hotel,
  room has Value ?Room
] and
  ?CheckIn memberOf dt#date and
  ?CheckOut memberOf dt#date)
then
  findHotelStayMediator .

```

### 3.3.3 Car Rental Web service

This web service is provided by Rac car rental service provider. It offers car rentals in Spain

- **Functionality:** A car rental booking will be created and the booking ticket will be send to the buyer email.
- **Capability**
  - **Precondition:** required input is: (1) the buyer contact information, including the email address and (2) the buyer car rental booking preferences, where it is told that the location must be in Spain
  - **Assumption:** the payment method is by points
  - **Postcondition:** a car rental booking for a buyer, payment by points and the seller is the Rac car rental service provider.
  - **Effect:** delivery of the car rental booking ticket to the buyer via email.
- **Interface**
  - **Choreography:**
    - when a carRentallnfoInstance is received, a partial carRentalBookingInstance is created
    - if a partial carRentalBookingInstance exists and if the booking identifier

instance and the carRentalBookingTicketInstance are received, then the partial booking is complete with all the attributes filled in

- **Orchestration:**

- when a carRentalInfoInstance is received, the service must make use of another service which provide the carRentalInfo

```

namespace {_ "http://www.wsmo.org/webservices/sfs/RacCarRentalBookingWS#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  car _ "http://www.wsmo.org/ontologies/sfs/carRental#",
  cb _ "http://www.wsmo.org/ontologies/sfs/carRentalBooking#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

webService _ "http://www.wsmo.org/webservices/sfs/RacCarRentalBookingWS"

nonFunctionalProperties
  dc#title hasValue "Online Car rental Booking Web Service"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Car rental", "Car booking web service", "Car"}
  dc#description hasValue "Web service for booking online a RAC rent-a-car in Spain"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#webservice"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/webservices/sfs/RacCarRentalBookingWS"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/carBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/carRentalBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/carRental",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability RacCarRentalBookingWSCapability

  precondition
    nonFunctionalProperties
      dc#description hasValue "Required input is:
        [1] buyer information
        [2] car rental booking preferences
        As precondition the buyer must have an existin email address
        and he has to indicate his preferences of a car rental booking,
        such as:the pikcup and return date, pikcup and return location
        desired number of doors and if he needs a car with
        air aconditioning or not.
        The pickup location must be in Spain"
    endNonFunctionalProperties
    definedBy
      ?Buyer memberOf bo#buyer[
        contactInformation hasValue ?BuyerContactInformation,
        bookingPreferences hasValue ?CarRentalBookingPreferences
      ] and
      ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?Emailaddress
      ] and
      ?CarRentalBookingPreferences memberOf cb#carRentalBookingPreferences.

```

**postcondition****nonFunctionalProperties**

dc#description **hasValue** "The output of the service is an RAC car rental booking. An instance of a car rental booking have been created. This booking has an identificator, a ticket, and the car rental booking info has been obtained from the service providers data base **and** satisfy the booking buyer preferences.

The car rental info has:  
 pickup and return date,  
 pickup and return location,  
 the assigned car"

**endNonFunctionalProperties****definedBy**

**exists** {?Buyer, ?BuyerContactInformation, ?CarRentalBookingPreferences  
 ?CarRentalBookingInfo, ?PickupLocation, ?ReturnLocation, ?PickupDateAndTin  
 ?ReturnDateAndTime, ?Car, RacCarRentalServiceProvider}

(  
 ?Buyer **memberOf** bo#buyer [  
 contactInformation **hasValue** ?BuyerContactInformation,  
 bookingPreferences **hasValue** ?CarRentalBookingPreferences  
 ] **and**  
 ?CarRentalBookingPreferences **memberOf** cb#carRentalBookingPreferences **a**  
 ?BuyerContactInformation **memberOf** bo#contactInformation [  
 emailAddress **hasValue** ?Emailaddress  
 ] **and**  
 ?CarRentalBookingInfo **memberOf** cb#carRentalBookingInfo  
 [  
 pickupLocation **hasValue** ?PickupLocation,  
 returnLocation **hasValue** ?ReturnLocation,  
 pickupDateAndTime **hasValue** ?PickupDateAndTime,  
 returnDateAndTime **hasValue** ?ReturnDateAndTime,  
 car **hasValue** ?Car  
 ] **and**  
 cb#fulfillCarRentalPreferences(?carRentalBookingInfo, ?CarRentalBookingPrefe  
**and** ?PickupLocation.inCountry **hasValue** SPAIN **and**  
 ?Car **memberOf** car#car **and**  
 RacCarRentalServiceProvider **memberOf** cr#carRentalServiceProvider **and**  
 [  
 cars **hasValue** {?Car}  
 ]  
 ) **and**  
 ?X **memberOf** cb#carRentalBooking [  
 bookingIdentifier **hasValue** ?BookingIdentifier,  
 carRentalBookingInfo **hasValue** ?CarRentalBookingInfo,  
 buyer **hasValue** ?Buyer,  
 seller **hasValue** RacCarRentalServiceProvider,  
 bookingTicket **hasValue** ?CarRentalBookingTicket,  
 paymentMethod **hasValue** ?Points  
 ].

**effect****nonFunctionalProperties**

dc#description **hasValue** "The booking ticket is delivered to the buyer via email from the service provider to the buyer emailAddress. The booking ticket will include the car rental info **and** the buyer info"

**endNonFunctionalProperties****definedBy**

**exists** {?CarRentalBooking, ?BookingIdentifier, ?CarRentalBookingTicket,  
 ?bookingTicketIdentifier, ?CarRentalBookingInfo, ?Buyer,  
 ?BuyerContactInformation}

(  
 ?Buyer **memberOf** bo#buyer [  
 contactInformation **hasValue** ?BuyerContactInformation,  
 ] **and**  
 ?BuyerContactInformation **memberOf** bo#contactInformation [  
 ]

```

        emailAddress hasValue ?Emailaddress
    ] and
    ?CarRentalBooking memberOf bo#carRentalBooking
    [
        bookingIdentifier hasValue ?BookingIdentifier,
        carRentalBookingInfo hasValue ?CarRentalBookingInfo,
        buyer hasValue ?Buyer,
        seller hasValue RacCarRentalServiceProvider,
        bookingTicket hasValue ?CarRentalBookingTicket,
        paymentMethod hasValue ?Points
    ] and
    ?BookingIdentifier memberOf xsd#string and
    ?CarRentalBookingInfo memberOf cb#carRentalBookingInfo and
    ?CarRentalBookingTicket memberOf cb#carRentalBookingTicket
    [
        bookingTicketIdentifier hasValue ?bookingTicketIdentifier,
        carRentalBookingInfo hasValue ?CarRentalBookingInfo
    ] and
    ?bookingTicketIdentifier memberOf xsd#string and
    RacCarRentalServiceProvider memberOf cr#carRentalServiceProvider
) and
?X memberOf bo#onlineDelivery[
    deliveryItem hasValue {?CarRentalBookingTicket},
    receiver hasValue ?Buyer,
    sender hasValue RacCarRentalServiceProvider,
    onlineDeliveryMethod hasValue "email"
].

```

**interface** RacCarRentalBookingWSInterface

**nonFunctionalProperties**

dc:description **hasValue** "describes the Interface of Web Service "

**endNonFunctionalProperties**

**choreography**

**state** \_ "http://www.wsmo.org/ontologies/sfs/RacCarRentalBookingWSChoreography#"

**guardedTransitions**

/\* rule 1:

when a carRentalBookingInfoInstance is received, a partial  
carRentalBookingInstance is created

\*/

```

if (carRentalBookingInfoInstance memberOf cb#carRentalBookingInfo [
    pickupLocation hasValue ?PickupLocation,
    returnLocation hasValue ?ReturnLocation,
    pickupDateAndTime hasValue ?PickupDateAndTime,
    returnDateAndTime hasValue ?ReturnDateAndTime,
    car hasValue ?Car

```

```

] and

```

```

?PickupLocation memberOf loc#location and

```

```

?ReturnLocation memberOf loc#location and

```

```

?PickupDateAndTime memberOf dt#dateAndTime and

```

```

?ReturnDateAndTime memberOf dt#dateAndTime)

```

**then**

```

carRentalBookingInstance memberOf cb#carRentalBooking[
    carRentalBookingInfo hasValue carRentalBookingInfo

```

```

].

```

/\* rule 2:

if a partial car rental booking exists and if the booking identifier  
instance and the carRentalBookingTicketInstance are received,  
then the partial booking is complete with all the attributes fill in.\*/

```

if ((carRentalBookingInstance memberOf cb#carRentalBooking) and

```

```

        (bookingIdInstance memberOf bo#bookingIdentifier) and
        (carRentalBookingTicketInstance memberOf cb#carRentalBookingTicket[
            bookingTicketIdentifier hasValue bookingTicketIdInstance,
            carRentalBookingInfo hasValue carRentalBookingInfoInstance]))
    then
        carRentalBookingInstance memberOf cb#carRentalBooking[
            bookingIdentifier hasValue bookingIdInstance,
            bookingTicket hasValue carRentalBookingTicketInstance,
            carRentalBookingInfo hasValue carRentalBookingInfoInstance,
            buyer hasValue ?Buyer,
            seller hasValue RacCarRentalServiceProvider,
            paymentMethod hasValue ?Points
        ]
orchestration

    guardedTransitions
        /* rule 1:
           when a carRentalBookingInfoInstance is received, the service
           must make use of another service which provide the
           carRentalBookingInfo */
        if (carRentalBookingInfoInstance memberOf cb#carRentalBookingInfo [
            pickupLocation hasValue ?PickupLocation,
            returnLocation hasValue ?ReturnLocation,
            pickupDateAndTime hasValue ?PickupDateAndTime,
            returnDateAndTime hasValue ?ReturnDateAndTime,
            car hasValue ?Car
        ] and
            ?PickupLocation memberOf loc#location and
            ?ReturnLocation memberOf loc#location and
            ?PickupDateAndTime memberOf dt#dateAndTime and
            ?ReturnDateAndTime memberOf dt#dateAndTime)
        then
            findCarRentalInfoMediator
            .

```

### 3.3.4 Shuttle Booking Web service

This web service is provided by TCO Shuttle service provider. It offers shuttles from Spain airports.

- **Functionality:** A shuttle booking will be created and the booking ticket will be send to the buyer email.
- **Capability**
  - **Precondition:** required input is: (1) the buyer contact information, including the email address and (2) the buyer shuttle booking preferences, where it is told that the airport must be in Spain
  - **Assumption:** the payment method is by points
  - **Postcondition:** a shuttle booking for a buyer, payment by points and the seller is the TCO Shuttle service provider.
  - **Effect:** delivery of the shuttle booking ticket to the buyer via email.
- **Interface**
  - **Choreography:**
    - when a shuttleInfoInstance is received, a partial shuttleBookingInstance is created
    - if a partial shuttleBookingInstance exists and if the booking identifier instance and the shuttleBookingTicketInstance are received, then the partial booking is complete with all the attributes filled in

- **Orchestration:**
  - when a shuttleInfoInstance is received, the service must make use of another service which provide the shuttleInfo

```

namespace {_ "http://www.wsmo.org/webservices/sfs/TCoShuttleBookingWS#",
  dc _ "http://purl.org/dc/elements/1.1#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  sh _ "http://www.wsmo.org/ontologies/sfs/shuttle#",
  sb _ "http://www.wsmo.org/ontologies/sfs/shuttleBooking#",
  bo _ "http://www.wsmo.org/ontologies/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#"
}

webService _ "http://www.wsmo.org/webservices/sfs/TCoShuttleBookingWS"

nonFunctionalProperties
  dc#title hasValue "Online TCo Shuttle Booking Web Service"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Taxi shuttle", "Shuttle booking", "Taxi"}
  dc#description hasValue "Web service for booking online a TCO shuttle in all Spain airports"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Jose López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#webservice"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/webservices/sfs/TCoShuttleBookingWS"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/booking",
    _ "http://www.wsmo.org/ontologies/shuttleBooking",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"

  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/sfs/shuttleBooking",
  _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/shuttle",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/dateTime"
}

capability TCoShuttleBookingWSCapability

  precondition
    nonFunctionalProperties
      dc#description hasValue "Required input is#
        [1] buyer information with the
        [2] shuttle preferences.
        As precondition the buyer must have an existing email address
        and he has to indicate his preferences of a shuttle booking,
        such as:the pickup date, pickup airport and destination.
        The airport must be in Spain"
    endNonFunctionalProperties
    definedBy
      ?Buyer memberOf bo#buyer[
        contactInformation hasValue ?BuyerContactInformation,
        bookingPreferences hasValue ?ShuttleBookingPreferences
      ] and
      ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?Emailaddress
      ] and
      ?ShuttleBookingPreferences memberOf sb#shuttleBookingPreferences.

```

**postcondition****nonFunctionalProperties**

dc#description **hasValue** "The output of the service is a TCo shuttle booking.

An instance of a shuttle booking have been created.

This booking has an identificator, a ticket, **and** the shuttle booking info has been obtained from the TCO service provider data base

**and** satisfy the booking buyer preferences.

The car rental info has:

pickup date,  
pickup airport,  
the assigned shuttle"

**endNonFunctionalProperties****definedBy**

**exists** {?BookingIdentifier, ?bookingTicketIdentifier, ?ShuttleBookingInfo,  
?PickupAirport, ?PickupDateAndTime, ?Destination, ?Buyer,  
?BuyerContactInformation, ?ShuttleBookingPreferences,  
TCoShuttleServiceProvider, ?Shuttle}

(

?Buyer **memberOf** bo#buyer [  
contactInformation **hasValue** ?BuyerContactInformation,  
bookingPreferences **hasValue** ?ShuttleBookingPreferences

] **and**

?ShuttleBookingPreferences **memberOf** fb#shuttleBookingPreferences **and**

?BuyerContactInformation **memberOf** bo#contactInformation [  
emailaddress **hasValue** ?Emailaddress

] **and**

?ShuttleBookingInfo **memberOf** sb#shuttleBookingInfo [  
pickupAirport **hasValue** ?PickupAirport,  
pickupDateAndTime **hasValue** ?PickupDateAndTime,  
destination **hasValue** ?Destination,  
shuttle **hasValue** ?Shuttle

] **and**

sb#fulfillShuttlePreferences(?ShuttleBookingInfo, ?ShuttleBookingPreferenc

?PickupAirport.inCountry **hasValue** SPAIN **and**

?Destination.inCountry **hasValue** SPAIN **and**

?Shuttle **memberOf** sh#shuttle **and**

TCoShuttleServiceProvider **memberOf** sh#shuttleServiceProvider

[ shuttles **hasValue** {?Shuttle}]

) **and**

?X **memberOf** sb#shuttleBooking [  
bookingIdentifier **hasValue** ?BookingIdentifier,  
bookingTicket **hasValue** ?ShuttleBookingTicket,  
shuttleBookingInfo **hasValue** ?ShuttleBookingInfo,  
buyer **hasValue** ?Buyer,  
seller **hasValue** TCoShuttleServiceProvider,  
paymentMethod **hasValue** ?Points

].

**effect****nonFunctionalProperties**

dc#description **hasValue** "The booking ticket is delivered to the buyer via email  
from the service provider to the buyer emailAddress.

The booking ticket will include the car rental info **and** the buyer info"

**endNonFunctionalProperties****definedBy**

**exists** {?ShuttleBooking, ?BookingIdentifier, ?ShuttleBookingInfo,  
?ShuttleBookingTicket, ?bookingTicketIdentifier, ?PickupAirport,  
?PickupDateAndTime, ?Destination, ?Buyer, ?BuyerContactInformation,  
?ShuttleBookingTicket}

(

?ShuttleBooking **memberOf** sb#shuttleBooking [  
bookingIdentifier **hasValue** ?BookingIdentifier,  
shuttleBookingInfo **hasValue** ?ShuttleBookingInfo,

```

        buyer hasValue ?Buyer,
        seller hasValue TCoShuttleServiceProvider,
        bookingTicket hasValue ?ShuttleBookingTicket,
        paymentMethod hasValue ?Points
    ] and
    ?BookingIdentifier memberOf xsd:string and
    ?ShuttleBookingInfo memberOf sb#shuttleBookingInfo and
    ?ShuttleBookingTicket memberOf sb#shuttleBookingTicket [
        bookingTicketIdentifier hasValue ?bookingTicketIdentifier,
        shuttleBookingInfo hasValue ?ShuttleBookingInfo
    ] and
    ?bookingTicketIdentifier memberOf xsd:string and
    ?Buyer memberOf bo#buyer[
        contactInformation hasValue ?BuyerContactInformation,
        bookingPreferences hasValue ?ShuttleBookingPreferences
    ] and
    TCoShuttleServiceProvider memberOf sh#shuttleServiceProvider and
    ?BuyerContactInformation memberOf bo#contactInformation [
        emailAddress hasValue ?Emailaddress
    ] and
    ?Emailaddress memberOf xsd:string
) and
    ?X memberOf bo#onlineDelivery[
        deliveryItem hasValue {?ShuttleBookingTicket},
        receiver hasValue ?Buyer,
        sender hasValue TCoShuttleServiceProvider,
        onlineDeliveryMethod hasValue "email"
    ].

```

**interface** TCoShuttleBookingWSInterface

**nonFunctionalProperties**

dc:description **hasValue** "describes the Interface of Web Service"

**endNonFunctionalProperties**

**choreography**

**state** \_ "http://www.wsmo.org/ontologies/sfs/carShuttleWSChoreography#"

**guardedTransitions**

/\* rule 1:

when a shuttleBookingInfoInstance is received, a partial  
shuttleBookingInstance is created \*/

**if** (shuttleBookingInfoInstance **memberOf** sb#shuttleBookingInfo [
 pickupAirport **hasValue** ?PickupAirport,
 pickupDateAndTime **hasValue** ?PickupDateAndTime,
 destination **hasValue** ?Destination,
 shuttle **hasValue** ?Shuttle

**]** **and**

?PickupAirport **memberOf** fb#airport **and**

?PickupAirport.inCountry **hasValue** loc#SPAIN

?PickupDateAndTime **memberOf** dt#dateAndTime **and**

?Destination **memberOf** loc#location

)

**then**

(shuttleBookingInstance **memberOf** sb#shuttleBooking[
 shuttleBookingInfo **hasValue** shuttleBookingInfoInstance ]) .

/\* rule 2:

if a partial shuttle booking exists and if the booking identifier  
instance and the shuttleBookingTicketInstance are received,  
then the partial booking is complete with all the attributes filled in. \*/

**if** ((shuttleBookingInstance **memberOf** sb#shuttleBooking) **and**  
(bookingIdInstance **memberOf** bo#bookingIdentifier) **and**  
(shuttleBookingTicketInstance **memberOf** sb#shuttleBookingTicket[

```

        bookingTicketIdentifier hasValue bookingTicketIdInstance,
        shuttleBookingInfo hasValue shuttleBookingInfoInstance))
    then
        (shuttleBookingInstance memberOf sb#shuttleBooking[
            bookingIdentifier hasValue bookingIdInstance,
            bookingTicket hasValue carRentalBookingTicketInstance,
            shuttleBookingInfo hasValue shuttleBookingInfoInstance,
            buyer hasValue ?Buyer,
            seller hasValue TCoShuttleServiceProvider,
            paymentMethod hasValue ?Points
        ]).

orchestration

    guardedTransitions
        /* rule 1:
           when a shuttleBookingInfoInstance is received, the service
           must make use of another service which provide the
           shuttleBookingInfo */
        if (shuttleBookingInfoInstance memberOf sb#shuttleBookingInfo [
            pickupAirport hasValue ?PickupAirport,
            pickupDateAndTime hasValue ?PickupDateAndTime,
            destination hasValue ?Destination,
            shuttle hasValue ?Shuttle
        ] and
            ?PickupAirport memberOf fb#airport and
            ?PickupAirport.inCountry hasValue loc#SPAIN
            ?PickupDateAndTime memberOf dt#dateAndTime and
            ?Destination memberOf loc#location
        )
        then
            findShuttleBookingInfoMediator.

```

## 3.4 Choreography Ontologies

As explained in [Roman et. al, 2005b] , the non-functional properties of some of the concepts, relations and functions used in the choreography of a service are extended with the attributes *mode* and *grounding* . For enriching elements defined in external ontologies with these two non-functional properties, the ontology that describes the state of the service imports the relevant ontologies and redefines these elements by inheriting their definition and defining values for the two additional non-functional properties (or just one in the case of entities with the mode *static* or *controlled* ). In our scenario, there will be four ontologies that will describe the state of each web service choreography and each of them will import the necessary ontologies.

### 3.4.1 Flight Booking WS Choreography Ontology

This ontology describes the state of the flight booking web service choreography, and the content of this ontology is provided in Listing 24 .

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/flightBookingWSChoreography#",
  dc _ "http://purl.org/dc/elements/1.1#",
  fb _ "http://www.wsmo.org/ontologies/sfs/flightBooking#",
  fl _ "http://www.wsmo.org/ontologies/sfs/flight#",
  bo _ "http://www.wsmo.org/ontologies/sfs/booking#",
  loc _ "http://www.wsmo.org/ontologies/location#",
  dt _ "http://www.wsmo.org/ontologies/dateTime#",
  fbws _ "http://www.wsmo.org/webservices/sfs/IBFlightBookingWS#"
}

ontology _ "http://www.wsmo.org/ontologies/sfs/flightBookingWSChoreography"
  nonFunctionalProperties
    dc#title hasValue "Flight Booking Ontology Choreography"
    dc#creator hasValue "ATOS ORIGIN S.A."
    dc#subject hasValue {"Flight", "Flight Booking", "Airport", "AirTrip", "Choreography"}
    dc#description hasValue "Choreography ontology for the Flight Booking web service"
    dc#publisher hasValue "ATOS ORIGIN S.A."
    dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
    dc#date hasValue "2005-02-11"
    dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
    dc#format hasValue "text/html"
    dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/flightBookingWSChoreography"
    dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
    dc#language hasValue "en-US"
    dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
      _ "http://www.wsmo.org/ontologies/sfs/booking",
      _ "http://www.wsmo.org/ontologies/dateTime",
      _ "http://www.wsmo.org/ontologies/location",
      _ "http://www.daml.org/2001/02/geofile/geofile-ont"}
    dc#coverage hasValue "ID:7029392 Name:World"
    version hasValue "$Revision: 1.1 $"
  endNonFunctionalProperties

  importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/flight"
  }

  concept airTripInfo subConceptOf fb#airTripInfo
    nonFunctionalProperties
      mode hasValue in
      grounding hasValue fbws#flightBookingCreation
    endNonFunctionalProperties

  concept flightBooking subConceptOf fb#flightBooking
    nonFunctionalProperties
      mode hasValue out
      grounding hasValue fbws#flightBookingCreation
    endNonFunctionalProperties

```

### 3.4.2 Hotel Room Booking WS Choreography Ontology

This ontology describes the state of the hotel booking web service choreography, and the content of this ontology is provided in Listing 25 .

```

namespace {_ "http://www.wsmo.org/ontologies/sfs/hotelRoomBookingWSChoreography#",

```

```

dc_ "http://purl.org/dc/elements/1.1#",
dt_ "http://www.wsmo.org/ontologies/dateTime#",
bo_ "http://www.wsmo.org/ontologies/sfs/booking#",
hb_ "http://www.wsmo.org/ontologies/sfs/hotelRoomBooking#",
ho_ "http://www.wsmo.org/ontologies/sfs/hotel#",
loc_ "http://www.wsmo.org/ontologies/location#",
xsd_ "http://www.w3.org/2001/XMLSchema#",
hbws_ "http://www.wsmo.org/webservices/sfs/MHHotelRoomBookingWS#"
}

ontology _ "http://www.wsmo.org/ontologies/sfs/hotelRoomBookingWSChoreography"

nonFunctionalProperties
  dc#title hasValue "Hotel Room Booking Ontology Choreography"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Hotel", "Hotel room booking", "Room", "hotelStay"}
  dc#description hasValue "Hotel reservation"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue { _ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
    _ "http://www.wsmo.org/ontologies/sfs/booking",
    _ "http://www.wsmo.org/ontologies/sfs/hotel",
    _ "http://www.wsmo.org/ontologies/dateTime",
    _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology { _ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/hotel"}

concept hotelRoomBooking subConceptOf hb#hotelRoomBooking
  nonFunctionalProperties
    mode hasValue out
    grounding hasValue hbws#hotelRoomBookingCreation
  endNonFunctionalProperties

concept hotelStay subConceptOf hb#hotelStay
  nonFunctionalProperties
    mode hasValue in
    grounding hasValue hbws#hotelRoomBookingCreation
  endNonFunctionalProperties

```

### 3.4.3 Car Rental Booking WS Choreography ontology

This ontology describes the state of the car rental booking web service choreography, and the content of this ontology is provided in Listing 26 .

Listing 26. Car Rental Booking WS Choreography Ontology.

```

namespace { _ "http://www.wsmo.org/ontologies/sfs/carRentalBookingWSChoreography#",
  dc_ "http://purl.org/dc/elements/1.1#",
  dt_ "http://www.wsmo.org/ontologies/dateTime#",

```

```

car _"http://www.wsmo.org/ontologies/sfs/carRental#",
cb _"http://www.wsmo.org/ontologies/sfs/carRentalBooking#",
bo _"http://www.wsmo.org/ontologies/sfs/booking#",
loc _"http://www.wsmo.org/ontologies/location#",
crbws _"http://www.wsmo.org/webservices/sfs/RacCarRentalBookingWS#"
}

ontology _"http://www.wsmo.org/ontologies/sfs/carRentalBookingWSChoreography"

nonFunctionalProperties
  dc#title hasValue "Car rental booking ontology Choreography"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Rent a car", "Car rental booking", "Car"}
  dc#description hasValue "Rent a car booking"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _"http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#source hasValue _"http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_"http://keg.cs.tsinghua.edu.cn/ontology/travel",
  _"http://www.wsmo.org/ontologies/sfs/booking",
  _"http://www.wsmo.org/ontologies/sfs/carRental",
  _"http://www.wsmo.org/ontologies/dateTime",
  _"http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_"http://www.wsmo.org/ontologies/dateTime",
  _"http://www.wsmo.org/ontologies/sfs/booking",
  _"http://www.wsmo.org/ontologies/sfs/carRental",
  _"http://www.wsmo.org/ontologies/location"
}

concept carRentalBooking subConceptOf cb#carRentalBooking
  nonFunctionalProperties
    mode hasValue out
    grounding hasValue crbws#carRentalBookingCreation
  endNonFunctionalProperties

concept carRentalBookingInfo subConceptOf cb#carRentalBookingInfo
  nonFunctionalProperties
    mode hasValue in
    grounding hasValue crbws#carRentalBookingCreation
  endNonFunctionalProperties

```

### 3.4.4 Shuttle Booking WS Choreography Ontology

This ontology describes the state of the shuttle booking web service choreography, and the content of this ontology is provided in Listing 27 .

Listing 27. Shuttle Booking WS Choreography Ontology.

```

namespace {_"http://www.wsmo.org/ontologies/sfs/shuttleBookingWSChoreography#",
  dc _"http://purl.org/dc/elements/1.1#",
  dt _"http://www.wsmo.org/ontologies/dateTime#",
  sh _"http://www.wsmo.org/ontologies/sfs/shuttle#",
  sb _"http://www.wsmo.org/ontologies/sfs/shuttleBooking#",
  bo _"http://www.wsmo.org/ontologies/booking#",

```

```

loc _ "http://www.wsmo.org/ontologies/location#",
sbws _ "http://www.wsmo.org/webservices/sfs/TCoShuttleBookingWS#"
}

ontology _ "http://www.wsmo.org/ontologies/sfs/shuttleBookingWSChoreography"
nonFunctionalProperties
  dc#title hasValue "Shuttle booking ontology Choreography"
  dc#creator hasValue "ATOS ORIGIN S.A."
  dc#subject hasValue {"Taxi shuttle", "Shuttle booking", "Taxi"}
  dc#description hasValue "The ontology for booking a shuttle"
  dc#publisher hasValue "ATOS ORIGIN S.A."
  dc#contributor hasValue {"Alejandro López", "Ozelin López", "Clara Pezuela"}
  dc#date hasValue "2005-02-11"
  dc#type hasValue _ "http://www.wsmo.org/2004/d2#ontologies"
  dc#format hasValue "text/html"
  dc#identifier hasValue _ "http://www.wsmo.org/ontologies/sfs/shuttleBookingWSChoreography"
  dc#source hasValue _ "http://keg.cs.tsinghua.edu.cn/ontology/travel"
  dc#language hasValue "en-US"
  dc#relation hasValue {_ "http://keg.cs.tsinghua.edu.cn/ontology/travel",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/shuttle#",
  _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/location"}
  dc#coverage hasValue "ID:7029392 Name:World"
  version hasValue "$Revision: 1.1 $"
endNonFunctionalProperties

importsOntology {_ "http://www.wsmo.org/ontologies/dateTime",
  _ "http://www.wsmo.org/ontologies/sfs/shuttle#",
  _ "http://www.wsmo.org/ontologies/sfs/booking",
  _ "http://www.wsmo.org/ontologies/sfs/flightBooking",
  _ "http://www.wsmo.org/ontologies/location"
}

concept shuttleBooking subConceptOf sb#shuttleBooking
nonFunctionalProperties
  mode hasValue out
  grounding hasValue sbws#shuttleBookingCreation
endNonFunctionalProperties

concept shuttleBookingInfo subConceptOf sb#shuttleBookingInfo
nonFunctionalProperties
  mode hasValue in
  grounding hasValue sbws#shuttleBookingCreation
endNonFunctionalProperties

```

## 3.5 Mediators

Since WSMO mediators are still underspecified, they will be considered in future versions of this document.

## 4. Conclusions and Future Work

We hereby provided a more detail overview of the Stream Flows! System use case, providing the interface descriptions for Web Services which would include the choreography and orchestration and also the ontologies which serve as the state-base for these aspects,

using WSMO as the base description language. Future work on this use case will include the following:

- The functions which are required to check that the buyer booking preferences are satisfied.
- The package goal which will include the interface necessary to check that the package satisfy all the customer global constraints.

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