S-OPL: Service Ontology Pattern Language

Specification
Version 1.5

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Summary

S-OPL: Service Ontology Pattern Language

This document presents the Service Ontology Pattern Language (S-OPL).

1. Introduction

An **Ontology Pattern Language** (OPL) aims to provide holistic support for using Domain-Related Ontology Patterns (DROPs) in the development of a domain ontology. It provides explicit guidance on what modeling problems can arise in that domain, informs the order to address these problems, and suggests one or more patterns to solve each specific problem. Moreover, an OPL explicitly considers pattern combinations to solve a given problem (as well as conflicting patterns), along with guidelines for integrating them into a concrete ontology conceptual model (FALBO et al., 2013).

An OPL indicates explicitly which patterns must be considered as mandatory and which ones as optional. To ensure a stable and sound pattern usage, the order in which such patterns are combined is structured by means of a *pattern application flow* (the OPL process). OPLs are structured to support and encourage the application of one pattern at a time. Step by step, the patterns are chosen and combined in a systematic way. This ensures that the main property of piecemeal growth is preserved: the 'whole' always precedes its 'parts' (FALBO et al., 2013).

The **Service Ontology Pattern Language** (S-OPL) is an OPL that addresses the core conceptualization about the service phenomena. S-OPL patterns were extracted from UFO-S, a core commitment-based reference ontology for services (NARDI et al., 2015), whose conceptualization is based on the establishment and fulfillment of commitments and claims between service participants (used to refer to both service providers and service customers) along the service life-cycle. UFO-S focus on the three main phases of the service life-cycle, namely: service offer, service negotiation, and service delivery. Thus, the patterns of S-OPL are organized in four groups: *Service Offering*, *Service Negotiation and Agreement*, *Service Delivery*, and *Service Provider and Customer*. As an OPL, besides the groups of patterns, S-OPL provides a process for guiding pattern use. The patterns that compose S-OPL are briefly presented in Section 2. S-OPL process is described in Section 3. Finally, in the Section 4, each S-OPL pattern is fully described.

2. S-OPL Domain-Related Ontology Patterns

As aforementioned, the patterns that compose S-OPL are organized in four groups, namely: (i) *Service Offering*, (ii) *Service Negotiation and Agreement*, (iii) *Service Delivery*, and (iv) *Service Provider and Customer*.

According to UFO-S (NARDI et al., 2015), at the beginning of a service relation, there is a service offering. A service offering is established between a service provider and a target customer community, whose members are said target customers. A service offering comprises a set of service offering commitments from the service provider towards the target customer community, and the corresponding service offering claims from the target community towards the service provider. Table 1 describes the intent of the patterns of the *Service Offering* group.

We should highlight that the choice of which patterns to use is driven by the scope of the ontology being developed. For instance, although a service offering always involves commitments from the service provider towards the target customer community, representing those aspects may be out of the scope of the ontology being developed. Thus, S-OPL allows reusing only the parts of UFO-S that are relevant to the ontology in hands.

Table 1- Patterns of the *Service Offering* group.

Id	Name	Intent
SOffering	Service Offering	Represents service offerings established from service providers towards target customer communities, and thus to the members of those communities.
SODescription	Service Offering Description	Allows describing service offerings by means of service offering descriptions.
SOCommitments	Service Offering Commitments	Represents the service offering commitments from a service provider towards the target customer community in the context of a service offering.
SOClaims	Service Offering Claims	Represents the service offering claims from a target customer community towards the service provider in the context of a service offering

Once a service is offered, service negotiation may occur. In general, service negotiation is motivated by the interest of a target customer in the service offering, considering its contents (including the conditions to be satisfied by the service customer in case it hires the service). During service negotiation, service provider and target customer interact in order to establish an agreement regarding their commitments and claims with respect to an eventual service delivery.

If service negotiation succeeds, a service agreement is established, and the service provider starts to play the role of hired service provider, while the target customer starts to play the role of service customer. Like a service offering, a service agreement is composed of commitments and claims. However, in contrast to the service offering, in a service agreement, service customers may also establish commitments to

service providers (e.g., the commitment to pay for the service). Service agreement involves not only commitments from the hired service provider towards the service customer, but may also involve commitments from the service customer towards the hired service provider. Thus, these two participants become co-responsible for the service delivery. A service agreement should conform to what was previously established in the corresponding service offering.

As in the case of a service offering, what is agreed between the parties (commitments and claims of both hired provider and service customer) depends on the context of the service agreement, as well as on the particular service business model, and, therefore, can refer to several different elements. These elements may be described in service agreement descriptions (such as a service contract). Table 2 describes the intent of the patterns of the *Service Negotiation and Agreement* group.

Table 1 - Patterns of the *Service Negotiation and Agreement* group.

Id	Name	Intent
SNegotiation	Service Negotiation	Represents a service negotiation and the service offering to which the negotiation regards, without addressing an agreement that possibly results from it.
SNegAgree	Service Negotiation and Agreement	Represents a service negotiation and the service agreement that possibly results from it, considering also the corresponding service offering.
SOfferAgree	Service Offering and Agreement	Represents a service agreement in conformance with a service offering, without addressing service negotiation aspects.
SAgreement	Service Agreement	Represents a service agreement, without addressing service negotiation and offering aspects.
SADescription	Service Agreement Description	Allows describing service agreements by means of service agreement descriptions.
HPCommitments	Hired Provider Commitments	Represents the commitments from a hired service provider towards a service customer.
HPClaims	Hired Provider Claims	Represents the claims of a hired service provider towards a service customer.
SCCommitments	Service Customer Commitments	Represents the commitments from service customer(s) towards a hired service provider.
SCClaims	Service Customer Claims	Represents the claims from service customer(s) towards a hired service provider.

Service delivery concerns the execution of actions aimed at fulfilling the commitments established in the service agreement. Service delivery is a complex action, which is composed by several actions, including actions performed only by the hired service provider (hired provider actions), actions performed only by the service customer (customer actions), and actions performed by both in an interaction (hired provider-customer interaction). All of these actions are motivated by the commitments established in the service agreement, between the hired provider and the service customer. Table 3 describes the intent of the patterns of the *Service Delivery* group.

Table 3 - Patterns of the *Service Delivery* group.

Id	Name	Intent
SDelivery	Service Delivery	Represents the process (complex action) carried out to fulfill commitments established in the service agreement.
HPActions	Hired Service Provider Actions	Represents the actions of the service delivery that are performed only by the hired service provider.
SCActions	Service Customer Actions	Represents the actions of the service delivery that are performed only by the service customers.
Interations	Interations	Represents the actions in a service delivery in which the hired service provider and the service customer(s) act in tandem.
HPActionMotivation	Hired Provider Action Motivation	Represents the relationships between the actions performed only by a hired service provider and the commitments that motivated them.
SCActionMotivation	Service Customer Action Motivation	Represents the relationships between the actions performed only by a service customer and the commitments that motivated them.
InteractionMotivation	Motivations for Interactions	Represents the relationships between the interactions of a hired service provider and the service customer(s) and the commitments that motivated them.

Service provider is the role played by agents when these agents commit themselves to a target customer community by a service offering. Target customer is the role played by agents when, as a consequence of a service offering, they become members of a target customer community. When a service agreement is established, the service provider starts to play the role of hired service provider, while the target customer starts to play the role of service customer.

Depending on the specific service being modeled, these roles (Service Provider, Target Customer, Hired Service Provider and Service Customer) can be played by different types of agents, namely persons, organizations and organizational units. The patterns of the Service Provider and Customer group allow the ontology engineer to choose which types of agents effectively play these roles in the case of the service being modeled. Table 4 describes the intent of the patterns of the *Service Provider and Customer* group.

Table 4- Patterns of the *Service Provider and Customer* group.

Id	Name	Intent
P-Provider	Person Provider	Represents persons as service providers.
O-Provider	Organization Provider	Represents organizations as service providers.
OU-Provider	Organizational Unit Provider	Represents organizational units as service providers.
O-OU-Provider	Organization / Organizational Unit Provider	Represents organizations and organizational units as service providers.
P-O-Provider	Person / Organization Provider	Represents persons and organizations as service providers.
P-OU-Provider	Person/ Organizational Unit Provider	Represents persons and organizational units as service providers.
P-O-OU-Provider	Person/ Organization / Organizational Unit Provider	Represents persons, organizations and organizational units as service providers.
P-TCustomer	Person Target Customer	Represents persons as target customers.
O-TCustomer	Organization Target Customer	Represents organizations as target customers.
OU-TCustomer	Organizational Unit Target Customer	Represents organizational units as target customers.
O-OU-TCustomer	Organization / Organizational Unit Target Customer	Represents organizations and organizational units as target customers.
P-O-TCustomer	Person / Organization Target Customer	Represents persons and organizations as target customers.
P-OU-TCustomer	Person / Organizational Unit Target Customer	Represents persons and organizational units as target customers.
P-O-OU-TCustomer	Person / Organization / Organizational Units Target Customer	Represents persons, organizations and organizational units as target customers.
P-HProvider	Person Hired Provider	Represents persons as hired service providers.
O-HProvider	Organization Hired Provider	Represents organizations as hired service providers.
OU-HProvider	Organizational Unit Hired Provider	Represents organizational units as hired service providers.
O-OU-HProvider	Organization / Organizational Unit Hired Provider	Represents organizations and organizational units as hired service providers.
P-O-HProvider	Person / Organization Hired Provider	Represents persons and organizations as hired service providers.
P-OU-HProvider	Person/ Organizational Unit Hired Provider	Represents persons and organizational units as hired service providers.
P-O-OU-HProvider	Person/ Organization / Organizational Unit Hired Provider	Represents persons, organizations and organizational units as hired service providers.
P-Customer	Person Customer	Represents persons as service customers.
O-Customer	Organization Customer	Represents organizations as service customers.
OU-Customer	Organizational Unit Customer	Represents organizational units as service customers.
O-OU-Customer	Organization / Organizational Unit Customer	Represents organizations and organizational units as service customers.
P-O-Customer	Person / Organization	Represents persons and organizations as service

	Customer	customers.
P-OU-Customer	Person / Organizational Unit Customer	Represents persons and organizational units as service customers.
P-O-OU-Customer	Person / Organization / Organizational Units Customer	Represents persons, organizations and organizational units as service customers.

3. S-OPL Process

Figure 1 presents the S-OPL process. The notation used is adapted from the notation for UML activity diagrams. In the proposed notation, patterns are represented by action nodes (the labeled rounded rectangles). Patterns groups are delimited by blue rounded rectangles. Initial nodes (solid circles) are used to represent entry points in the OPL, i.e., patterns in the language that can be used first, without using other patterns. Fork nodes (line segments with multiple output flows) are used to represent parallel paths, i.e., if the ontology engineer decides to follow the fork node input path, then she can follow any path leaving them. Join nodes (line segments with multiple input flows) are used to represent multiple dependencies, that is, to follow the join node output path, the ontology engineer must have already traveled all the join node input paths. Decision nodes (represented by diamonds) are used to represent alternative paths. Thus, if the ontology engineer decides to follow the decision node input path, then she has to select one and only one of the decision node output paths. Sub-groups of patterns shown in dotted rounded rectangles group variant patterns, i.e., a set of patterns that solve the same problem, but in different ways. Thus, from this set of patterns, only one of them can be selected. Finally, control flows (arrowed lines) represent the admissible sequences of paths that the ontology engineer can follow in the OPL. By default, a control flow is optional, i.e., the ontology engineer can decide to follow it or not, depending on the scope of the ontology being developed. Thus, the ontology engineer can select a certain pattern and decide not to use any other after that, even if there are control flows from the pattern to others. However, when a control flow is stereotyped with <<mandatory>>, this means that the path must be mandatorily followed. In Figure 1, different colors are used to identify patterns from different groups.
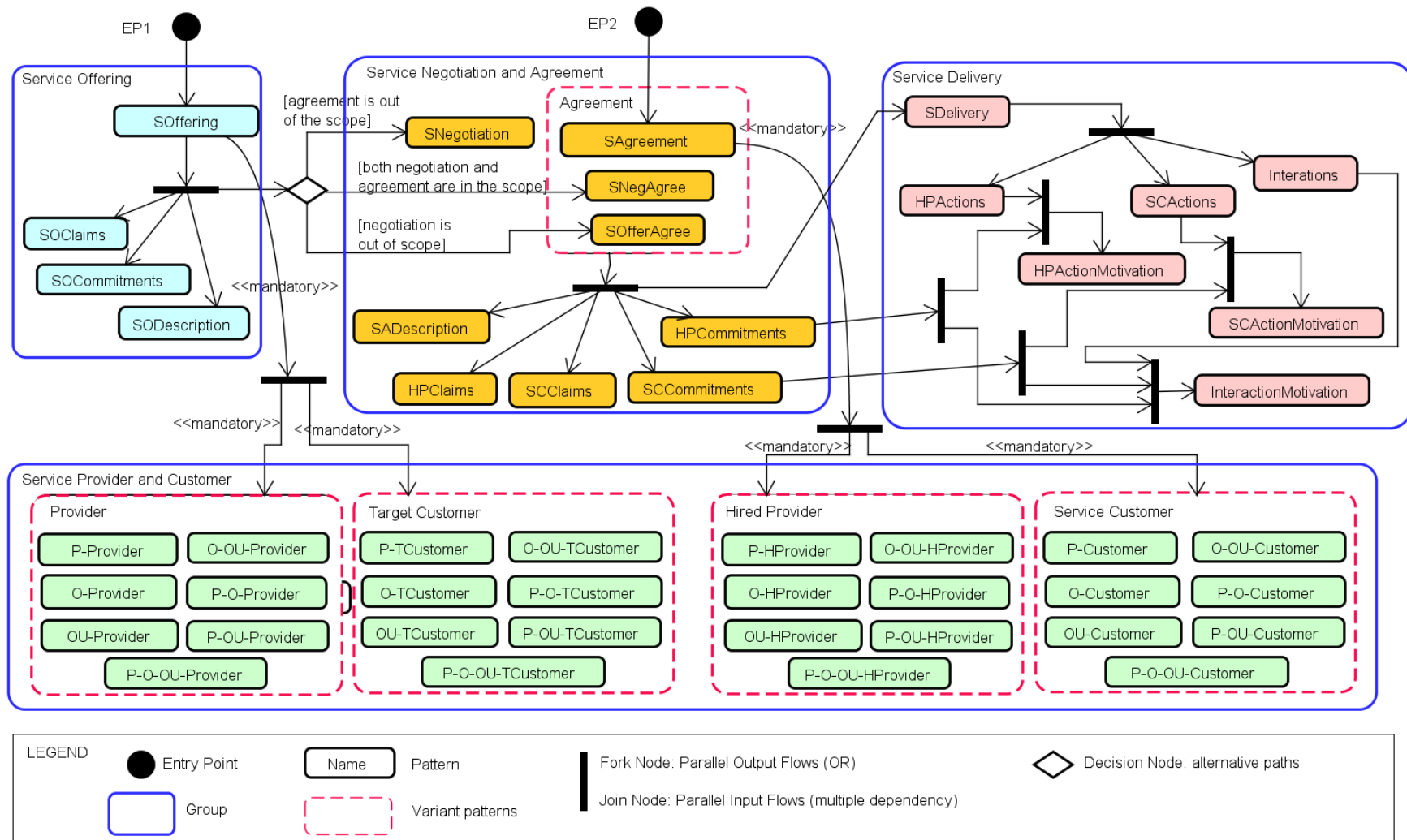
Figure 1 – S-OPL Process.

As Figure 1 shows, S-OPL has two entry points: EP1 and EP2. The ontology engineer should choose one of them, depending on the scope of the specific service ontology being developed. When the requirements for the ontology being developed include describing the service offering, then the starting point is EP1. Otherwise, the starting point is EP2.

When EP1 is chosen, the ontology engineer should use first the *SOffering* pattern for modeling the service offering itself. Next, she can follow several paths (those coming out of the connector #1). One of them is mandatory: the one that leads to the *Service Provider and Customer* group, for modeling which types of providers and target customers are involved in the offering being modeled. Providers and target customers can be people, organizations or organizational units. Therefore, the ontology engineer must select one of the patterns of the *Provider* sub-group, and one of the patterns of the *Target Customer* sub-group. Besides modeling the types of providers and target customers, the ontology engineer can use the following patterns: *SOClaims* and *SOCommitment*s, if the ontology engineer is interested in modeling offering claims and commitments, respectively; and *SODescription*, if the ontology engineer is interested in describing the offering by means of a service offering description.

Once modeled the service offering, the ontology engineer is able to address problems related to service negotiation and agreement. We should highlight, however, that service offering may be out of the scope of the ontology. In this case, EP2 is the entry point.

If the ontology engineer has already modeled service offering, she must decide first if she needs to represent service negotiation and service agreement. If she is interested only in representing service negotiation (agreement is out of the scope of the ontology being developed), she should use *SNegotiation*, a pattern that captures only the service negotiation and its relation to the service offering to which the negotiation regards. If she is interested in representing both the service negotiation and the agreement possibly resulting from it, she should use *SNegAgree*, a pattern that models the service negotiation, the service agreement, and their relations to the corresponding service offering. Finally, if she is interested in modeling only the service agreement and its conformance with a service offering (negotiation is out of the scope of the ontology being developed), then she should choose the *SOfferAgree* pattern, which represents an agreement in conformance with an offering.

If EP2 is the entry point (service offering, and thus service negotiation, are out of the scope of the ontology being developed), the first pattern to be used is *SAgreement*. Next, the ontology engineer must select one of the patterns of the *Hired Provider* sub-group and one of the patterns of the *Service Customer* sub-group, to model the possible types of hired provider and service customer. Note that this is necessary only if the entry point is EP2, since, when entry point is EP1, the types of providers and target customers were already modeled.

Once the agreement is modeled, the following patterns can be optionally used: *HPCommitments* and *HPClaims*, if the ontology engineer is interested in modeling the hired provider commitments and claims, respectively; *SCCommitments* and *SCClaims*, if she is interested in modeling service customer commitments and claims, respectively; and *SADescription*, if she is interested in describing the service agreement by means of a description.

After modeling the agreement, the ontology engineer can model the service delivery. The first pattern to be used is *SDelivery*. Next, if she wants to model the actions involved in a delivery, the following patterns must be applied: *HPActions*, for modeling the actions performed by the hired provider; *SCActions*, for modeling the actions performed by the service customer; and *Interactions*, for modeling the actions performed by both, in conjunction. Once modeled the actions, she can model the relationships between the actions and the commitments that motivated them, by using the following patterns: *HPActionMotivation*, *SCActionMotivation* and *InteractionMotivation*. Since these patterns establish links between commitments and actions, they require the patterns related to the former to be used prior to the patterns related to the latter.

4. S-OPL Patterns Descriptions

The description of S-OPL patterns includes the following items:

- **Name**: provides the name of the pattern.

- **Intent**: describes the pattern purpose.

- **Rationale**: describes the rationale underlying the pattern. A short statement answering the following question: What is the pattern rationale?

- **Competency Questions**: describes the competency questions that the pattern aims to answer.

- **Conceptual Model**: depicts the OntoUML diagram representing the pattern elements.

- **Axiomatization**: presents the axioms related to the pattern conceptual model.

- **Complementary Patterns:** lists other ontology patterns that are related to the pattern being presented, but that are not part of this pattern language.

4.1 Service Offering Group

| SOffering - Service Offering |
|---|

Name: Service Offering

Intent: Represents *Service Offerings* established from *Service Providers* towards *Target Customer Communities*.

Rationale: A *Service Offering* mediates the relation between a *Service Provider* and a *Target Customer Community*. A *Service Offering* is offered by a <u>Service Provider</u> to a *Target Customer Community. Target Customer Community* is the group of agents that constitute the community to which the service is being offered. *Target Customer* is the role played by the agents when they become members of a *Target Customer Community.*

Competency Questions:
- What are the service offerings established between a service provider and a target customer community?
- What is the service provider of a service offering?
- What is the target customer community of a service offering?
- What are the members of a target customer community?

Conceptual Model:
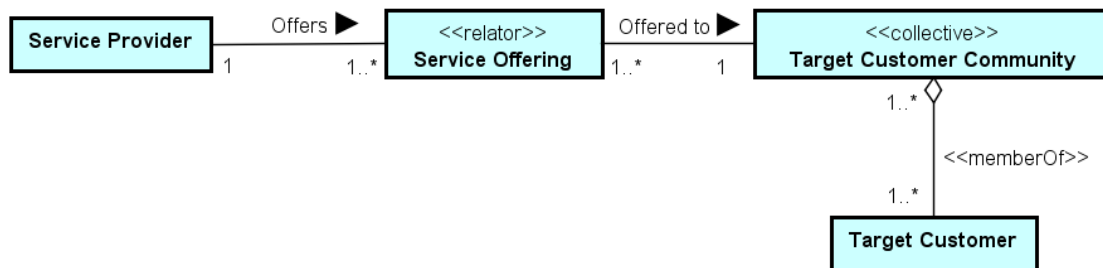
Note: The stereotype of the *Service Provider* class is given by the pattern selected from the Provider sub-group. For instance, if O-Provider pattern is selected, than *Service Provider* is a <<role>>; if P-O-Provider pattern is selected, than *Service Provider* is a <<rolemixin>>. Due to this fact, *Service Provider* class is not stereotyped in the current pattern. The stereotype of the *Target Customer* class is given by the pattern selected from the Target Customer sub-group. For instance, if P-Customer pattern is selected, than *Target Customer* is a <<role>>; if P-O-Customer pattern is selected, than *Target Customer* is a <<rolemixin>>. Due to this fact, the *Target Customer* class is not stereotyped in the current pattern.

Axiomatization:

-

Term Definitions:

Service Provider	The role played by agents when these agents commit themselves to a *Target Customer Community* by means of a *Service Offering*.
Service Offering	A promise of the *Service Provider* to provide a service under certain conditions to a *Target Customer Community*.
Target Costumer Community	The group of agents that constitutes the community to which the service is being offered.
Target Costumer	The role played by agents that are members of the *Target Customer Community*.

SODescription - Service Offering Description

Name: Service Offering Description

Intent: Allows describing *Service Offerings* by means of *Service Offering Descriptions*.

Rationale: *Service Offerings* can be described by means of *Service Offering Descriptions*, such as folders, registration documents in a chamber of commerce, artifacts in a service registry, and so on.

Competency Questions:
- Which are the descriptions of a service offering?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Service Offering Description	A normative description that describes the different aspects of a particular *Service Offering*, such as terms and conditions, as well as aspects related to the service business model performed by the *Service Provider*.

SOCommitment - Service Offering Commitment

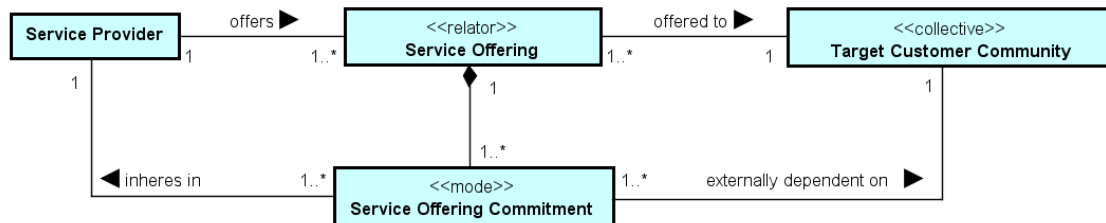**Name:** Service Offering Commitment

Intent: Represents the *Service Commitments* established from a *Service Provider* towards the *Target Customer Community*, in the context of a *Service Offering*.

Rationale: A *Service Offering Commitment* is a social moment (in the sense of UFO-C) that inheres in the *Service Provider* (the committed agent), and is externally dependent on the *Target Customer Community*. The S*ervice Offering Commitments* from the S*ervice Provider* towards the *Target Customer Community* are part of the *Service Offering*.

Competency Questions:

- What are the service commitments from a service provider towards the target customer community established in the service offering?

Conceptual Model:

Axiomatization:

A1	$\forall$ so: ServiceOffering, sp: ServiceProvider, tcc: TargetCustomerCommunity, soco: ServiceOfferingCommitment (provides(sp, so) $\wedge$ offeredTo(so, tcc) $\wedge$ partOf(soco, so)) $\rightarrow$ (inheresIn(soco, sp) $\wedge$ externallyDependentOn(soco, tcc))

- Axiom A1: Each **Service Offering Commitment** that is part of a **Service Offering** inheres in the **Service Provider** that provides the **Service Offering**, and is externally-dependent on the **Target Customer Community** to which this offering is offered.

Term Definitions:

Service Offering Commitment	Commitments by the *Service Provider* towards the *Target Customer Community* that are part of a *Service Offering*.

SOClaim - Service Offering Claim
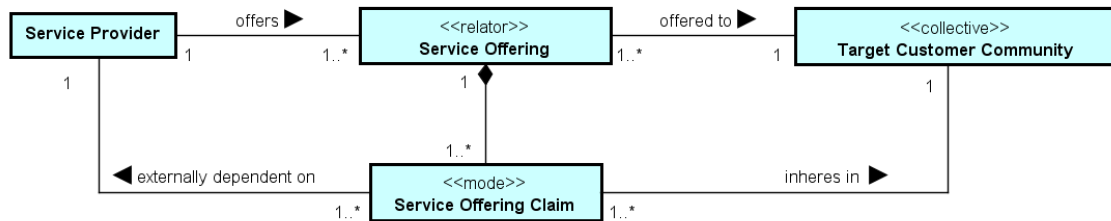
Name: Service Offering Claim

Intent: Represents the *Service Offering Claims* from a *Target Customer Community* towards the *Service Provider* in the context of a *Service Offering*.

Rationale: A *Service Offering Claim* is a social moment (in the sense of UFO-C) that inheres in a *Target Customer Community* and is externally dependent on the *Service Provider* (committed agent) of the corresponding *Service Offering*. The *Service Offering Claims* from the *Target Community* towards to the *Service Provider* are part of the *Service Offering*,

Competency Questions:

- What are the claims of the target customer community to the service provider established in the service offering?

Conceptual Model:

Axiomatization:

A1	∀ so: ServiceOffering, sp: ServiceProvider, tcc: TargetCustomerCommunity, socl: ServiceOfferingCommitment (provides(sp, so) ^ offeredTo(so, tcc) ^ partOf(socl, so)) → (inheresIn(socl, tcc) ^ externallyDependentOn(socl, sp))

- Axiom A1: Each **Service Offering Claim** that is part of a **Service Offering** inheres in the **Target Customer Community** to which the **Service Offering** is offered, and is externally-dependent on the **Service Provider** that provides the service offering.

Term Definitions:

Service Offering Claim	*Claims* that the *Target Customer Community* can make to the *Service Provider* related to a *Service Offering*..

4.2 Service Negotiation and Agreement Group
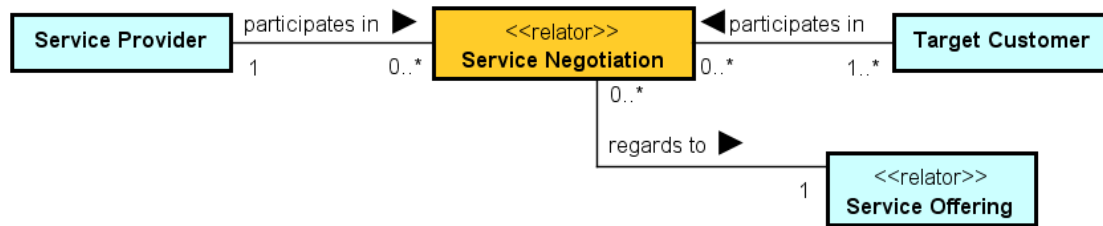
Name: Service Negotiation

Intent: Represents a *Service Negotiation* and the *Service Offering* to which the negotiation regards, without addressing an agreement that possibly results from it.

Rationale: In a *Service Negotiation*, the *Service Provider* and a specific *Target Customer* negotiates. The terms and conditions addressed in a *Service Negotiation* must regard to those of the corresponding *Service Offering*.

Competency Questions:
- Which are the parties involved in a service negotiation?
- To which terms and conditions must a service negotiation regard?

Conceptual Model:

Note: The stereotype of the *Service Provider* class is given by the pattern selected from the Provider sub-group. For instance, if O-Provider pattern is selected, than *Service Provider* is a <<role>>; if P-O-Provider pattern is selected, than *Service Provider* is a <<rolemixin>>. Due to this fact, *Service Provider* class is not stereotyped in the current pattern. The same applies for *Target Customer*, considering, in this case, the pattern selected from the Target Customer sub-group.

Axiomatization:

A1	$\forall$ sp: ServiceProvider, tc:TargetCustomer, sn: ServiceNegotiation (participatesIn(sp, sn) ^ participatesIn(tc, sn) $\rightarrow$ (sp≠tc))
A2	$\forall$ sp: ServiceProvider, sn: ServiceNegotiation participatesIn(sp, sn) $\rightarrow$ ($\exists$so: ServiceOffering (provides(sp, so) ^ regardsTo(sn, so))

- Axiom A1: An agent cannot simultaneously play the roles of **Service Provider** and **Target Customer** in the same **Service Negotiation**.
- Axiom A2: The **Service Provider** that participates in a **Service Negotiation** must provide the **Service Offering** to which the negotiation regards.

Term Definitions:

Service Negotiation	The interaction between the *Service provider* and a *Target Customer* aiming at establishing an agreement regarding a *Service Offering*.

SNegAgree - Service Negotiation and Agreement

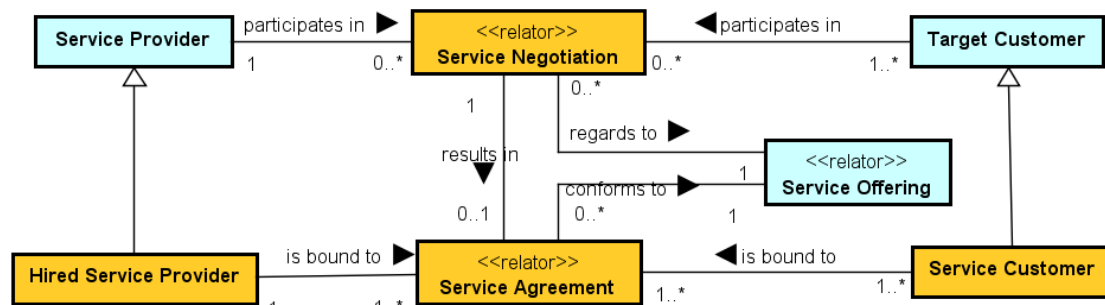**Name:** Service Negotiation and Agreement

Intent: Represents a *Service Negotiation* and the *Service Agreement* that possibly results from it, considering also the corresponding *Service Offering*.

Rationale: In a *Service Negotiation*, the *Service Provider* and a specific *Target Customer* participate aiming to establish a *Service Agreement*. In case of a successful *Service Negotiation*, a *Service Agreement* is established. The terms and conditions addressed in a *Service Negotiation* and that may take part of a *Service Agreement* must regard to/be in conformance with those of the corresponding *Service Offering*.

Competency Questions:

- Which are the parties involved in a service negotiation (and in the resulting agreement, if it is the case)?

- To which service offering does a service negotiation regard?

- To which service offering does a service agreement conform to?

- From which service negotiation did a service agreement result?

Conceptual Model:

Note: The stereotype of the *Service Provider* class is given by the pattern selected from the Provider sub-group. For instance, if O-Provider pattern is selected, than *Service Provider* is a <<role>>; if P-O-Provider pattern is selected, than *Service Provider* is a <<rolemixin>>. Due to this fact, *Service Provider* class is not stereotyped in the current pattern. The same applies for *Target Customer*, considering, in this case, the pattern selected from the Target Customer sub-group.

Axiomatization:

A1	$\forall$ so: ServiceOffering, sn: ServiceNegotiation, sa: ServiceAgreement (resultsIn(sn, sa) $\wedge$ regardsTo(sn, so) $\rightarrow$ conformsTo(sa, so))
A2	$\forall$ sp: ServiceProvider, tc:TargetCustomer, sn: ServiceNegotiation (participatesIn(sp, sn) $\wedge$ participatesIn(tc, sn) $\rightarrow$ (sp$\neq$tc))

A3	∀ sp: ServiceProvider, sn: ServiceNegotiation participatesIn(sp, sn) → (∃so: ServiceOffering (provides(sp, so) ^ regardsTo(sn, so))

- Axiom A1: When a **Service Negotiation** results in a **Service Agreement**, that agreement must conform to the offering to which the negotiation refers.
- Axiom A2: An agent cannot simultaneously play the roles of **Service Provider** and **Target Customer** in the same **Service Negotiation**.
- Axiom A3: The **Service Provider** that participates in a **Service Negotiation** provides the **Service Offering** to which the negotiation refers.

Term Definitions:

Service Negotiation	The interaction between the *Service provider* and a *Target Customer* regarding a *Service Offering*, aiming at achieving a *Service Agreement* between the parties.
Service Agreement	An agreement established between a *Hired Service Provider* and *Service Customers*, regarding a *Service Offering*.
Hired Service Provider	The role played by a *Service Provider*, when the *Service Provider* commits itself to a *Service Customer* to perform actions or to achieve the results determined in the *Service Agreement*.
Service Customer	The role played by a *Target Customer* that hires a service in the context of a *Service Agreement*.

SOfferAgree - Service Offering and Agreement

Name: Service Offering and Agreement

Intent: Represents a *Service Agreement* in conformance with a *Service Offering*, without addressing service negotiation aspects.

Rationale: A *Service Agreement* is established between a *Hired Service Provider* and a *Service Customer*. The terms and conditions that may take part of a *Service Agreement* must be in conformance to those of the correspondent *Service Offering*.

Competency Questions:
- Which are the parties involved in a service agreement?
- To which service offering does a service agreement conform to?

Conceptual Model:
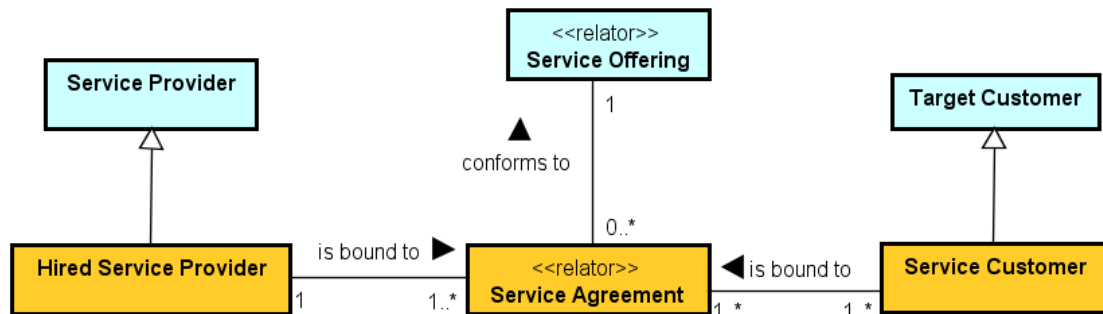
Note: The stereotype of the *Service Provider* class (and also of the *Hired Service Provider* class) is given by the pattern selected from the Provider sub-group. For instance, if O-Provider pattern is selected, than *Service Provider* is a <<role>>; if P-O-Provider pattern is selected, than *Service Provider* is a <<rolemixin>>. Due to this fact, *Service Provider* and *Hired Service Provider* classes are not stereotyped in the current pattern. The same applies for *Target Customer* and *Service Customer*, considering, in this case, the pattern selected from the Target Customer sub-group.

Axiomatization:

A1	$\forall$ hsp: HiredServiceProvider, sc:ServiceCustomer, sa: ServiceAgreement (isBoundTo(hsp, sa) ^ isBoundTo(sc, sa) $\rightarrow$ (hsp≠sc))
A3	$\forall$ hsp: HiredServiceProvider, sa: ServiceAgreement isBoundTo(hsp, sa) $\rightarrow$ ($\exists$so: ServiceOffering (provides(hsp, so) ^ conformTo(sa, so))

- Axiom A1: An agent cannot simultaneously play the roles of **Hired Service Provider** and **Service Customer** in the same **Service Agreement**.
- Axiom A2: The **Service Provider** is bound to a **Service Agreement** provides the **Service Offering** to which the agreement is in conform.

Term Definitions:

Service Agreement	An agreement established between a *Hired Service Provider* and *Service Customers*, regarding a *Service Offering*.
Hired Service Provider	The role played by a *Service Provider*, when the *Service Provider* commits itself to a *Service Customer* to perform actions or to achieve the results determined in the *Service Agreement*.
Service Customer	The role played by a *Target Customer* that hires a service in the context of a *Service Agreement*.

SAgreement - Service Agreement

Name: Service Agreement

Intent: Represents a service agreement, without addressing service negotiation and offering aspects.

Rationale: A *Service Agreement* mediates a service relation established between a *Hired Service Provider* and *Service Customers*.

Competency Questions:
- Which are the parties involved in a service agreement?

Conceptual Model:

Note: The stereotype of the *Hired Service Provider* class is given by the pattern selected from the Hired Provider sub-group. For instance, if O-HProvider pattern is selected, than *Hired Service Provider* is a <<role>>; if P-O-HProvider pattern is selected, than *Hired Service Provider* is a <<rolemixin>>. Due to this fact *Hired Service Provider* class is not stereotyped in the current pattern. The same applies for *Service Customer*, considering, in this case, the pattern selected from the Service Customer sub-group.

Axiomatization:

A1	∀ hsp: HiredServiceProvider, sc:ServiceCustomer, sa: ServiceAgreement (isBoundTo(hsp, sa) ^ isBoundTo(sc, sa) → (hsp≠sc))

- Axiom A1: An agent cannot simultaneously play the roles of **Hired Service Provider** and **Service Customer** in the same **Service Agreement**.

Term Definitions:

Service Agreement	An agreement established between a *Hired Service Provider* and *Service Customers*, regarding a *Service Offering*.
Hired Service Provider	The role played by an agent that is hired to provide a service in the context of a *Service Agreement*.
Service Customer	The role played by an agent that hires a service in the context of a *Service Agreement*.

SADescription - Service Agreement Description
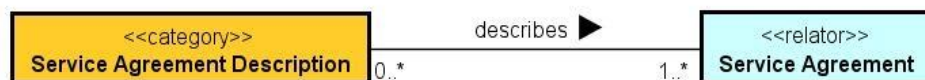
Name: Service Agreement Description.

Intent: Allows describing *Service Agreements* by means of *Service Agreement Descriptions*.

Rationale: A *Service Agreement* can be described by means of *Service Agreement Descriptions*, which describe the agreement terms and conditions, such as payment conditions, service availability, etc.

Competency Questions:
- What are the descriptions of a service agreement?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Service Agreement Description	A normative description of different aspects of a *Service Agreement*, such as terms and conditions, as well as aspects related to the service business model performed by the *Service Provider*.

HPCommitments - Hired Provider Commitments
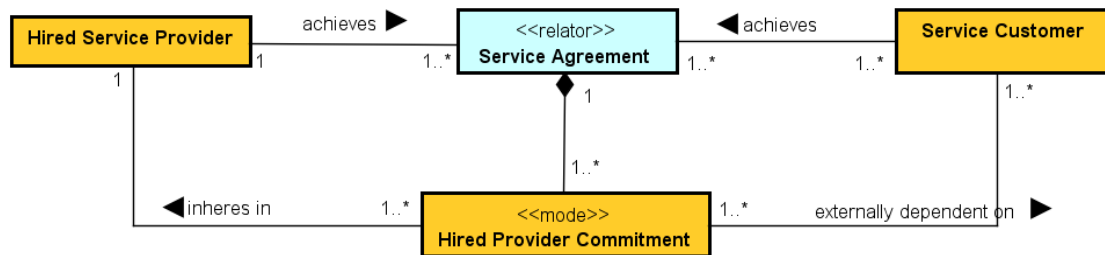
Name: Hired Provider Commitments

Intent: Represents the commitments from a *Hired Service Provider* towards a *Service Customer*.

Rationale: A *Hired Provider Commitment* is a social moment (in terms of UFO-C) that inheres in a *Hired Service Provider* and is externally dependent on the corresponding *Service Customer(s)*. The *Hired Provider Commitments* from the *Hired Service Provider* towards the *Service Customer(s)* are part of the *Service Agreement*.

Competency Questions:
- What are the service commitments from a hired service provider towards the service customer(s) established in a service agreement?

Conceptual Model:

Axiomatization:

A1	$\forall$ sa: ServiceAgreement, hsp: HiredServiceProvider, sc: ServiceCustomer, hpco: HiredProviderCommitment (achieves(hsp, sa) $\wedge$ achieves(sc, sa) $\wedge$ partOf(hpco, sa)) $\rightarrow$ (inheresIn(hpco, hsp) $\wedge$ externallyDependentOn(hpco, sc))

- Axiom A1: Each **Hired Provider Commitment** that is part of a **Service Agreement** inheres in the **Hired Service Provider** that achieves the **Service Agreement**, and is externally dependent on the **Service Customer** that achieves the **Service Agreement**.

Term Definitions:

Hired Provider Commitment	Commitments by the *Hired Service Provider* towards the *Service Customer* that are part of the *Service Agreement*.

HPClaims - Hired Provider Claims
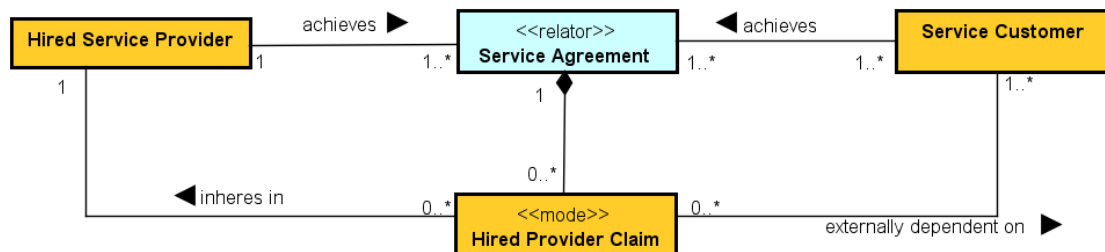
Name: Hired Provider Claims

Intent: Represents the claims of a *Hired Service Provider* towards a *Service Customer*.

Rationale: A *Hired Provider Claim* is a social moment (in the sense of UFO-C) that inheres in a *Hired Service Provider* and is externally dependent on the corresponding *Service Customer(s)*. The *Hired Provider Claims* towards the *Service Customer(s)* are part of the *Service Agreement.*

Competency Questions:
- What are the service claims of a hired service provider towards the service customer(s), considering the established service agreement?

Conceptual Model:

Axiomatization:

A1	∀ sa: ServiceAgreement, hsp: HiredServiceProvider, sc: ServiceCustomer, hpcl: HiredProviderClaim (achieves(hsp, sa) ^ achieves(sc, sa) ^ partOf(hpcl, sa)) → (inheresIn(hpcl, hsp) ^ externallyDependentOn(hpcl, sc))

- Axiom A1: Each **Hired Provider Claim** that is part of a **Service Agreement** inheres in the **Hired Service Provider** that achieves the **Service Agreement**, and is externally dependent on the **Service Customer** that achieves the **Service Agreement**.

Term Definitions:

Hired Provider Claim	Claims that the *Hired Service Provider* can make to the *Service Customer* relative to a *Service Agreement.*

SCCommitments - Service Customer Commitments
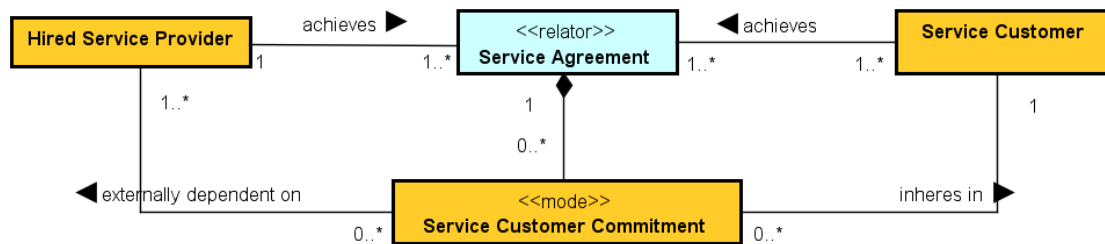
Name: Service Customer Commitments

Intent: Represents the commitments of Service Customer(s) towards a *Hired Service Provider*.

Rationale: A *Service Customer Commitment* is a social moment that inheres in a *Service Customer* and is externally dependent on a *Hired Service Provider*. Such commitments are established in the context of a *Service Agreement*. The *Service Customer Commitments* towards the *Hired Service Provider* are part of the *Service Agreement*.

Competency Questions:
- What are the commitments from the service customer(s) towards the hired service provider established in a service agreement?

Conceptual Model:

Axiomatization:

A1	∀ sa: ServiceAgreement, hsp: HiredServiceProvider, sc: ServiceCustomer, scco: ServiceCustomerCommitment (achieves(hsp, sa) ^ achieves(sc, sa) ^ partOf(scco, sa)) → (inheresIn(scco, sc) ^ externallyDependentOn(scco, hsp))

- Axiom A1: Each **Service Customer Commitment** that is part of a **Service Agreement** inheres in the **Service Customer** that achieves the **Service Agreement**, and is externally dependent on the **Hired Service Provider** that achieves the **Service Agreement**.

Term Definitions:

Service Customer Commitment	Commitments by the *Service Customer* towards the *Hired Service Provider* that are part of the *Service Agreement*.

SCClaims - Service Customer Claims
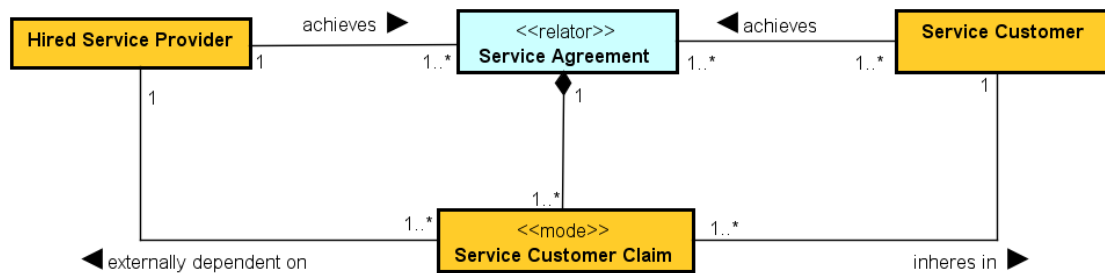
Name: Service Customer Claims

Intent: Represents the claims from *Service Customer(s)* towards a *Hired Service Provider*.

Rationale: *Service Customer Claims* are social moments that inhere in a *Service Customer* and are externally dependent on the *Hired Service Provider*. The *Service Customer Claims* towards the *Hired Service Provider* are part of the *Service Agreement.*

Competency Questions:
- What are the service claims of service customers to the hired service provider, established in the context of a service agreement?

Conceptual Model:

Axiomatization:

A1	∀ sa: ServiceAgreement, hsp: HiredServiceProvider, sc: ServiceCustomer, sccl: ServiceCustomerClaim (achieves(hsp, sa) ^ achieves(sc, sa) ^ partOf(sccl, sa)) → (inheresIn(sccl, sc) ^ externallyDependentOn(sccl, hsp))

- Axiom A1: Each **Service Customer Claim** that is part of a **Service Agreement** inheres in the **Service Customer** that achieves the **Service Agreement**, and is externally dependent on the **Hired Service Provider** that achieves the **Service Agreement**.

Term Definitions:

Service Customer Claim	Claims that the *Service Customer* can make to the *Hired Service Provider* relative to a *Service Agreement.*

4.3 Service Delivery Group

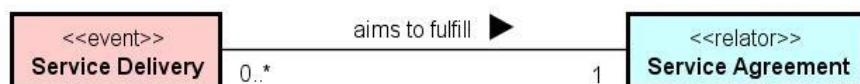| **SDelivery - Service Delivery** |
|:---:|

Name: Service Delivery

Intent: Represents the process (complex action) carried out to fulfill commitments established in the *Service Agreement*.

Rationale: Some commitments established in a *Service Agreement* are only fulfilled by performing actions. The *Service Delivery*, as a complex action, represents the actions performed as a whole, aiming at fulfilling the *Service Agreement.*

Competency Questions:
- Which are the processes performed to fulfill a service agreement?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Service Delivery	A process (complex action) performed aiming at fulfilling a *Service Agreement.*

HPActions - Hired Service Provider Actions
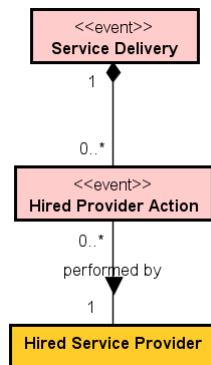
Name: Hired Service Provider Actions

Intent: Represents the actions of the *Service Delivery* that are performed only by the *Hired Service Provider*.

Rationale: A *Hired Provider Action* is a kind of action performed only by the *Hired Service Provider*. *Hired Provider Actions* are part of the *Service Delivery* process.

Competency Questions:

- What are the actions of the service delivery process that are performed only by the hired service provider?

Conceptual Model:

Note: The stereotype of the *Hired Service Provider* class (in fact, defined by the *Service Provider* class) is given by the pattern selected from the Provider sub-group. For instance, if O-Provider pattern is selected, than *Hired Service Provider* is a <<role>>; if P-O-Provider pattern is selected, than *Hired Service Provider* is a <<rolemixin>>. Due to this fact, *Hired Service Provider* class is not stereotyped in the current pattern.

Axiomatization:

-

Term Definitions:

Hired Provider Action	An action performed by the *Hired Service Provider* as part of the *Service Delivery*

SCActions - Service Customers Actions

Name: Service Customers Actions

Intent: Represents the actions of the *Service Delivery* process that are performed only by the *Service Customers*.

Rationale: A *Customer Action* is a kind of action that is performed only by the *Service Customer*. *Customer Actions* are part of the *Service Delivery* process.

Competency Questions:

- What are the actions of the service delivery process that are performed only by the service customer(s)?

Conceptual Model:
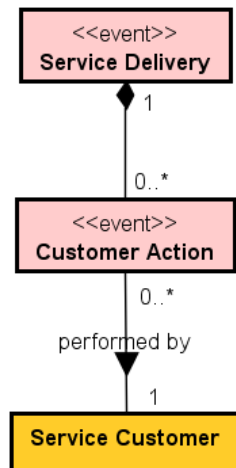
Note: The stereotype of the *Service Customer* class (in fact, defined by the *Target Customer* class) is given by the pattern selected from the Target Customer sub-group. For instance, if P-Customer pattern is selected, than *Service Customer* is a <<role>>; if P-O-Customer pattern is selected, than *Service Customer* is a <<rolemixin>>. Due to this fact, *Service Customer* class is not stereotyped in the current pattern.

Axiomatization:

-

Term Definitions:

Customer Action	An action performed by the *Service Customer* as part of the *Service Delivery*.

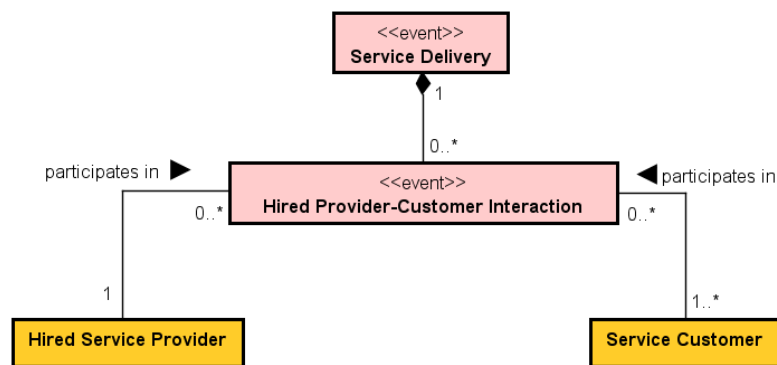## Interactions - Interactions

Name: Interactions

Intent: Represents the actions in a *Service Delivery* in which the *Hired Service Provider* and the *Service Customer(s)* act in tandem.

Rationale: A *Hired Provider-Customer Interaction* is an event in which *Hired Service Provider* and *Service Customer(s)* participate. *Hired Provider-Customer Interactions* are part of a *Service Delivery*.

Competency Questions:

- What are the actions of the service delivery process that are performed by both the hired service provider and the service customer(s)?

Conceptual Model:

Note: The stereotype of the *Hired Service Provider* class (in fact, defined by the *Service Provider* class) is given by the pattern selected from the Provider sub-group. For instance, if O-Provider pattern is selected, than *Hired Service Provider* is a <<role>>; if P-O-Provider pattern is selected, than *Hired Service Provider* is a <<rolemixin>>. Due to this fact, *Hired Service Provider* class is not stereotyped in the current pattern. The same applies for *Service Customer*, considering, in this case, the pattern selected from the Target Customer sub-group.

Axiomatization:

-

Term Definitions:

Hired Provider - Customer Interaction	An *Interaction* between the *Hired Service Provider* and the *Service Customer(s)* performed as part of the *Service Delivery*.

HPActionMotivations - Hired Provider Action Motivation
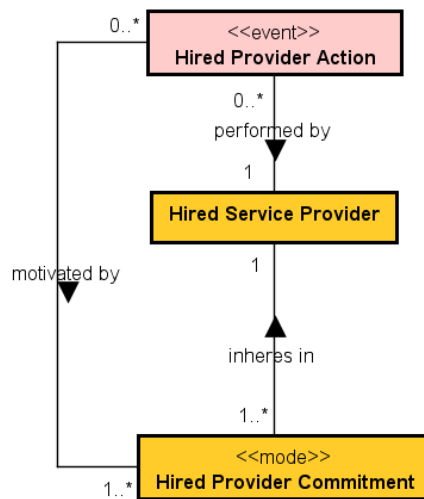
Name: Hired Provider Action Motivation

Intent: Represents the relationships between the actions performed only by a *Hired Service Provider* and the commitments that motivated them.

Rationale: *Hired Provider Actions* are performed by a *Hired Service Provider* and are motivated by some of its commitments (the *Hired Provider Commitments*).

Competency Questions:

- What did motivate the actions performed only by a hired service provider?

Conceptual Model:

Axiomatization:

A1	$\forall$ hpac: HiredProviderAction, hpco: HiredProviderCommitment, hsp: HiredServiceProvider (motivatedBy(hpac, hpco) ^ performedBy(hpac, hsp) $\rightarrow$ inheresIn (hpco, hsp))

- Axiom A1: The **Hired Provider Commitments** that motivate a **Hired Provider Action** should inhere in the **Hired Service Provider** that performs the action.

SCAMotivations - Service Customer Action Motivation
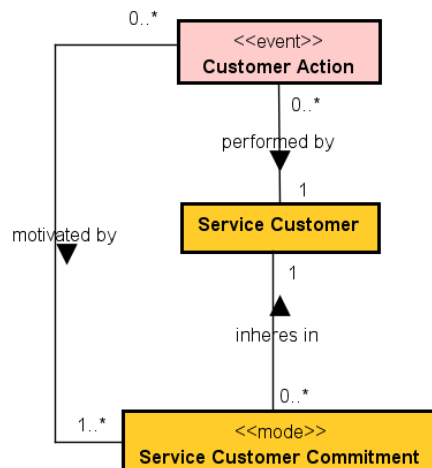
Name: Service Customer Action Motivation

Intent: Represents the relationships between the actions performed only by a *Service Customer* and the commitments that motivated them.

Rationale: *Customer Actions* are performed only by a *Service Customer* and are motivated by some of its commitments (the *Service Customer Commitments*).

Competency Questions:

- What did motivate the actions performed only by the service customer?

Conceptual Model:

Axiomatization:

A1	∀ cac: CustomerAction, scco: ServiceCustomerCommitment, sc: ServiceCustomer (motivatedBy(cac, scco) ^ performedBy(cac, sc) → inheresIn (scco, sc))

- Axiom A1: The **Service Customer Commitments** that motivate a **Customer Action** should inhere in the **ServiceCustomer** that performs the action.

InteractionMotivation - Motivations for Interactions

Name: Motivations for Interactions

Intent: Represents the relationships between the interactions of a hired service provider and the service customer(s) and the commitments that motivated them.

Rationale: *Hired Provider-Customer Interactions* are motivated by either the commitments established by the *Hired Service Provider* (*Hired Provider Commitment*) or by the commitments established by *Service Customer(s)* (*Service Customer Commitment)*. Motivated by these commitments, *Hired Service Provider* and *Service Customer(s)* participate in interactions (*Hired Provider-Customer Interaction*).

Competency Questions:

- What did motivate the interactions between hired service provider and service customer(s)?

Conceptual Model:
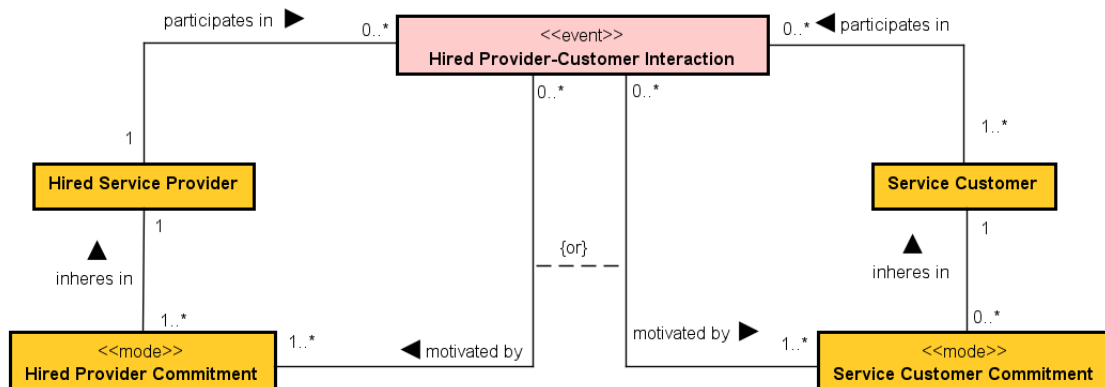
Axiomatization:

A1	∀ hpi: HiredProviderCustomerInteraction (∃co ((HiredProviderCommitment(co) ∨ ServiceCustomerCommitment(co)) ^ motivatedBy(hpi, co))
A2	∀ hpi: HiredProviderCustomerInteraction, hpco: HiredProviderCommitment, hsp: HiredServiceProvider (motivatedBy(hpi, hpco) ^ participatesIn(hsp, hpi)) → inheresIn (hpco, hsp)
A3	∀ hpi: HiredProviderCustomerInteraction, scco: ServiceCustomerCommitment, sc: ServiceCustomer (motivatedBy(hpi, scco) ^ participatesIn(sc, hpi)) → inheresIn (scco, sc)

- Axiom A1: Each **Hired Provider-Customer Interaction** is motivated by at least one commitment (a **Hired Provider Commitment** or a **Service Customer Commitment**).

- Axiom A2: The **Hired Provider Commitments** that motivate a **Hired Provider-Customer Interaction** should inhere in the **Hired Service Provider** that participates in the **Interaction**.

- Axiom A3: The **Service Customer Commitments** that motivate a **Hired Provider-Customer Interaction** should inhere in a **Service Customer** that participates in the **Interaction**.

4.4 Service Provider and Customer Group

<div style="background-color:#b6e87a; text-align:center; font-weight:bold;">
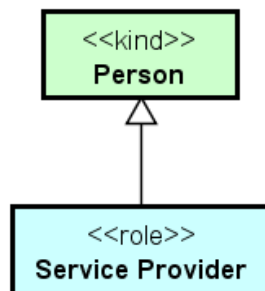
P-Provider - Person Provider

</div>

Name: Person Provider

Intent: Represents persons as *Service Providers*.

Rationale: *Persons* can act as (play the role of) *Service Providers*, i.e., the ones responsible for the service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Service Provider	The role played by a *Person* when she commits herself to a *Target Customer Community* by means of a *Service Offering*.

O-Provider - Organization Provider
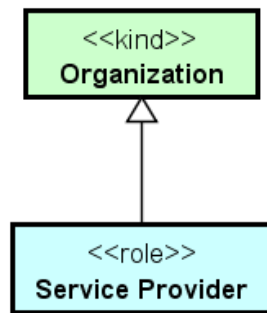
Name: Organization Provider

Intent: Represents organizations as *Service Providers*.

Rationale: *Organizations* can act as (play the role of) *Service Providers*, i.e., the ones responsible for the service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Service Provider	The role played by an *Organization* when it commits itself to a *Target Customer Community* by means of a *Service Offering*.

OU-Provider - Organizational Unit Provider
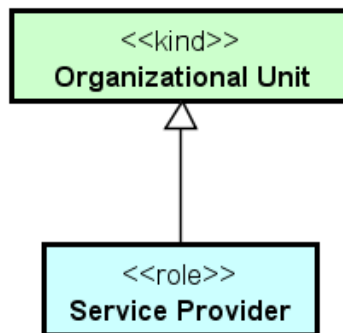
Name: Organizational Unit Provider

Intent: Represents *Organizational Units* as *Service Providers*.

Rationale: *Organizational Units* can act as (play the role of) *Service Providers*, i.e., the ones responsible for the service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization*. In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Provider	The role played by an *Organizational Unit* when it commits itself to a *Target Customer Community* by means of a *Service Offering*.

O-OU-Provider - Organization / Organizational Unit Provider

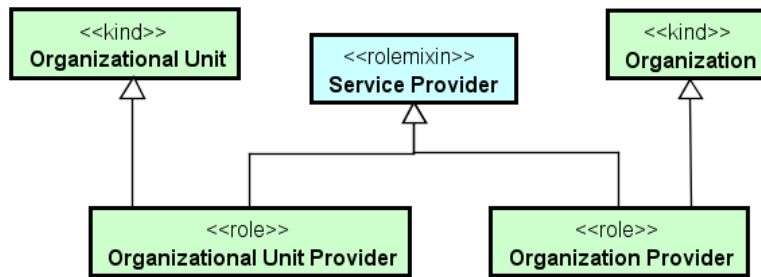**Name:** Organization / Organizational Unit Provider

Intent: Represents *Organizations* and *Organizational Units* as *Service Providers*.

Rationale: *Organizational Units* (playing the role of *Organizational Unit Provider)* and *Organizations* (playing the role of *Organization Provider)* can act as *Service Providers*, i.e., the ones responsible for the service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Provider	The role played by agents when these agents commit themselves to a *Target Customer Community* by means of a *Service Offering*.
Organizational Unit Provider	The role played by an *Organizational Unit* as a *Service Provider*.
Organization Provider	The role played by an *Organization* as a *Service Provider*.

P-O-Provider - Person/Organization Provider
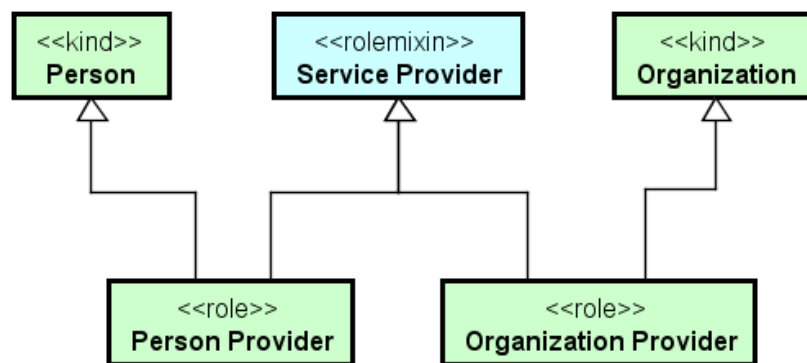
Name: Person/Organization Provider

Intent: Represents *Persons* and *Organizations* as *Service Providers*.

Rationale: *Persons* (playing the role of *Person Provider)* and *Organizations* (playing the role of *Organization Provider)* can act as *Service Providers*, i.e., the ones responsible for the service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Service Provider	The role played by agents when these agents commit themselves to a *Target Customer Community* by means of a *Service Offering*.
Person Provider	The role played by a *Person* as a *Service Provider*.
Organization Provider	The role played by an *Organization* as a *Service Provider*.

P-OU-Provider - Person/Organizational Unit Provider
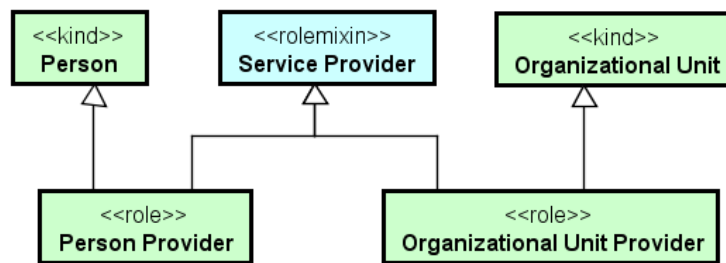
Name: Person/Organizational Unit Provider

Intent: Represents *Persons* and *Organizational Units* as *Service Providers*.

Rationale: *Persons* (playing the role of *Person Provider)* and *Organizational Units* (playing the role of *Organizational Unit Provider)* can act as *Service Providers*, i.e., the ones responsible for the service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Person	An individual human being.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Provider	The role played by agents when these agents commit themselves to a *Target Customer Community* by means of a *Service Offering*.
Person Provider	The role played by a *Person* as a *Service Provider*.
Organizational Unit Provider	The role played by an *Organizational Unit* as a *Service Provider*.

P-O-OU-Provider: Person/Organization/ Organizational Unit Provider

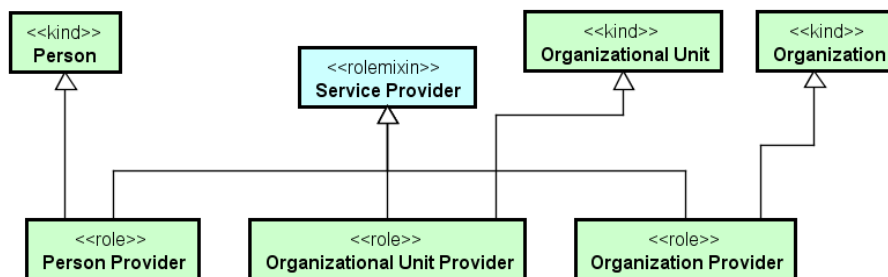**Name:** Person/Organization/Organizational Unit Provider

Intent: Represents *Persons*, *Organizations* and *Organizational Units* as *Service Providers*.

Rationale: *Persons* (playing the role of *Person Provider)*, *Organizational Units* (playing the role of *Organizational Unit Provider)*, and *Organizations* (playing the role of *Organization Provider)* can act as *Service Providers*, i.e., the ones responsible for service provision.

Competency Questions:
- Which are the types of service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Provider	The role played by agents when these agents commit themselves to a

	Target Customer Community by means of a *Service Offering*.
Organizational Unit Provider	The role played by an *Organizational Unit* as a *Service Provider*.
Person Provider	The role played by a *Person* as a *Service Provider*.
Organization Provider	The role played by an *Organization* as a *Service Provider*.
Organizational Unit Provider	The role played by an *Organizational Unit* as a *Service Provider*.

P-TCustomer – Person Target Customer
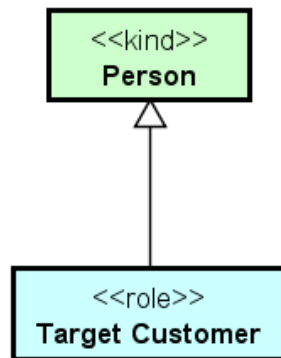
Name: Person Target Customer.

Intent: Represents *Persons* as *Target Customers*.

Rationale: *Persons* can act as (play the role of) *Target Customers* of a service offering.

Competency Questions:
- Which are the types of target customers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Target Customer	The role played by agents that are members of the *Target Customer Community*.

O-TCustomer - Organization Target Customer
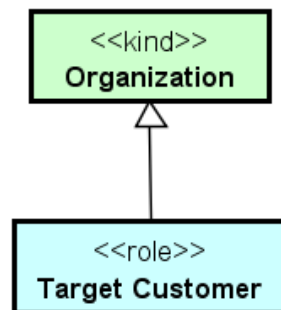
Name: Organization Target Customer

Intent: Represents *Organizations* as *Target Customers*.

Rationale: *Organization*s can act as (play the role of) *Target Customers* of a service offering.

Competency Questions:
- Which are the types of target customers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Target Customer	The role played by agents that are members of the *Target Customer Community*.

OU-TCustomer - Organizational Unit Target Customer
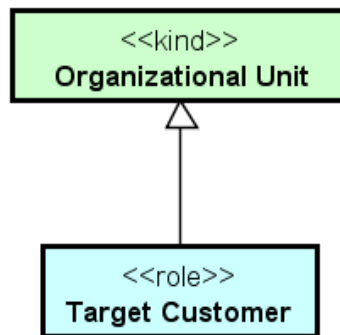
Name: Organizational Units Target Customer

Intent: Represents *Organizational Units* as *Target Customers*.

Rationale: *Organizational Units* can act as (play the role of) *Target Customers* of a service offering.

Competency Questions:
* Which is the type of target customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Target Customer	The role played by agents that are members of the *Target Customer Community*.

O-OU-TCustomer - Organization/Organizational Unit Target Customer

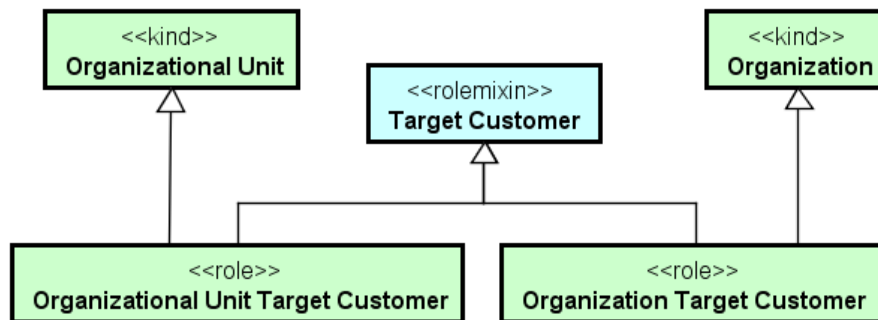**Name:** Organization/Organizational Unit Target Customer

Intent: Represents *Organizations* and *Organizational Units* as *Target Customers*.

Rationale: *Organizations* (playing the role of *Organization Target Customer)* and *Organizational Units* (playing the role of *Organizational Unit Target Customer*) can be *Target Customers* of a service offering.

Competency Questions:
- Which are the types of target customers?

Conceptual Model:

Axiomatization:

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Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Target Customer	The role played by agents that are members of the *Target Customer Community*.
Organization Target Customer	The role played by an *Organization* as a *Target Customer*.
Organizational Unit Target Customer	The role played by an *Organizational Unit* as a *Target Customer*.

P-O-TCustomer - Person/Organization Target Customer
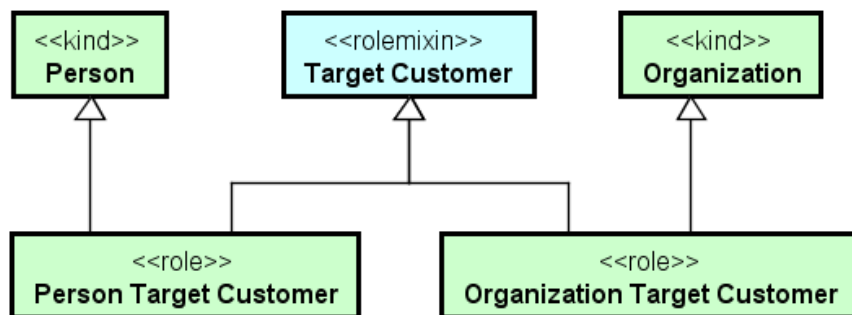
Name: Person/Organization Target Customer

Intent: Represent persons and organizations as *Target Customer*.

Rationale: *Persons* (playing the role of *Person Target Customer*) and *Organizations* (playing the role of *Organization Target Customer*) can act as *Target Customers* of a service offering.

Competency Questions:
- Which are the types of target customers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Target Customer	The role played by agents that are members of the *Target Customer Community*.
Person Target Customer	The role played by a *Person* as a *Target Customer*.
Organization Target Customer	The role played by a *Organization* as a *Target Customer*.

P-OU-TCustomer - Person/Organizational Unit Target Customer

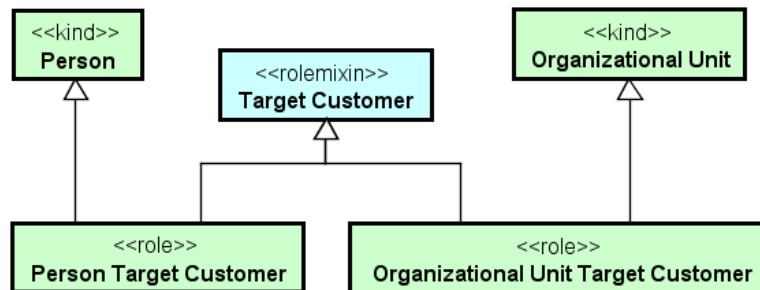**Name:** Person/Organizational Unit Target Customer

Intent: Represents *Persons* and *Organizational Units* as *Target Customers*.

Rationale: *Person*s (playing the role of *Person Target Customer*) and *Organizational Units* (playing the role of *Organizational Unit Target Customer*) can act as *Target Customers* of a service offering.

Competency Questions:
- Which are the types of target customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Person	An individual human being.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Target Customer	The role played by agents that are members of the *Target Customer Community*.
Person Target Customer	The role played by a *Person* as a *Target Customer.*
Organizational Unit Target Customer	The role played by an *Organizational Unit* as a *Target Customer.*

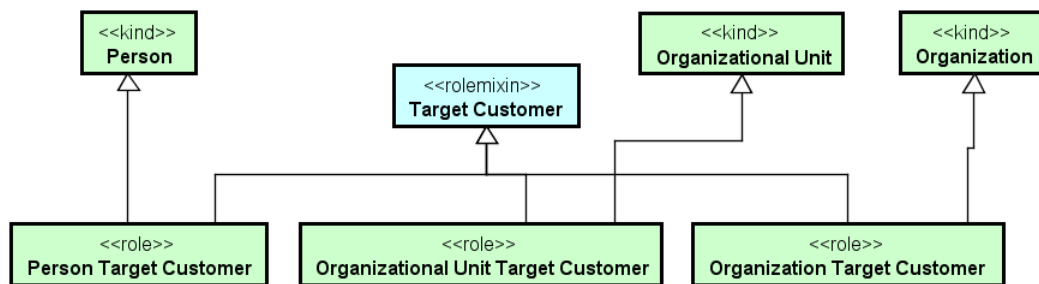**Name:** Person/Organization/Organizational Unit Target Customer

Intent: Represents *Persons*, *Organizations* and *Organizational Units* as *Target Customer*.

Rationale: *Persons* (playing the role of *Person Target Customer*), *Organizations* (playing the role of *Organization Target Customer*), and *Organizational Units* (playing the role of *Organizational Unit Target Customer*) can act as *Target Customers* in a service offering.

Competency Questions:
- Which are the types of target customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Target Customer	The role played by agents that are members of the *Target Customer*

	Community.
Person Target Customer	The role played by a *Person* as a *Target Customer.*
Organization Target Customer	The role played by an *Organization* as a *Target Customer.*
Organizational Unit Target Customer	The role played by an *Organizational Unit* as a *Target Customer.*

P-HProvider - Person Hired Provider
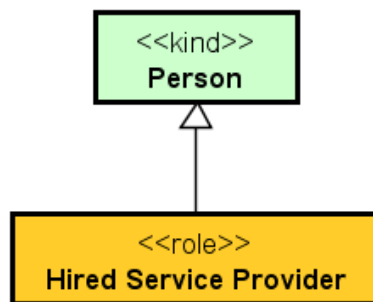
Name: Person Hired Provider

Intent: Represents persons as *Hired Service Providers*.

Rationale: *Persons* can act as (play the role of) *Hired Service Providers*, i.e., the ones responsible for the hired service provision.

Competency Questions:
- Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Hired Service Provider	The role played by a *Person* who is hired to provide a service in the context of a *Service Agreement*.

O-HProvider - Organization Hired Provider
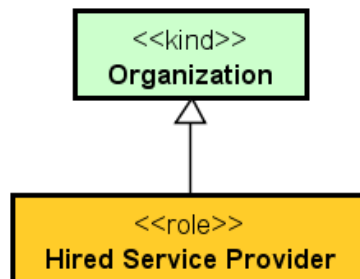
Name: Organization Hired Provider

Intent: Represents organizations as *Hired Service Providers*.

Rationale: *Organizations* can act as (play the role of) *Hired Service Providers*, i.e., the ones responsible for the hired service provision.

Competency Questions:
- Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Hired Service Provider	The role played by an *Organization* that is hired to provide a service in the context of a *Service Agreement*.

OU-HProvider - Organizational Unit Hired Provider
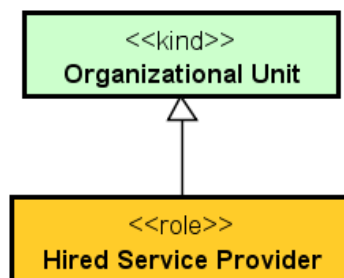
Name: Organizational Unit Hired Provider

Intent: Represents *Organizational Units* as *Hired Service Providers*.

Rationale: *Organizational Units* can act as (play the role of) *Hired Service Providers*, i.e., the ones responsible for the hired service provision.

Competency Questions:
- Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Hired Service Provider	The role played by an *Organizational Unit* that is hired to provide a service in the context of a *Service Agreement*.

O-OU-HProvider - Organization / Organizational Unit Hired Provider

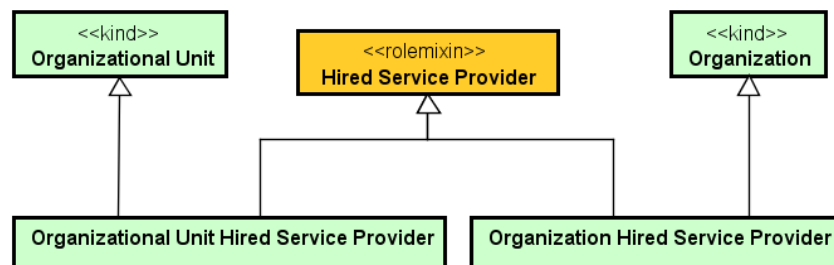**Name:** Organization / Organizational Unit Hired Provider

Intent: Represents *Organizations* and *Organizational Units* as *Hired Service Providers*.

Rationale: *Organizational Units* (playing the role of *Organizational Unit Hired Provider)* and *Organizations* (playing the role of *Organization Hired Provider)* can act as *Hired Service Providers*, i.e., the ones responsible for the hired service provision.

Competency Questions:
- Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

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Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Hired Service Provider	The role played by an agent that is hired to provide a service in the context of a *Service Agreement*.
Organization Hired Provider	The role played by an *Organization* as a *Hired Service Provider.*
Organizational Unit Hired Provider	The role played by an *Organizational Unit* as a *Hired Service Provider.*

P-O-HProvider - Person/Organization Hired Provider
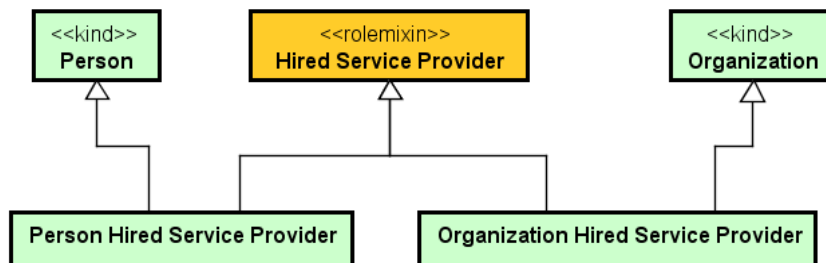
Name: Person/Organization Hired Provider

Intent: Represents *Persons* and *Organizations* as *Hired Service Providers*.

Rationale: *Persons* (playing the role of *Person Hired Service Provider)* and *Organizations* (playing the role of *Organization Hired Service Provider)* can act as *Hired Service Providers*, i.e., the ones responsible for the hired service provision.

Competency Questions:
- Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Hired Service Provider	The role played by an agent that is hired to provide a service in the context of a *Service Agreement*.
Person Hired Provider	The role played by a *Person* as a *Hired Service Provider*.
Organization Hired Provider	The role played by an *Organization* as a *Hired Service Provider*.

P-OU-HProvider - Person/Organizational Unit Hired Provider

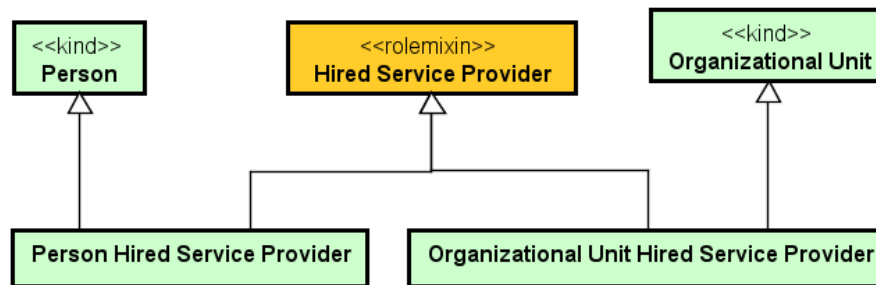**Name:** Person/Organizational Unit Hired Provider

Intent: Represents *Persons* and *Organizational Units* as *Hired Service Providers*.

Rationale: *Persons* (playing the role of *Person Hired Service Provider)* and *Organizational Units* (playing the role of *Organizational Unit Hired Service Provider)* can act as *Hired Service Providers*, i.e., the ones responsible for the hired service provision.

Competency Questions:
- Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Person	An individual human being.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Hired Service Provider	The role played by an agent that is hired to provide a service in the context of a *Service Agreement*.
Person Hired Provider	The role played by a *Person* as a *Hired Service Provider.*
Organizational Unit Hired Provider	The role played by an *Organizational Unit* as a *Hired Service Provider.*

P-O-OU-HProvider: Person/Organization/ Organizational Unit Hired Provider

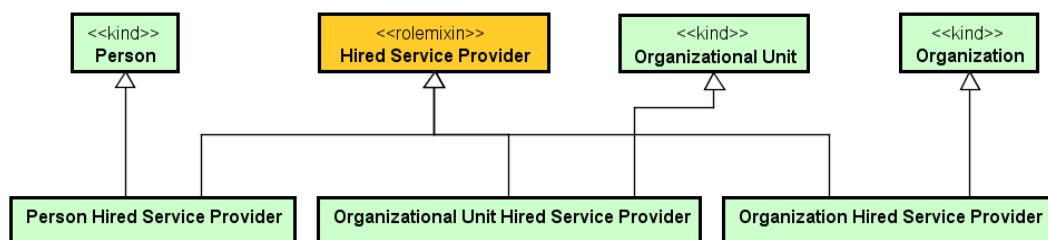**Name:** Person/Organization/Organizational Unit Hired Provider

Intent: Represents *Persons*, *Organizations* and *Organizational Units* as *Hired Service Providers*.

Rationale: *Persons* (playing the role of *Person Hired Service Provider)*, *Organizational Units* (playing the role of *Organizational Unit Hired Service Provider)*, and *Organizations* (playing the role of *Organization Hired Service Provider)* can act as *Hired Service Providers*, i.e., the ones responsible for hired service provision.

Competency Questions:
* Which are the types of hired service providers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Hired Service Provider	The role played by an agent that is hired to provide a service in the context of a *Service Agreement*.

Person Hired Provider	The role played by a *Person* as a *Hired Service Provider.*
Organization Hired Provider	The role played by an *Organization* as a *Hired Service Provider.*
Organizational Unit Hired Provider	The role played by an *Organizational Unit* as a *Hired Service Provider.*

P-Customer – Person Customer
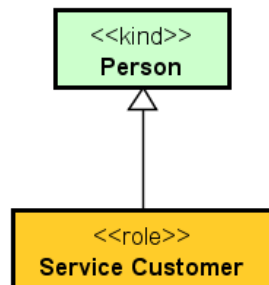
Name: Person Customer.

Intent: Represents *Persons* as *Service Customers*.

Rationale: *Persons* can act as (play the role of) *Service Customers* in a service agreement.

Competency Questions:
- Which are the types of services customers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Person	An individual human being.
Service Customer	The role played by a *Person* that hires a service in the context of a *Service Agreement*.

O-Customer - Organization Customer
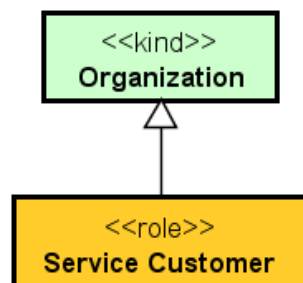
Name: Organization Customer

Intent: Represents *Organizations* as *Service Customers*.

Rationale: *Organization*s can act as (play the role of) *Service Customers* of a service agreement.

Competency Questions:
- Which are the types of services customers?

Conceptual Model:

Axiomatization:

-

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Service Customer	The role played by an *Organization* that hires a service in the context of a *Service Agreement*.

OU-Customer - Organizational Unit Customer
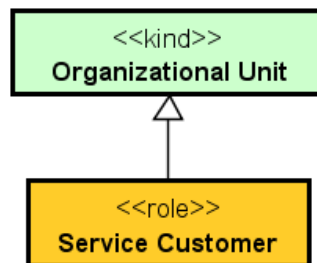
Name: Organizational Units Customer

Intent: Represents *Organizational Units* as *Service Customers*.

Rationale: *Organizational Units* can act as (play the role of) *Service Customers* of a service agreement.

Competency Questions:
- Which is the type of services customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR pattern from E-OPL.

Term Definitions:

Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Customer	The role played by an *Organizational Unit* that hires a service in the context of a *Service Agreement*.

O-OU-Customer - Organization/Organizational Unit Customer

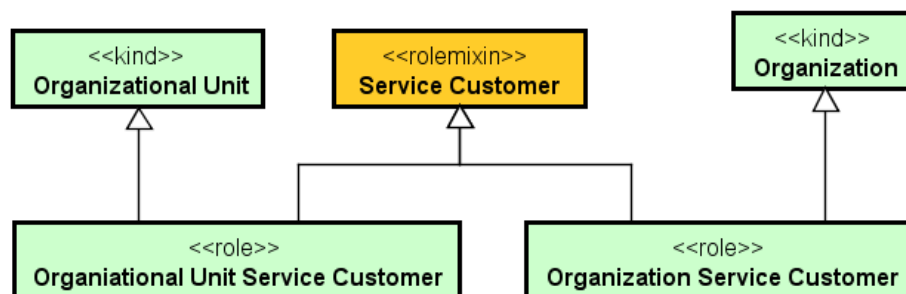**Name:** Organization/Organizational Unit Customer

Intent: Represents *Organizations* and *Organizational Units* as *Service Customers*.

Rationale: *Organizations* (playing the role of *Organization Service Customer)* and *Organizational Units* (playing the role of *Organizational Unit Service Customer*) can be *Service Customers* of a service agreement.

Competency Questions:
- Which are the types of services customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

Term Definitions:

Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Customer	The role played by an agent that hires a service in the context of a *Service Agreement*.
Organizational unit Service Customer	The role played by an *Organizational Unit* as a *Service Customer.*
Organization Service Customer	The role played by an *Organization* as a *Service Customer.*

P-O-Customer - Person/Organization Customer
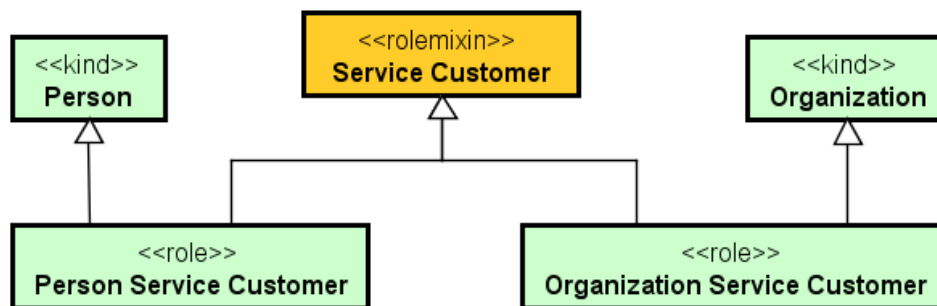
Name: Person/Organization Customer

Intent: Represent persons and organizations as *Service Customer*.

Rationale: *Persons* (playing the role of *Person Service Customer*) and *Organizations* (playing the role of *Organization Service Customer*) can act as *Service Customers* of a service agreement.

Competency Questions:
- Which are the types of services customers?

Conceptual Model:

Axiomatization:

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Term Definitions:

Person	An individual human being.
Organization	A social agent that has as its main purpose the provision of services or products, and that is formally recognized by its external environment.
Service Customer	The role played by an agent that hires a service in the context of a *Service Agreement*.
Person Service Customer	The role played by a *Person* as a *Service Customer*.
Organization Service Customer	The role played by an *Organization* as a *Service Customer*.

P-OU-Customer - Person/Organizational Unit Customer
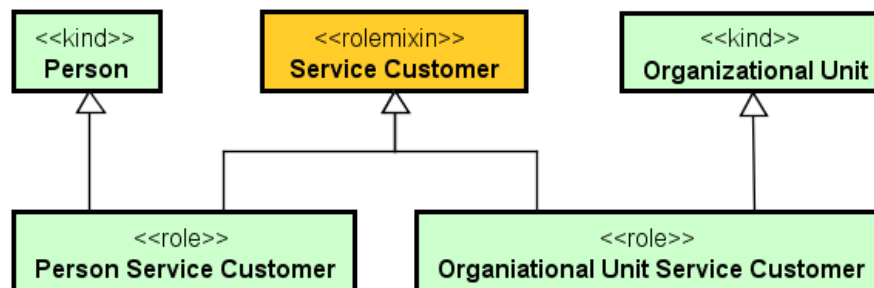
Name: Person/Organizational Unit Customer

Intent: Represents *Persons* and *Organizational Units* as *Service Customers*.

Rationale: *Person*s (playing the role of *Person Service Customer*) and *Organizational Units* (playing the role of *Organizational Unit Service Customer*) can act as *Service Customers* of a service agreement.

Competency Questions:
* Which are the types of services customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

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Term Definitions:

Person	An individual human being.
Organizational Unit	A working group of an *Organization* that is only recognized in the internal context of this *Organization*.
Service Customer	The role played by an agent that hires a service in the context of a *Service Agreement*.
Person Service Customer	The role played by a *Person* as a *Service Customer*.
Organizational unit Service Customer	The role played by an *Organizational Unit* as a *Service Customer*.

P-O-OU-Customer - Person/Organization/Organizational Unit Customer

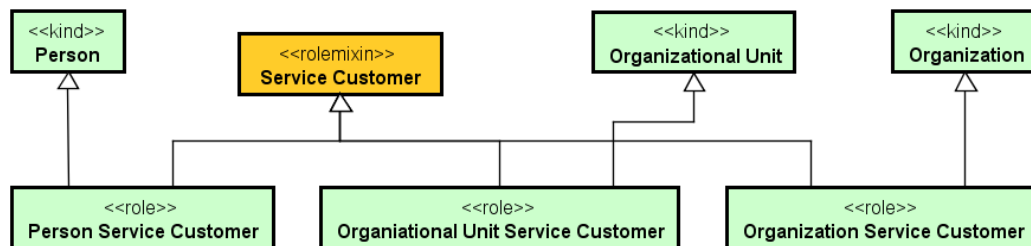**Name:** Person/Organization/Organizational Unit Customer

Intent: Represents *Persons*, *Organizations* and *Organizational Units* as *Service Customer*.

Rationale: *Persons* (playing the role of *Person Service Customer*), *Organizations* (playing the role of *Organization Service Customer*), and *Organizational Units* (playing the role of *Organizational Unit Service Customer*) can act as *Service Customers* in a service agreement.

Competency Questions:
- Which are the types of services customers?

Conceptual Model:

Axiomatization:

-

Complementary Patterns:

An *Organizational Unit* is part of a *Complex Organization.* In order to address this issue, consider applying the COAR and MOAR patterns from E-OPL.

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Service Customer	The role played by an agent that hires a service in the context of a *Service Agreement*.
Person Service Customer	The role played by a *Person* as a *Service Customer*.
Organization Service Customer	The role played by an *Organization* as a *Service Customer*.
Organizational unit Service Customer	The role played by an *Organizational Unit* as a *Service Customer*.

5. References

1. Falbo, R. A., Barcellos, M.P., Nardi, J.C., and Guizzardi, G., *Organizing Ontology Design Patterns as Ontology Pattern Languages*. Proceedings of the 10th Extended Semantic Web Conference - ESWC 2013, 2013

2. Nardi, J.C., Falbo, R.A., Almeida, J.P.A., Guizzardi, G., Pires, L.F., van Sinderen, M.J., Guarino, N., Fonseca, C.M., *A Commitment-based Reference Ontology for Services*, Information Systems, 54, 2015, pp. 262–287