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Future of Identity in the Information Society

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Modelling New Forms of Identities: *Applicability of the Model Based on Virtual Persons*

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Summary

The objective of this document is to illustrate the applicability of the model based on virtual persons, model developed in FIDIS deliverable D2.13.

First, typical use-cases are described using the model based on virtual persons as well as the traditional one-to-one, one-to-many or even many-to-many models. This allows comparing the efficiency of those models, i.e., their ability to faithfully describe the observed reality.

Then, a UML-description of the model based on virtual persons is given to show the internal consistency of this model.

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Foreword

FIDIS partners from various disciplines have contributed as authors to this document. The following list names the main contributors for the sections of this document. Other partners have brought their expertise through valuable comments, discussions and feedback.

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Executive Summary

The objective of this document is to illustrate the applicability and the adaptability of the model based on virtual persons, a model developed in FIDIS deliverable D2.13 “Virtual Persons and Identities”..

Typical use-cases and scenarios are described using the model based on virtual persons as well as the traditional one-to-one, one-to-many or even many-to-many models. This allows for a comparison the efficiency of those models, i.e., their ability to faithfully describe the observed reality.

The model based on virtual persons is a time-dependant many-to-many model; it is therefore more general than the other three models. Examples have been chosen to illustrate the limits of traditional models when trying to faithfully represent some new forms of identities appearing in the information society. Each use-case has its own specificity in terms of new forms of identities and thus brings an added value to the deliverable.

For pseudonyms, a comparison between the model based on virtual persons and the definitions given in [Pfitzmann 2008] shows that pseudonyms in the light of virtual persons can be interpreted in some aspects as a refinement of Pfitzmann and Hansen’s approach.

The legal system has a long experience of using abstract entities to define rules, categories, etc., in order to associate legal rights, obligations, and responsibilities to persons that can be considered instances of these abstract entities in specific situations. The model developed in FIDIS deliverable D2.13 intentionally uses a similar construction. The example of unborn entities, for example, shows that only the model based on virtual persons can catch and faithfully represent legal subtleties related to this use-case.

In section 7, a UML-description of the model based on virtual persons is given to show the internal consistency of this model.

1 Introduction

1.1 Scope

This document, created in the context of the FIDIS work package 17 “Abstract Persons” of the FIDIS Network of Excellence, proposes to compare the applicability and the adaptability of different models when modelling identities and their related concepts in the information society. The comparison is based on the modelling of well-chosen typical real life scenarios. Special attention is given to the new model based on virtual persons, developed in FIDIS deliverable D2.13 “Virtual Persons and Identities”; a re-formalization and representation of the model’s core elements is given in the well known UML-notation in order to show the internal consistency of this model and to make its hypotheses explicit. Previous work related to this deliverable has been mainly done in Work package 2, where several authors have already contributed to other deliverables, in particular to FIDIS deliverable D2.13.

1.2 Objective

In the context of Work package 2, FIDIS deliverable D2.13 has produced a formal description of many concepts related to identities in the information society, in relation with the new, very general concept of virtual person (virtual entities that can have rights, duties, obligations and/or responsibilities). FIDIS deliverable D2.13 also presents both an intuitive and a formal description of a two-layer model based on virtual persons. The concept of virtual person used in this model generalizes current uses of the term. This model is the result of sometimes difficult but fruitful discussions between FIDIS partners with very different backgrounds. As a consequence, the model covers a wide range of applications and is expected to allow for a faithful description of scenarios from different domains, in particular from both technical and legal domains.

The main objective of this deliverable is to subject the model that is based on virtual persons to real life scenarios and, from this confrontation, to either confirm its applicability or to pinpoint its weaknesses. A comparison between this model and the traditional one-to-one, one-to-many or even many-to-many models allows to evaluate both their efficiency and their ability to represent legal and technical subtleties related to new forms of identities in the information society.

To allow for a deeper understanding of the model based on virtual persons, of its core components and of the relations between these components, a more formal description using UML (Unified Modelling Language) [Fowler 3rd edition] is introduced at the end of this document. The UML language – a commonly used language in the field of computer science – is intended to unambiguously represent complex structures; it also appears to be perfectly appropriate to model identity related concepts. All core components of the model, as well as their relations, are described using UML; short examples are also presented to illustrate the descriptions in order to give the reader a better insight into the concepts.

Last but not least, results of this deliverable should feed upcoming deliverables in Work package 17, especially FIDIS deliverable D17.4 “Trust and identification in the light of virtual persons”.

1.3 Content and Document Structure

This deliverable evaluates the applicability of a model based on virtual persons. This model has been precisely defined in section 5.1 of FIDIS deliverable D2.13 “Virtual persons and Identities”. We will not repeat here the description of this model, its definitions and all context information with respect to these definitions. We strongly recommend the reader who does not know this model yet, either to read first FIDIS deliverable D2.13, or to study the UML description of the model given in Section 7 of this document.

In Section 2, we start our study with pseudonyms. A comparison between the model based on virtual persons and the definitions given in [Pfitzmann 2008] shows that pseudonyms in the light of virtual persons can be interpreted in some aspects as a refinement of Pfitzmann and Hansen’s approach. Two case-studies are described using the model based on virtual persons. The first one presents the artist-pseudonym of a French singer, a non anonymizing pseudonym. We continue with a second case-study related to e-commerce, namely eBay pseudonyms used as anonymizing tools.

Then, Section 3 discusses the concept of avatars from the field of online games with respect to virtual identities. The discussion shows that the model based on virtual persons captures not only the links between players and their avatars, but also links between players themselves (outsourcing of virtual identities for example).

Within Section 4, we show how categories and profiling are linked with virtual persons.

Section 5 focuses on unborn or dead entities. Laws have a long experience of using abstract entities to define rules, categories, etc., in order to associate legal rights, obligations, and responsibilities to persons that can in concrete situations be considered instances of these abstract entities. The model developed in FIDIS deliverable D2.13 intentionally uses a similar construction. The example of unborn entities, for example, shows that only the model based on virtual persons can catch and faithfully represent legal subtleties related to this use-case.

Section 6 covers software agents and shows how the model based on virtual persons can represent the increasing distance between software agents and their principal.

Finally, Section 7 of this document introduces UML-models describing the concepts defined in FIDIS deliverable D2.13 “Virtual persons and Identities”; it contains short examples to get the reader used to this notation. This section is also given in order to show the internal consistency of the model based on virtual persons.

Section 8 is an overall conclusion for this document which also refers to further work planned in Work package 17.

In Appendix A, a short introduction into UML presents the main concepts used for the “graphical definitions” in Section 7.

Within the work on this deliverable, a mind map was used as an internal working document to better visualize questions, concepts and domains of research related to virtual persons, as well as the relations between these concepts. Appendix B contains this mind map.

2 Pseudonyms in the Light of Virtual Persons

We begin the evaluation of the applicability and efficiency of the model based on virtual persons by trying to apply it to describe pseudonyms as they occur in real life situations.

In the introduction, we first remind the common perceptions and uses of pseudonyms. We also compare Pfitzmann & Hansen's definition of pseudonyms with the approach offered by the model based on virtual persons.

Then we continue with two case-studies that illustrate the efficiency of the model based on virtual persons to catch and represent subtleties related to pseudonyms as they appear in real life examples.

2.1 Introduction

The term "pseudonym" comes from the Greek word *pseudonumon* which means *false name*. Traditionally, a pseudonym refers to a fictitious name taken by an author, a pen name. *Voltaire* and *Molière* are pseudonyms of famous French writers. Nowadays, pseudonyms are often used by artists, especially in show-business, to mask their official identity. In this case, a pseudonym can be seen as a self-chosen name becoming an identity in the artist context. In several cases, actors do not want to be confronted with their official name given by their parents – maybe because it sounds less glamorous.

In some situations, the pseudonym is used to conceal the true identity of the person, i.e., it acts as a privacy enhancing tool. Journalists sometimes use such pseudonyms. On the Internet, many people use a pseudonym (or multiple pseudonyms) hoping to stay anonymous.

In show-business, however, the mask is often transparent. The link between the physical person (actor, singer, etc.) and his or her pseudonym can even become stronger than the one with his or her official identity. As an example, the famous French singer Johnny Hallyday – whose real name is Jean-Philippe Smet – is better known and recognized by most people by his pseudonym than by his real name. For her last name, his wife has even chosen the surname of the pseudonym after their wedding; she is known as Laeticia Hallyday, not Laeticia Smet. The same is true for Johnny Hallyday's son, David Hallyday.¹ In such a situation, the use of a pseudonym is clearly not a way to protect anonymity anymore. It transcends its original purpose and becomes assimilated within a full identity.

These examples illustrate that a pseudonym, as a (false) name, can become *an identity in the common language*. This is in line with the approach proposed by the model based on virtual persons: *a pseudonym is the identity of a virtual person*. The user of the pseudonym is linked to this virtual person: it is represented by this virtual person.

Pseudonyms also intervene as User IDs in the information society. The term digital identity is often used for sets of data representing a person, or more generally identity-related digital information that characterize this person in a specific context. A person can choose to use only subsets of these attributes to be represented in different situations and roles.

These subsets of attributes are called partial identities (pID) in [Pfitzmann/Hansen 2008]. For transactions and interactions on the Internet and online applications, e.g. when participating in

¹ Laura Smet, daughter of Johnny Hallyday and the French actress Nathalie Baye, uses Smet for her last name.

social networks, forums, instant messaging, or eCommerce, people make use of partial identities. Very often, instead of a person’s real name, a pseudonym is used in order to reach a certain level of anonymity. In [Pfitzmann/Hansen 2008], *pseudonyms act as pointers² to partial identities*. Pfitzmann and Hansen focus on a pseudonym being a pointer to a partial identity instead of being an identity attribute or even an identity itself, to clearly distinguish between pointers to partial identities, and attributes or partial identities.

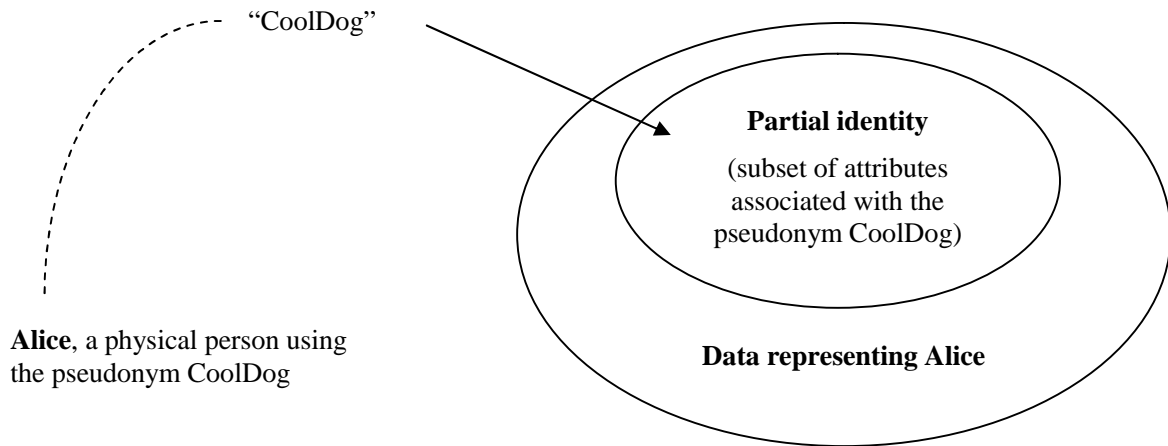


Figure 1: A pointer to a partial identity [Pfitzmann/Hansen]

Reducing a pseudonym to a mere pointer may constitute an accurate depiction when a pseudonym is some completely meaningless UserID, for example a random number. However, it eliminates the intrinsic “identity” nature of a pseudonym in real life. As a name, (chosen) pseudonyms usually contain more identity-related information than randomly generated identifiers.

We agree with Pfitzmann and Hansen that a pseudonym acts as a pointer. However, the “pointer” nature of a pseudonym should not be considered to be in opposition with its “identity” nature. Indeed, according to the identity model that we developed (see section 5.1 in FIDIS deliverable D2.13) any identity of an entity is identifying information linkable to this entity. In particular, the identity points to the entity (without being necessarily a pointer in the strict sense). For a pseudonym, our model can be interpreted in some aspects as a refinement of Pfitzmann and Hansen’s approach.

² The term “identifier” as used in [Pfitzmann/Hansen 2008] essentially means pointer. However, as identifiers have several different meanings in specialized literature, we write “pointer” in order to avoid a possible confusion. In FIDIS deliverable D2.13, identifiers have a different meaning.

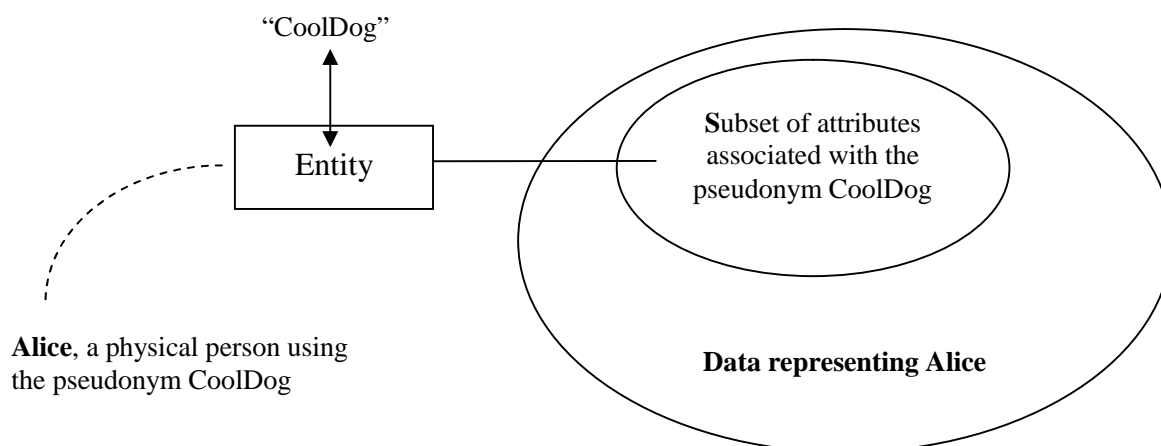


Figure 2: An identity pointing to its corresponding virtual entity [FIDIS D2.13]

In our model, the corresponding entity is called a virtual person – the one called *CoolDog* – and the pseudonym *CoolDog* is the (tautological) identity of this virtual person. Attributes can be directly associated with this virtual person.

Similarly to Pfitzmann and Hansen, we make a distinction between an identity pointing to an entity and the attributes associated with this entity. We also recognize in our model that both identities and attributes are identity-related information. The same identity-related information can be an identity for an entity while also being an attribute for this same entity or for another one.

In our model, the fundamental unifying concept behind *identifier*, *identity*, *attributes*, *pseudonyms*, etc. is information or more precisely identity-related information. Attributes are identity-related information; identifiers are identity-related information too, etc. Let us recall two core concepts in our model:

- the concept of *entity* (anything that has a distinct existence; it is the fundamental “thing” that can be identified) and
- the concept of *identity-related information* (any information that characterizes – uniquely or not – an entity).

In our model however, contrarily to Pfitzmann and Hansen, attributes can be identifiers and identifiers can be attributes: an identifier is essentially information that characterizes exactly one entity within a specific context.³ It does not prevent this entity from being represented by other sets of data or information, too. However, an identifier points to an entity rather than to a subset of attributes – a partial identity according to Pfitzmann and Hansen. Actually, in our model, a partial identity is a partial identifier.⁴ A (partial) identity is relative; it depends on the

³ A partial identifier (or partially identifying information) is any information that characterizes at least one entity within a specific context or environment. An identifier is a partial identifier that characterizes *exactly* one entity within this specific context or environment.

⁴ A (partial) identity of an entity – according to an observer – is a (partial) identifier that can be linked to this entity by that observer.

ability of the observer to find or verify the link between the entity and the (partial) identifier, i.e., the identifying information.

In our model, we take full advantage of the *identity* nature of a pseudonym as it is commonly perceived. A pseudonym is considered as an identifier as well as the identity of a virtual person: the one called by this pseudonym. This is in line with the common perception of a pseudonym being an identity among others. This virtual person is a new entity with its own existence. This new entity even survives the physical person(s) using this pseudonym.

Such a construction allows us to associate attributes and give rights, in a broad, not necessarily legal sense, directly to the virtual person, i.e., almost to the pseudonym itself rather than to tie them to the physical entity/entities behind the mask. For example, as we will see in the case-study that follows, royalties can be associated to the virtual person “the one called *Johnny Hallyday*”.

2.2 First case: “Johnny Hallyday”, a non-anonymizing pseudonym

In this case-study, we consider further the artist-pseudonym *Johnny Hallyday* used by a famous singer whose real name is Jean-Philippe Smet. In this situation, the use of a pseudonym does not work as an anonymizing mechanism. It is an artist-name, a self-chosen identity.

2.2.1 Representation in the one-to-one model

The traditional one-to-one model (one person – one identity) would emphasize the very strong link between the singer Jean-Philippe Smet and his artist-pseudonym Johnny Hallyday in merging both “names” into a single identity. This is a good example where the one-to-one model seems to be reasonably applicable with a pseudonym at first sight.

However, this model could not faithfully represent the scenario in “Jean-Philippe”⁵, a 2006 Belgian movie where, one morning, the link between “Jean-Philippe Smet” and “Johnny Hallyday” has disappeared: “Johnny Hallyday” does not exist anymore (only one unique fan remembers him) and Jean-Philippe Smet (who plays his own role) has just become a “normal” citizen who never realized his dream of becoming “Johnny Hallyday”.

2.2.2 Representation in the one-to-many model

The one-to-many model allows us to make a distinction between Jean-Philippe Smet, as a physical person, and its role(s) as a singer, for example. This would allow representing the scenario in “Jean-Philippe” (see previous section). Indeed, the link between the physical person Jean-Philippe Smet and his official name “Jean-Philippe Smet” is kept while the link between this same physical person and “Johnny Hallyday” is destroyed.

However, what happens if there is yet another physical person named Jean-Philippe Smet? Even the one-to-many model cannot catch the subtlety of this reality.

⁵ (Belgium 2006) Film directed by Laurent Tuel, with Fabrice Luchini and Johnny Hallyday respectively playing the roles of Fabrice and Jean-Philippe in the movie.

<http://www.imdb.com/title/tt0477988/fullcredits#cast> (September 2008).

[Final], Version: 1.0

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2.2.3 Representation in the model based on virtual persons

To represent the above examples in our model, we consider two different virtual persons: “the one called *Johnny Hallyday*” and “the one called *Jean-Philippe Smet*” (see Figure 3).

Note that if there is another physical person named Jean-Philippe Smet, our model can easily catch this fact. Even in this simple case, the model based on virtual persons allows for a finer description of the relations between the different entities that are involved.

Johnny Hallyday is a pseudonym used by the physical person Jean-Philippe Smet. It is

- the (tautological) *identity* of the virtual person “the one called *Johnny Hallyday*” and
- a *virtual identity* for Jean-Philippe Smet (physical person) linked to this virtual person.

Identities do not exist by themselves; they must relate and point to an entity. The traditional one-to-one, or one-to-many, or even many-to-many models cannot faithfully describe the scenario in “Jean-Philippe”, a 2006 French movie: One morning, the link between Jean-Philippe Smet and Johnny Hallyday has disappeared; Johnny Hallyday does not exist anymore (only one unique fan remembers him) and Jean-Philippe Smet (who plays his own role) has just become a “normal” citizen who never realized his dream of becoming Johnny Hallyday. These models also meet difficulties when the corresponding physical entity/entities do not exist anymore, e.g., after Jean-Philippe Smet’s death.

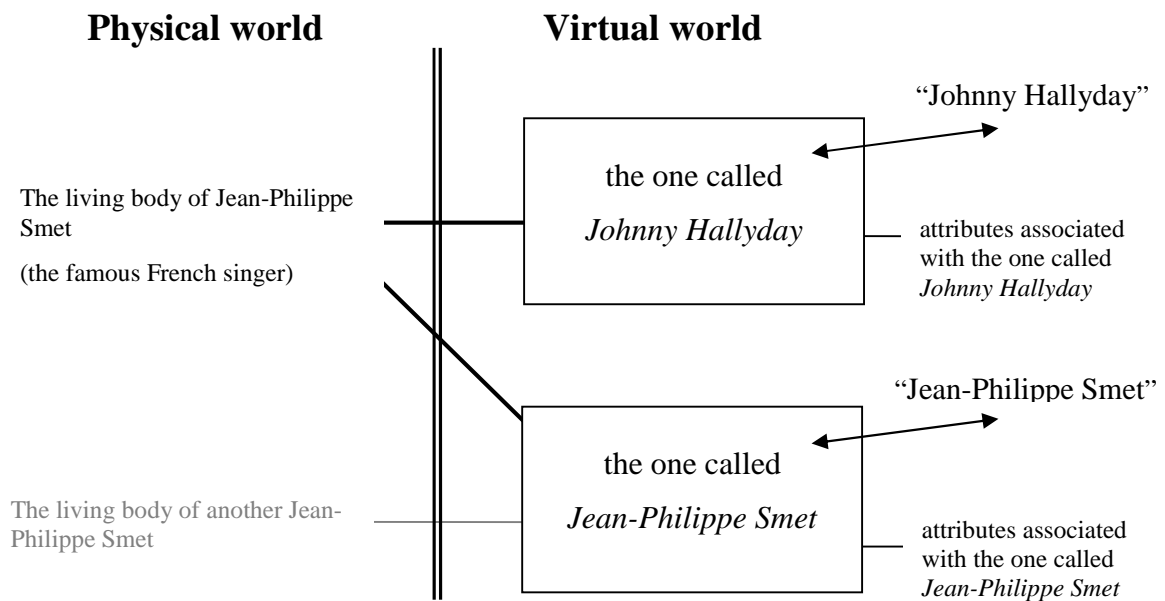


Figure 3: Jean-Philippe Smet & Johnny Hallyday

The situation in the movie “Jean-Philippe” is easy to describe in our model (see Figure 4). The link between the living body of Jean-Philippe Smet and the virtual person “the one called *Johnny Hallyday*” does not exist anymore. However, the virtual person “the one called *Johnny Hallyday*” continues to exist in the movie. Indeed, it is the product of someone’s mind: the unique fan that “remembers” Johnny (see Figure 4).

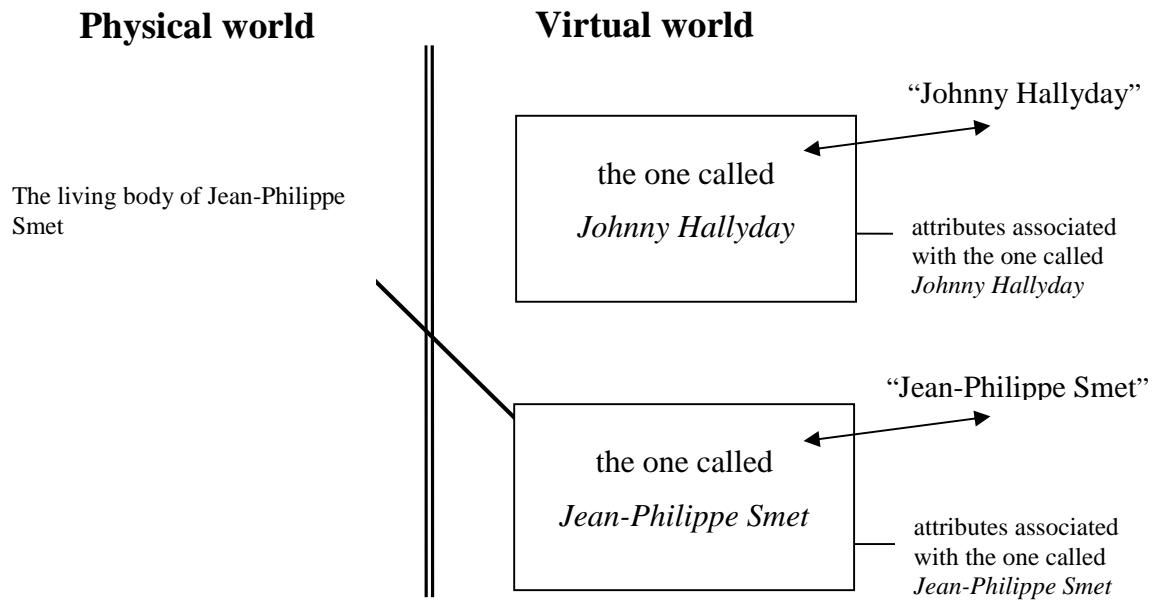


Figure 4: “Jean-Philippe”, the movie

This example illustrates one of the advantages of having virtual persons with their own existence. The virtual person “the one called *Johnny Hallyday*” exists even if it does not represent any physical entity.

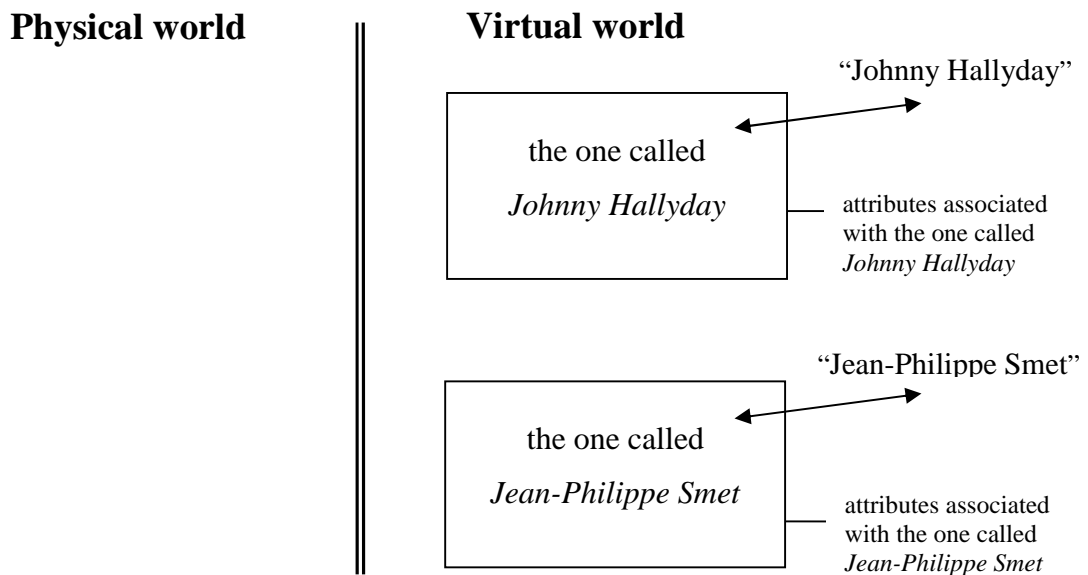


Figure 5: After Jean-Philippe Smet’s death

After the death of this famous French singer, both virtual persons “the one called *Johnny Hallyday*” and “the one called *Jean-Philippe Smet*” will continue to exist but will not be

linked to any physical entity anymore.⁶ In this case, the connection between the physical and virtual worlds is severed, as it is depicted in Figure 5 above.

These virtual persons that are not linked to physical entities anymore might have some rights, for example intellectual property rights. Such a situation is not covered in a convincing way by the traditional one-to-one, or one-to-many, or even many-to-many models.

According to our model, royalties are to be paid to the virtual person “the one called *Johnny Hallyday*”. They are transferred to the physical person called Jean-Philippe Smet as long as he lives; then, after his death, these royalties will be transferred to the virtual person “Jean-Philippe Smet’s heir” and eventually to the physical or legal person(s) represented by “Jean-Philippe Smet’s heir”:

- any foundation (another virtual person) that inherits (some of) those royalties
- physical persons that inherit those royalties, etc.

The following figure illustrates how royalties stay associated with the virtual person “the one called *Johnny Hallyday*”, even after this French singer will have died:

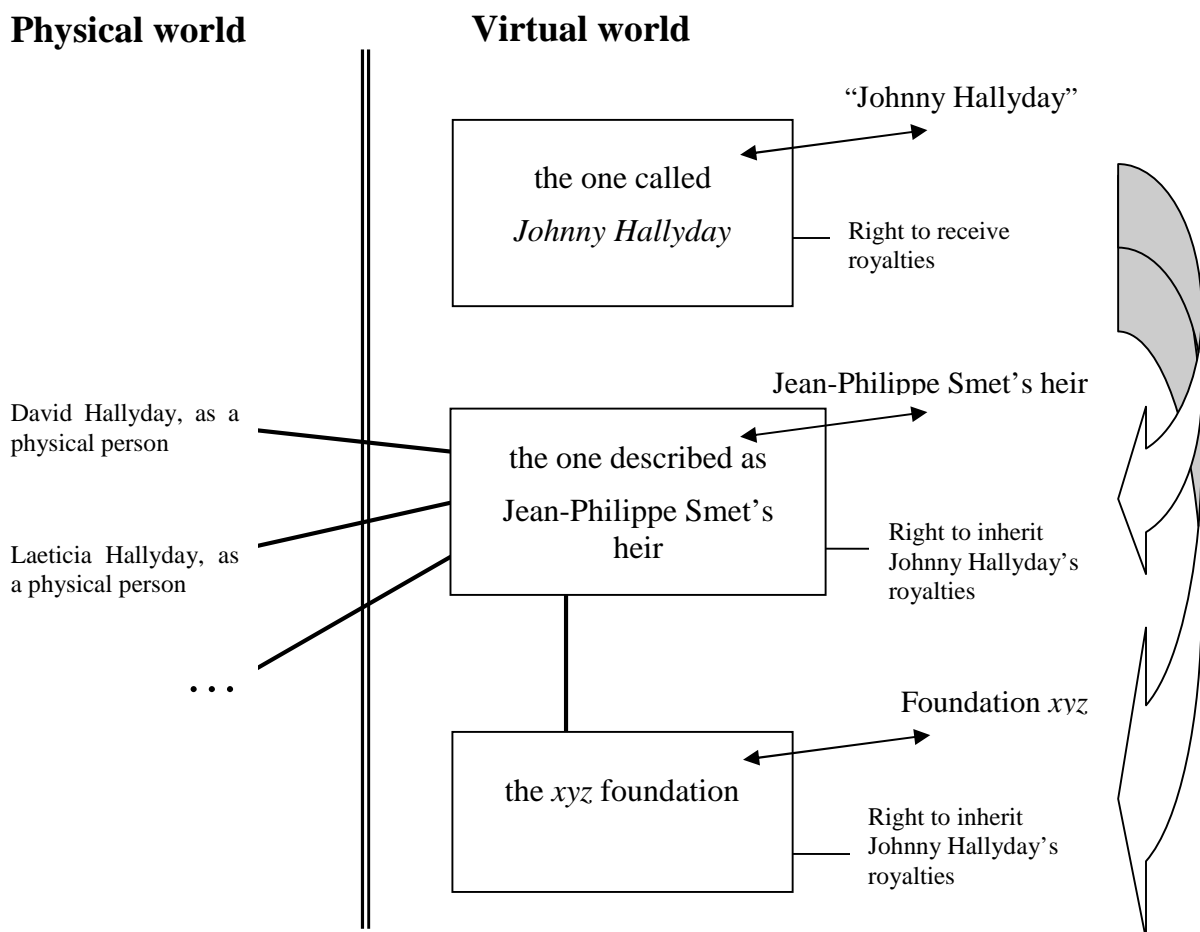


Figure 6: Jean-Philippe Smet’s heir

⁶ Except if another physical person is called Jean-Philippe Smet or Johnny Hallyday.

The above figure could be refined in order to include other, more precise, virtual persons: for example, categories of heirs (wife, children, grandchildren, etc.). Law uses those categories in order to determine the distribution of the heritage if there is no will stipulating otherwise. The model based on virtual persons can catch well this legal mechanism.

2.3 Second case: eBay and Pseudonyms, as anonymizing tools

This case-study focuses on the creation and use of pseudonyms, as anonymizing tools, on the online marketplace eBay. The eBay company offers an online platform for trading items.

2.3.1 Registration

People who want to sell or buy items on eBay first need to register and create a user account. Creating a pseudonym on eBay is required for every person wanting to engage in eBay online transactions, be it as a seller or buyer of goods. During the registration process people have to enter personal information comprised of their real name, address, telephone number, email address, etc. The eBay user agreement⁷ imposes the obligation to enter no false or otherwise misleading data:

“While using the Site, you will not [...] post, list or upload false, inaccurate, misleading or defamatory content (including personal information)”.

- In addition, a “User ID” and a password have to be entered. The eBay User ID acts as an identifier of the eBay customer and thus, according to Pfitzmann/Hansen, as a pseudonym for the partial identity of the user acting in the eBay context and at the same time as an identity attribute. In the model based on virtual persons, we make a distinction between a physical person using an eBay account and the virtual person described as “the one named *CoolDog*” in the eBay context (if *CoolDog* is the User ID), i.e., the eBay customer having this account.

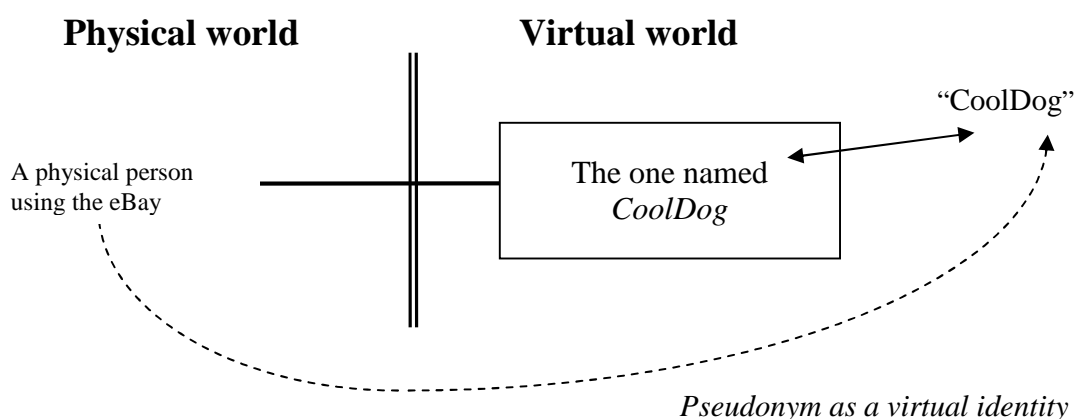


Figure 7: Pseudonym as a virtual identity

⁷See <http://pages.ebay.co.uk/help/policies/user-agreement.html> “using eBay”.

The eBay User ID *CoolDog* is an identifier of this virtual person; it is even its tautological identity. It is

- an *identifier* and *identity* – according to any observer – of the virtual person described as “the one called *CoolDog*” in the eBay context, as well as

a *pseudonym* or *virtual identity* for any physical person using the corresponding account.

An eBay User ID is a unique identifier because no User ID can be chosen twice within the eBay context. The eBay Inc. user agreement prohibits the transfer of eBay accounts and eBay User IDs to another party without the company’s express consent:

“While using the Site, you will not [...] transfer your eBay account (including feedback) and User ID to another party, without our express consent”.

It can be assumed that each eBay User ID refers to exactly one specific holder, taking into account that according to the user agreement the use of group pseudonyms which refer to a set of holders is not permissible. However, in reality and contradicting the user agreement, eBay User IDs are sometimes used by several members of one family or of another group of people.

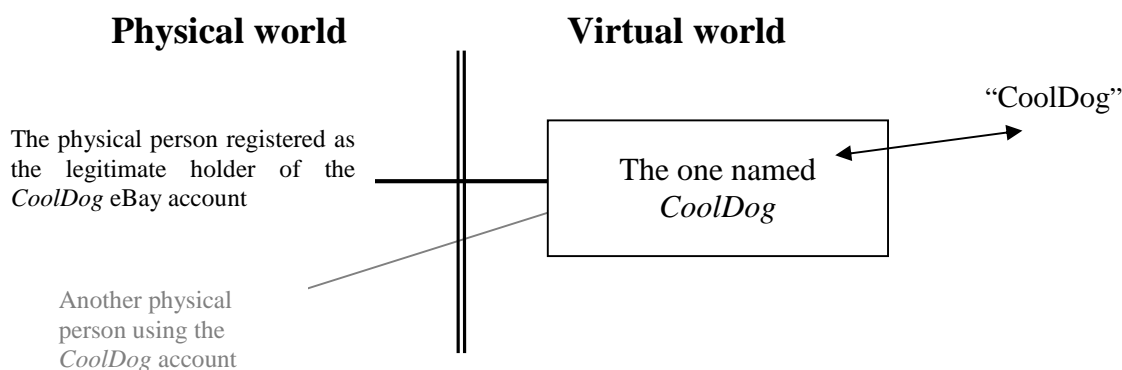


Figure 8: Multiple users

2.3.2 eBay transactions

The eBay Inc. is the identity broker regarding eBay User IDs because the company stores the information regarding the holders of eBay pseudonyms. Holders of eBay User IDs can be identified in different situations. The disclosure of personal information by eBay is explained in the privacy policy. Possible parties that are eligible to receive the personal data of eBay users including the link between a pseudonym and its holder’s real name include:

- other eBay users. For example, where an eBay user is involved in a transaction with another user, the other user may view the email address and obtain the contact information and postal address to help complete the transaction;
- eBay Europe S.à r.l. and eBay Inc. for the purpose of providing the eBay services;
- law enforcement agencies, other governmental agencies or third parties in response to a request for information relating to a criminal investigation, alleged illegal activity or any other activity that may expose eBay, the customer or any other eBay user to legal

liability. The personal information eBay discloses may include the User ID and User ID history, name, city, county, telephone number, email address, fraud complaints and bidding and listing history or anything else that eBay deems relevant.

While an item is offered, all eBay users and non-registered visitors of the marketplace can view the seller's User ID and usually the User ID of the highest bidder. Only the buyer of an item receives an automatically generated email containing the seller's real name, and address. The seller receives the buyer's real name and his or her address.

2.3.3 eBay reputation system

The eBay platform uses a reputation system in order to establish trust where users have to make transactions with pseudonymous strangers [Steinbrecher 2007]. The reputation system (called "feedback profile") collects experiences of former eBay transaction partners. When trading on eBay, users have expectations with regards to the obligations the transaction partner should fulfil. The main obligations with regards to the seller are:

- the sold item corresponds to the description given by the seller and is in the condition and quality described by the seller,
- the item is sent in due time after payment was received and is wrapped accurately.

The main obligation with regards to the buyer is:

- execute the payment in due time.

A user who fulfils the expectation of the transaction partner is regarded to be trustworthy and this is reflected on the feedback that they receive. Indeed, feedback within the eBay reputation system is considered to be the most critical element for enhancing trust, according to a wide survey carried out on this matter by [Pavlou 2002]. Users expect eBay users' behaviour in former transactions to correspond with their behaviour in future transactions [Resnik 2006].

2.3.4 Representation in the one-to-one model

The one-to-one model not only supposes that to each eBay User ID corresponds a unique physical person; it also implies that a specific physical person cannot have two or more different eBay User IDs. This is far from faithfully representing the reality of the eBay platform.

2.3.5 Representation in the one-to-many model

The one-to-many model corresponds to the ideal situation in the view of eBay Inc. Actually, eBay regulations tend to force physical persons using this service to be compliant with the one-to-many model:

- the same physical person can have several eBay User ID, but
- only one physical person is allowed to use one specific eBay User ID.

This model makes it easier for eBay Inc. to link an action in an auction with one specific physical person. This person, according to the user agreement, is held responsible for this action.

However, as it has been noticed, in reality and contradicting the user agreement, eBay User IDs are sometimes used by several members of one family or of another group of people. The one-to-many model can not catch this fact.

2.3.6 Representation in the model based on virtual persons

In Figure 9, we represent an eBay customer (whose eBay User ID is “CoolDog”), in the light of virtual persons: The eBay Company knows personal information about this physical person (name, first name, postal address, etc.). All this information is stored and linked to “The holder of the *CoolDog* account”.

According to the eBay user agreement, the virtual person “The one called *CoolDog*” and the virtual person “The holder of the *CoolDog* account” must both represent the same, unique physical person.

However, in reality and contradicting the user agreement, eBay User IDs are sometimes used by several members of one family or of another group of people. The model based on virtual persons has no difficulties to catch this reality. Indeed, in this model, nothing prevents several physical persons to share the same pseudonym, i.e., to be represented by the same virtual person. Figure 9 illustrates this situation. The identifier *CoolDog* is a pseudonym for two physical persons using the *CoolDog* eBay account.

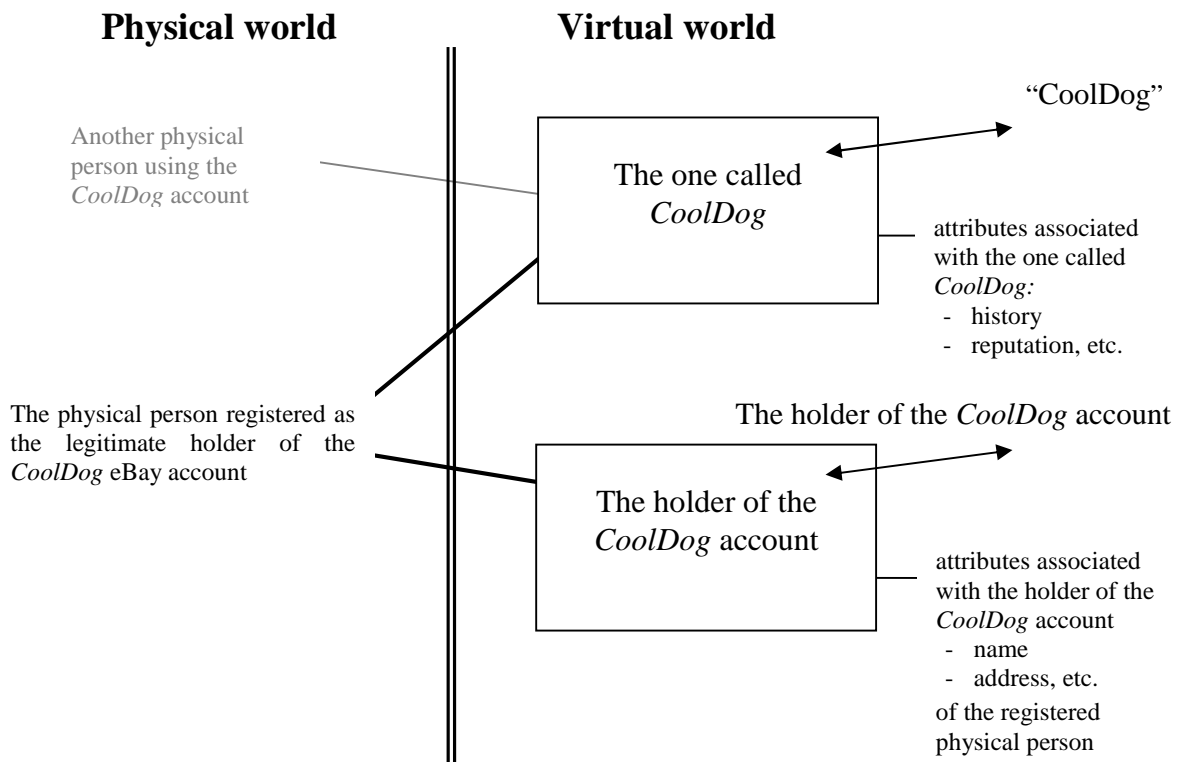


Figure 9: *CoolDog*, an eBay pseudonym

Such a situation can be represented neither in the one-to-one model, nor in the one-to-many model.

“The holder of the *CoolDog* account” is held responsible for any action of “The one called *CoolDog*”. In case of a fraud, attributes of “The holder of the *CoolDog* account” can be revealed in order to eventually transfer the responsibility to the physical person registered as the legitimate holder of the *CoolDog* eBay account.

When the personal information about the legitimate holder of the account is revealed, the link between this physical person and the virtual person “The holder of the *CoolDog* account” is made visible. The responsibility is transferred to the physical person registered as the legitimate holder of the *CoolDog* eBay account independently from who has really initiated the action.

The model based on virtual persons emphasizes the fact that the physical person held responsible for an action and the physical person that has caused this action are not necessarily the same. Indeed, in the eBay platform, the responsibility is automatically transferred according to the model imposed by the user agreement.

Eventually, the same physical person can have two (or more) different eBay User IDs. For example, *CoolDog* and *HotCat* could both be pseudonyms representing the same physical person. The one-to-one model cannot catch this fact. However, both the one-to-many model and the model based on virtual persons can faithfully represent this case. Figure 10 illustrates this situation in the light of virtual persons:

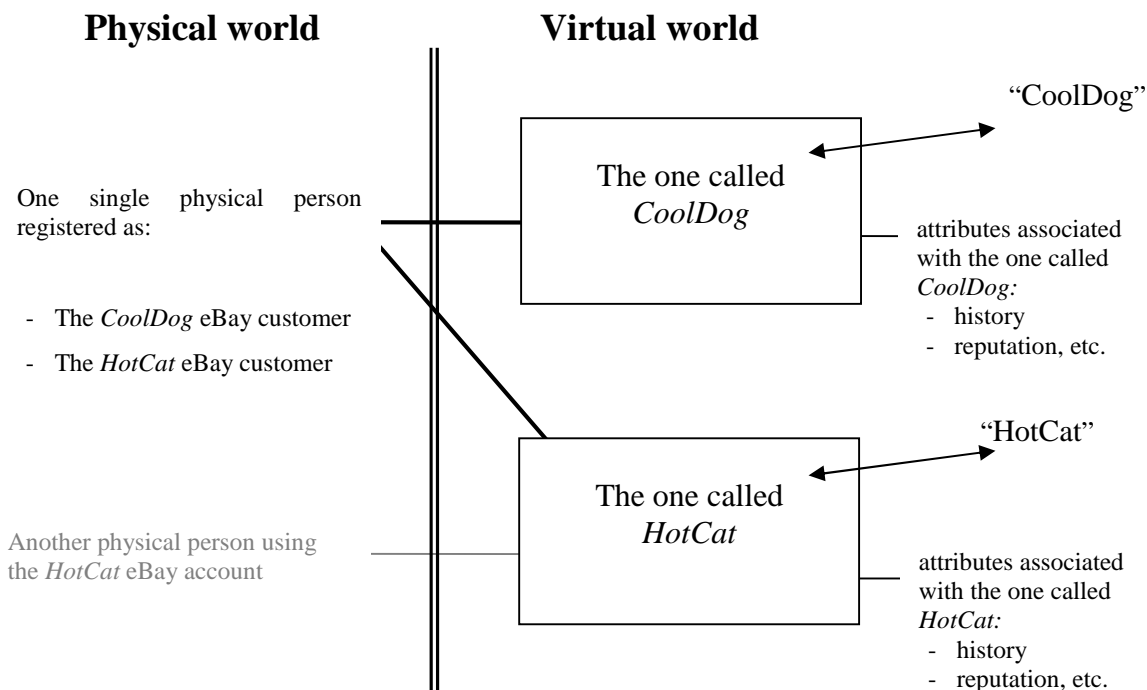


Figure 10: “CoolDog” and “HotCat”

2.4 Conclusion

Everything that can be represented in the one-to-one model or in the one-to-many model can of course be described in the model based on virtual persons which is a time-dependant many-

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to-many model. Therefore, the model based on virtual persons is more general than the two others.

For pseudonyms, our model developed in FIDIS deliverable D2.13 can be interpreted in some aspects as a refinement of Pfitzmann and Hansen's approach. Our model uses abstract entities, called virtual persons, to tie a pseudonym to an entity that can exist independently of any physical entity and survives the physical person(s) using this pseudonym.

In our model, a pseudonym is a special kind of *identity*. It is the (tautological) identity of its corresponding virtual person "The one called by this pseudonym" as well as a *virtual identity* for any existing entity/entities using this pseudonym.

Moreover, our model also catches some typical legal mechanisms: categorizing entities in order to specify how law applies. The widespread use of pseudonyms on the Internet makes the link between an action (or a transaction) and the physical person who has initiated this action (or transaction) invisible for most observers. How do we deal with this new reality, when no physical person can be linked with a reasonable amount of effort to an action (or a transaction) or an event? *Who* is responsible or will bear the (legal) consequences? New forms of unlawful activities take advantage of these grey zones, where the law is (theoretically) applicable but not enforceable anymore. The concept of virtual person allows to give rights strongly related to the pseudonym itself (for example, the right to receive royalties), which remain valid even when the physical person using the pseudonym does not exist anymore. What about obligations and responsibilities? Could we attribute responsibilities or obligations directly to the virtual entity defined by a pseudonym in some contexts for example? These questions will be discussed further in FIDIS deliverables D17.2 "New (Id)entities and the Law: Perspectives on Legal Personhood for Non-Humans" and D17.3 "Abstract Persons and the Law: New Perspectives".

3 Avatars and Virtual Identities

3.1 Introduction

Before an examination of the implications of ‘identity’ in relationship with *avatars*, it is important to reflect on the concept of the *avatar* itself, examine its origins – briefly – and ponder some of the attributes that avatars may be associated with. This section therefore has three intertwined roles: firstly, to review the concept of the avatar and present the attributes that are mostly relevant for the case of avatars; secondly, to discuss the applicability of identity models in the case of avatars; thirdly, to provide reflections on the different aspects of avatars that may be used to reflect on the concept of identity itself.

The word ‘avatars’ in itself has been used in a number of contexts and its origins have been different from one of its current attributions to *participatory forms* in online games known as MMORPGs (Massively Multiplayer Online Role Playing Games) or other virtual worlds.⁸ The word avatar in itself has its origins to Hindu philosophy and is in fact derived from the Sanskrit word *avatāra* which implies a ‘descent’ or ‘manifestation of the divine in human form’.⁹ The importance of this primordial concept around avatars should not be missed as it involves a number of elements that are relevant to an examination of the identity problems surrounding it. Most of all, it entails the processes by which an avatar is created, its representation, and also, function. In a computing environment, an avatar constitutes a virtual form of an entity that participates in a designed computing environment in 3D, or in simpler 2D forms, or even in forms delimited to text-constructs.

Different forms of avatars can be examined within the context of theological discussions but this would diverge from the purposes of this section. Nevertheless, this primordial form of definition for an avatar that discusses concepts of descent or manifestation of the divine in human form is what may lead us to examine the process that is implicated in the identity-attributes of an avatar. First of all the process of *descent* implies that an alternative *form* of identity is created from the original form. This implies that the alternative form is not only stemming from the original form but that the identity of the alternative form becomes dependent on the properties that construct the avatar (and those that either perceive or control the possibilities for the avatars’ characteristics). The process of *descent* in the form of an avatar is what leads to an acceptance of a process of *disembodiment*. This implies that the alternative form by which the process of descent becomes possible, generates the potential for the *disembodiment* of the original form and therefore we can observe a self-referential process by which *identity* comes out of *identity*. Identity in this regard can be thought of as a self-referential system.¹⁰

This brings us further to the concept most relevant to this section, the concept of digital avatars that can be considered to be a more refined form of avatars. A connection between the concept of ‘avatar’ and ‘digital avatar’ needs to be further elaborated. Whereas an ‘avatar’ is an entity describing the process of descent and embodiment into another form, the concept of the ‘digital avatar’ moves on to describe (also originating from the same Hindu tradition), the

⁸ For further information on virtual worlds the interested reader may refer to <http://www.virtualworldsreview.com/> as an example

⁹ Parrinder, G. (1970). "Avatar and Incarnation." *Faber and Faber, London*: p13-14, 19-22.

¹⁰ Luhmann, N. (1995). *Social systems*. Stanford, Calif, Stanford University Press

phenomenon of *amshas*, a concept that focuses primarily on the *simultaneous existence of 'the god himself as well as the incarnation'*.¹¹

This simultaneity in the existence of both forms at the same time, despite the disembodiment that takes place both via the concept of the 'digital avatar' (as well as that of the 'avatar'), stands crucial in examining identity implications for digital avatars themselves. Despite the fact that a striking analogy can be attempted here in order to indicate and highlight the simultaneous presence of a person in the physical world *and* in the cyberspace, the degree to which this process implies identity characteristics (and what those characteristics precisely are) remains ambiguous. Also, if we are to examine the case behind the digital avatars and the implications for identity then we have to stress that digital avatars are not based upon a variety of other technologies like virtual robots; in this regard, a physical person would be behind the control of the avatar's digital mask. This acknowledgment of a one-to-one relationship between a physical person and its avatar does nothing to reduce the underlying complexity that comes into play (as we shall see in a moment). In fact, as it is subsequently demonstrated, the presupposition behind a one-to-one relationship between a physical person and its avatar seems to be restrictive.

3.2 Identity Implications for Digital Avatars

Informed by FIDIS deliverable D2.13 on Virtual Persons and Identities, this section describes the potential of framing the case of digital avatars with constructed relationships on identity. Elements or characteristics that are implicated in the relationships are further elaborated. On the basis of an initial hypothesis that was previously articulated, we shall commence the examination on the relationship between identity and digital avatars. This initial hypothesis frames the connection between a physical person and its identity/identities. Each avatar has a unique tautological identity that is constant over time. This is a virtual identity for any physical entity controlling the avatar.

However, partial identities of an avatar evolve according to its involvement and its experience in a game/virtual world. Note that any partial identity of an avatar is the tautological identity of another virtual person linked to this avatar according to the model defined in FIDIS deliverable D2.13. It is therefore a virtual identity for this avatar. In term of the model based on virtual persons, the construction of the avatar-partial-identities (its virtual identities) is reflected by the evolution of time-dependant links between this avatar and other virtual persons.

In the context of avatars, we have therefore two different kinds of virtual identities:

- The tautological identity of an avatar is a *virtual identity for any player/user* controlling this avatar (see Figure below);

¹¹ Damer, B. (1997). "Avatars! Exploring and Building Virtual Worlds on the Internet." Peachpit Press, Berkeley.

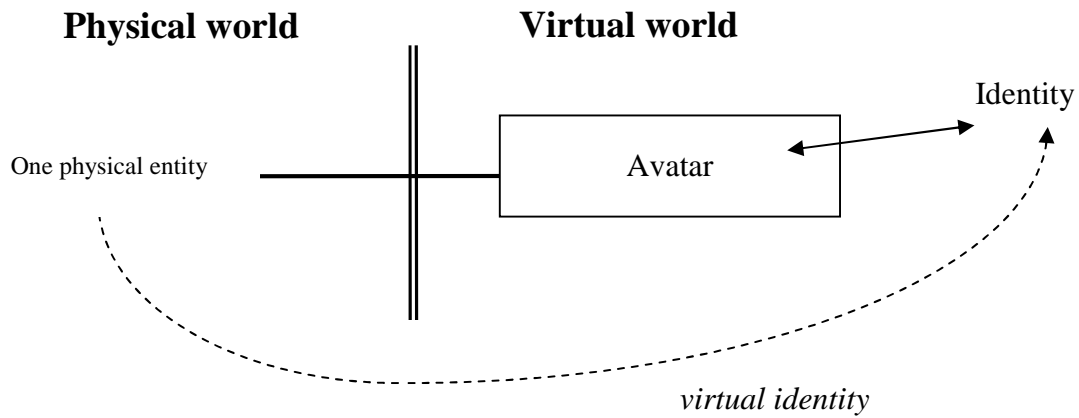


Figure 11 : The (tautological) identity of an avatar

- each partial identity of the avatar is a *virtual identity for this avatar* (i.e., the identity of another virtual person linked to this avatar, see Figure below).

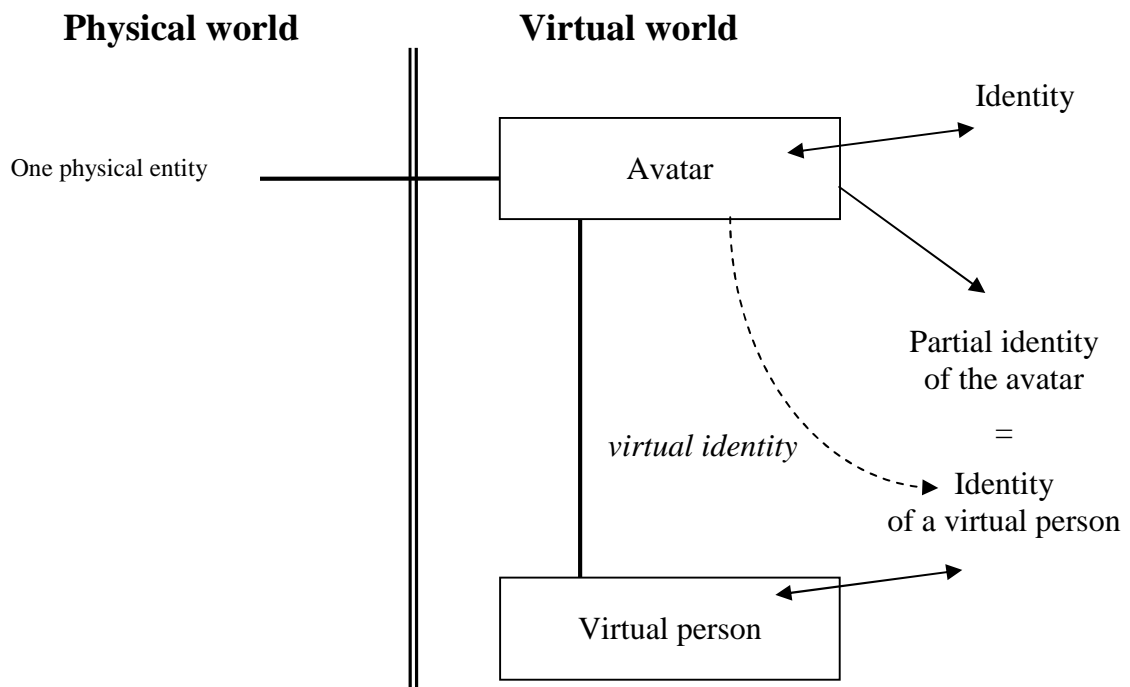


Figure 12 : A partial/virtual identity of an avatar

Furthermore, it is suggested in the literature that a physical person needs to be in control of the digital avatar; this connection, according to the form of the initial identity model presented within FIDIS deliverable 2.13 is contested in the figure below which not only poses the possibility of two different players gaining control of the same avatar (and subsequently

controlling its partial identities) but the possibility also that a computer program can be controlling a digital avatar and therefore its partial identities too.

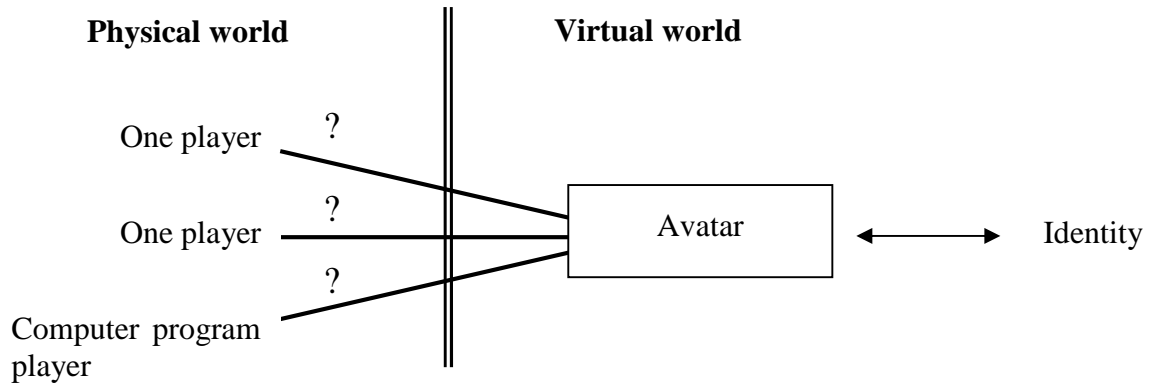


Figure 13: Connection between the physical world and the virtual world in the case of avatars

Two questions immediately arise regarding the applicability of the aforementioned figure:

- a) Is it possible to consider the control of the partial identities of a digital avatar or of the digital avatar itself by different physical persons (i.e. players in the context of MMORPGs)?
- b) Is it possible for a computer program to control a digital avatar and the evolution of its partial identities?

While the answer to both of these questions may appear to be in the positive, there are a few interesting complications that are worth considering.

In the case of the digital avatar, we cannot consider different players gaining access to the same avatar at the same time since this form of access is typically restricted by the rules imposed by the designers of the MMORPGs. This restriction in the form of access of the avatar does not in any way contradict the appropriation of a user's identity by other users (or even the deliberate transfer of a virtual identity from one physical person to another). An avatar owner could make it appear as if another player is performing such actions, particularly since these actions are further restricted by the avatar-roles that are prescribed by computer programmers. But this case would classify as a form of virtual-identity-fraud. The process of a number of physical persons controlling a single avatar simultaneously would remain dysfunctional in the control of the avatar itself if the possibility arose. This is one way of looking at this particular aspect. An alternative interpretation emanating from the perspective portrayed in the previous figure would imply that different persons or a computer program may gain access to *a single avatar*. Following these two interpretations, we may synthesize them in reflecting on the *relationship between entities in the physical world themselves* that affect the relationship between a physical person and a digital avatar. What is therefore indicated as 'one player' within the aforementioned figure and 'one player' again in order to repeat a different physical person that has access to the virtual world of avatars (regardless of the fact that this access may be a one-to-one relationship or not) *allows to encapsulate special*

relationships that can be established between ‘one player’ and ‘one player’. Far from being trivial, these relationships not only redefine the construction of the avatar-partial-identities but they also have an impact on aspects like the *economic rational with which digital avatars operate*.

One such atypical example underpinned by the relationship between ‘one player’ and another player of the same ontology (‘one player’) is the mutation of the *economic divide* between developed and developing countries. Why this is so is described straightaway.

Within the structure of MMORPGs that are constructed for the purpose of creating a variety of roles for the digital avatars that participate in these platforms, a number of roles require the avatar to be skilled. Whether this *initial introduction of complexity* into the gaming platform is necessary for creating the initial momentum of users is another matter but the fact remains that every digital avatar has specific skills; these skills have to be developed in order for the avatar to perform better in certain tasks and engage in more ‘meaningful’ ways of participation within the game. These skills are therefore developed gradually as the user participates in the game, and consequently, they require a considerable amount of time in its initial stages. The economic aspect of globalization (that is controversial enough as it stands in current debates) is then mutating in the virtual sphere. One player coming from a developed country that seeks to engage into more structured economic activities within the MMORPG is *outsourcing his/her avatar (and hence outsourcing the digital representation of himself/herself)* to another player from a developing country that is entrusted with the virtual identity with the purpose of building up the avatar’s skills before transferring it back to its ‘rightful’ owner. This may of course be done in breach of a non-transferable right of avatar according to the companies behind MMORPGs but it does have implications on how avatar-partial-identities are built, and also, on how the relationship between physical and virtual persons (in the case of avatars) is established. Underpinned by an economic rationale, it does bare a considerable implication on the *economic exploitation* on the back of economic globalization; as the digital avatar is outsourced to other players (mostly China and India), these players are paid a very small amount of money in order to build the avatar’s skills and then pass it over to the original owner. This occurrence implies that the relationship between players connected to the same digital avatar may acquire more complex characteristics than the simple projected one-to-one relationship between physical person and digital avatar. This complexity in the relationship (underpinned in this example by an economic rationale) modifies the strength of the relation between partial identities of a player and partial identities of an avatar controlled by this player.

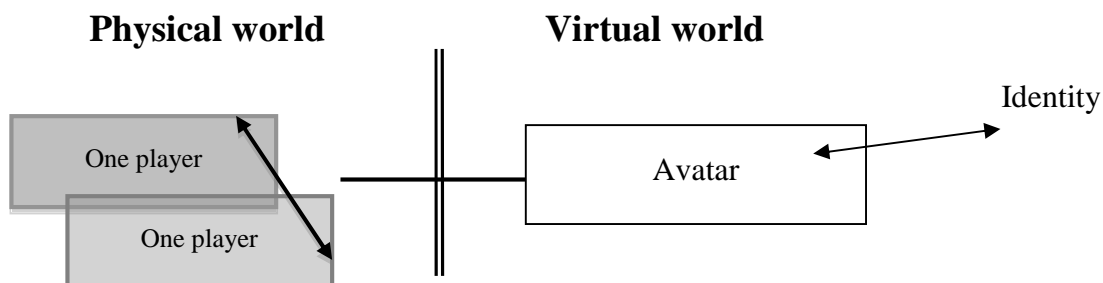


Figure 14 : Relationships between players in the physical world

A simple raw-transaction dataset analysed below, based on data from Second Life, indicates that the volume of economic activity can assist further in elaborating the point that further forms of identity-interchange and manipulation will evolve on the basis of rationalities that could be economic or otherwise. In the table provided below, it becomes evident that the mass volume of the transactions that take place are in low-value virtual currency. Nevertheless, the volume of such low-value transacting is so large (when compared to the total number of virtual persons online) that high-frequency activity is suggested. Furthermore, while the decrease in volume of transacting as the transaction size increases is something to be expected, it is important to stress that only within February of 2008, more than 20,000 transactions took place in the region of 20,000 to 99,999 Linden Dollars.¹²

Resident Transactions by Amount (2008 February)

Transaction Size	Volume
1L\$	4,325,219
2 - 19 L\$	4,748,368
20 - 49 L\$	1,913,128
50 - 199 L\$	3,029,952
200 - 499 L\$	1,420,402
500 - 999 L\$	490,530
1,000 - 4,999 L\$	468,275
5,000 - 19,999 L\$	90,456
20,000 - 99,999 L\$	20,753
100,000 - 499,999 L\$	2,807
>= 500,000 L\$	266
Total Transaction Count	16,510,156

This fertile ground for economic activity, which could be portrayed as a function of the virtual identity, does not only materialise online as an economic by-product of the control of the avatar but may also feed back to the development of virtual identities themselves. An example has already been discussed with the outsourcing of virtual identities and the interactions that this outsourcing presupposes on the back of economic globalization. A series of other implications may also come into play: online fraud, virtual identity theft feeding back to real identity theft if sufficient *identity functions are considerably fulfilled within the auspices of the online space*, money-laundering, etc. Within this dynamic, the potential processes between real identity theft and virtual identity theft become more problematic and as indicated in the previous sentence, the gravity of the interplay becomes dependent upon the identity functions that are considerably (or not) fulfilled within the auspices of the online space.

How these functions relate to partial identities of the players is another matter and what links could be attempted to social, economic or even political expressions of interconnections

¹² Interestingly enough a virtual exchange rate has been introduced for this purpose which implies that a number of technological effects take place that may go unnoticed. The key question here is *how is the virtual economy manipulated algorithmically?*

would require a considerable analysis on the basis of ‘virtual ethnographic’ studies. Nevertheless it becomes evident that the interactions are complicated on the basis of the possibilities raised within an MMORPG in the case of avatars. This possibility is further related to the second question that was raised regarding the relationship between *a computer program* and an *avatar* and to what degree it is possible for a computer program to control an avatar. The simple answer would be yes; it is obvious that the very nature of avatars implies that there is a clear potential of them being controlled by computer programs. As indicated within FIDIS deliverable D2.13, this is established as follows:

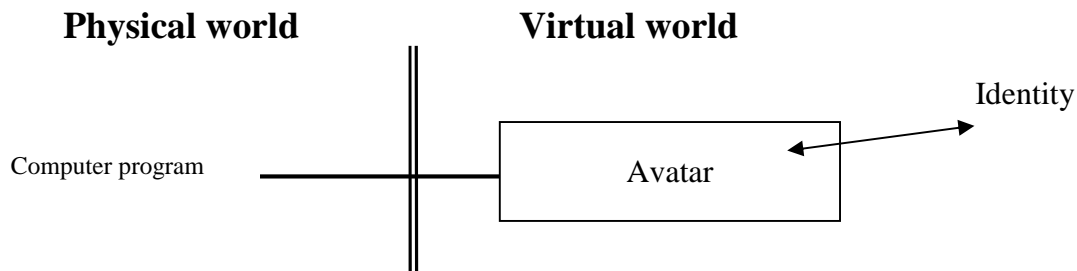


Figure 15 : Computer program controlling an avatar and hence manipulating the partial identities that can be ‘attached’ to this virtual person

Here *computer program* stands for the physical instantiation of an abstract algorithmic representation. While the nature of the above interaction where computer programs control the partial identities of an avatar and their development may appear to be obvious, still, it raises a set of interesting questions that need to be pondered. Even more importantly, it *influences the relationship established between physical and virtual worlds and emphasizes the malleability that this relationship*. Since the algorithmic representations that govern a computer program are virtual in themselves then the manipulation of an avatar by a computer program shows how the virtual world can influence itself, and how identities are built and developed within the virtual world, through the use of a physical tool.

The form that this interaction may assume within the context of avatars is quite straightforward (if we are to take the example of MMORPGs). Computer controlled avatars *mediate* well-specified interactions between *avatars* controlled by physical persons and themselves. Alternatively, computer controlled avatars may be utilised in order to interfere with structural interactions between human-controlled avatars. These possibilities where the manifestations of an avatar’s partial identities become reconstructed on the basis of further possibilities and interactions, or where interference is created amongst them, creates further elusive characteristics to “identity” itself.

A further interference comes into play here; one that is equally important even though it can be attributed as an opposite effect.¹³ In the physical world, manifestations of identity-related

¹³ There is a number of interesting possibilities here to rise but one way of looking at this would be as a new paradigm for human-computer interaction with its effects on “identity” itself. Within this new paradigm human-computer interaction, we have the situation where humans are guided and controlled by the computer. This ‘control’ can be viewed in the operative sense (see *Petriu, E.M and Whalen, T.E. , Computer-controlled human operators* ,IEEE, Instrumentation & Measurement Magazine, Vol.5, Issue.1, 2002) but it can also be viewed as a necessary reduction in complexity which is occurring.

information or engagements that require the use of one's identity-related information are generated spontaneously from the physical persons that willingly engage into such interactions (as needed). Some of them are of course imposed by regulatory forces, etc., but nevertheless they require the engagement of the physical person for the construction of the partial identities to begin with.

In the context of avatars in the case of MMORPGs, this creates an inversion within the construction of partial identities. A series of instantiated virtual persons (e.g. computer programs) are involved in the construction of *the potential through which the avatar-partial-identities* can be manifested and this restriction imposed by the designers is ultimately delimiting the interplay between the partial identities of a physical entity and the partial identities of an avatar controlled by this physical entity. In most cases, the roles of the *form that an avatar may take* are delimited by prescribed classes of avatar-partial-identities and these in their turn, come to host the interaction and the relationship between partial identities of both worlds.

Nevertheless, within modernity, the primary function that any systems seek to fulfil is the function of communication. This implies that even though predetermined classes of avatar-partial-identities may be constructed for those that participate in avatar-form-games/virtual-worlds, communication is still facilitated through the primary notational schemas that are utilized in the real world (e.g. language here being the most obvious). These forms of communication that play an integral part in solidifying the "identity" of a person in the real world come to transcend to the virtual world by means of interoperation (the prestructuring of interactions between physical/virtual world). The manifestations of an avatar's partial identities that enrich this single entity become much more than an abstract extension of a physical person that resides in a virtual/online space.

An avatar becomes a virtual abstraction of a physical person that inherits sociological characteristics and participates by well-established forms of communication in the virtual structures that become available. In this sense, attributes that may characterise a physical person sociologically, can be extended and considered within the realm of virtual persons. Legal and economic functions that shape important interactions in the physical world come to re-create the virtually-social capacities of an avatar. This has of course been the case in a number of virtual fraud cases, or even investments of real money into the virtual space. These attributes that come to define to a large extent the functions that an individual holds within society, come to feed back to that person's utilization of its own abstract representation.

As demonstrated in the figure below, things can get even more complicated when one considers the possibility of one physical person controlling multiple identities in the virtual world.

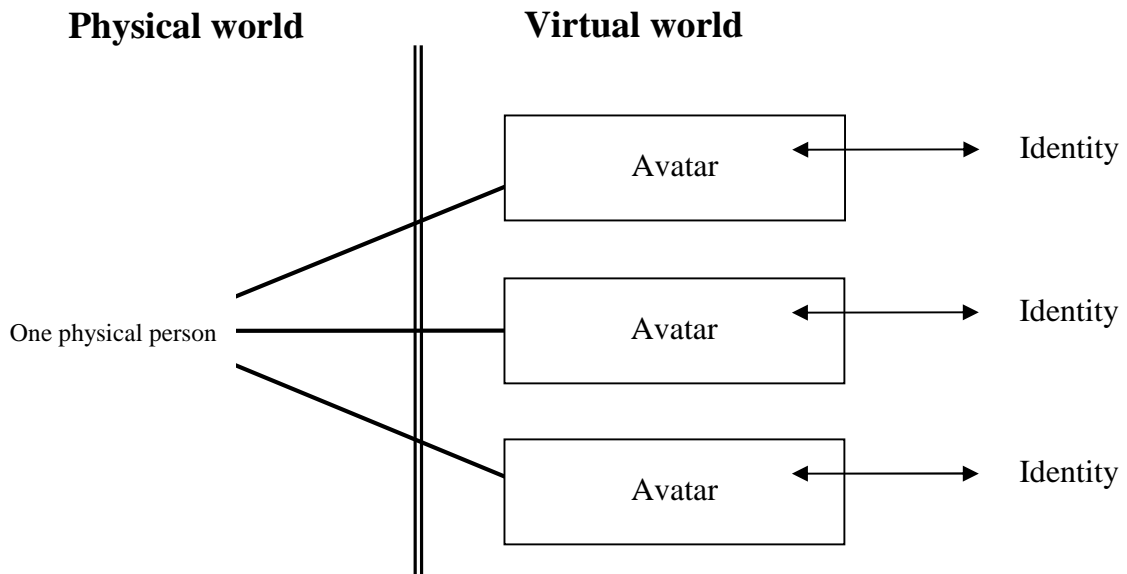


Figure 16 : Multiple avatars of the same physical person

This possibility implies of course a number of issues. In the case of MMORPGs, there is typically a provision of providing “real” identity information for the physical person before one is allowed to create a virtual person, in order to prevent a physical person from creating more than one virtual person in a specific virtual environment. At least, this appears to be the request from the owners of the virtual world. In reality, there are occurrences where “real” identity information becomes ambiguous (e.g. in the case of a dual citizenship for instance) even though such information is attached to a unique physical person. Since there is no efficient and reliable way of controlling the independency of “real” identity information, a multitude of virtual persons can be created which can then be utilised for performing virtual-sociological functions within the virtual space they come to participate. Furthermore, virtual persons controlled by the same individual in the same online space can be utilised to perform specific functions that could ultimately lead to a manipulation of the virtual space, either through fraud or through attaining virtual persons for context-specific purposes which could vary from one MMORPG to another.

4 Categories and Profiling in the Light of Virtual Persons

Many applications already use intensively profiling techniques in the information society. The importance of profiling techniques might still drastically increase if the AmI (Ambient Intelligence) space becomes once a reality.

Individual profiling is used either to identify an individual within a community or just to infer his/her habits, his/her behaviour, his/her preferences, his/her knowledge, his/her risks, his/her potential or other social and economic characteristics. Forensic individual profiling, for example, covers both aspects. Commercial individual profiling on the other hand is more interested in the second one, the inference of knowledge or rules about the individual.

Group profiling is used either to find shared features between members of a predefined community or to define categories of individuals sharing some properties. Forensic group profiling could, for example, find common characteristics in the community of convicted murderers or define risk categories of individuals. More generally, group profiling often raises ethical issues as it can lead very quickly to discrimination for example. A recent enough example has been the introduction of legislation on terrorist financing where financial institutions were forced to adopt profiling technologies and engage into group profiling of individuals that could be associated with the financing of terrorism. Even though the regulatory initiatives have provided an abstract description on this matter, practice differs and individuals from a Muslim background appear to be targeted more frequently.

Data mining techniques help to find correlations between large sets of data collected about groups of people. These correlations might allow in turn the creation of categories: for example individuals sharing some attributes, having some habits or preferences, earning more than €50'000 a year, etc. Profiles are defined by associating knowledge with each category.

Each defined category can be virtualized in a generalized category (a virtual entity), defined by the properties identifying¹⁴ the original category; it inherits the profile of the original category. Generalized categories as virtual persons acquire their own existence, which no longer depends on any specific, original categories.

The traditional one-to-one and one-to-many models cannot describe the link between individuals and categories. Indeed, several individuals might belong to the same category and the same individual usually belongs to several categories.

A detailed description of categories and profiling in the light of virtual persons is given in the answer provided in Chapter 2, by David-Olivier Jaquet-Chiffelle, in [Hildebrandt 2008]: Direct and Indirect Profiling in the Light of Virtual Persons. For copyright reasons, we refer the interested reader directly to the original text.

¹⁴ Those identifying properties become the tautological identity of this generalized category, i.e. of this virtual entity.

5 Unborn or Dead Entities

In this chapter, we explore the concept of virtual persons from a legal perspective. We apply the chosen models on entities before or at the beginning, as well as after the end of their (human) life.

5.1 Unborn Human Entities

Law recognizes a capability to be subject of rights and duties to unborn human entities for some special and restricted purposes. We analyse and discuss this topic in the light of the model of virtual persons as developed in FIDIS deliverable D2.13. According to the definition given there¹⁵ a *virtual person* is a virtual entity that can have rights, duties, obligations and/or responsibilities associated to it in a certain context. We will therefore concentrate on contexts in which it is possible for unborn entities to be subject of rights or duties and which may raise identity-specific issues.

Unborn possible subjects of rights are the *nondum conceptus* and the *nasciturus*. The *nondum conceptus* describes the not conceived person, who is acknowledged in law as a possible heir or beneficiary of a third party's contract. The *nasciturus* is the conceived but not yet born entity which in many jurisdictions is already treated as an heir under the condition of being born alive later. Humans do not gain full legal personhood until birth¹⁶ or in some jurisdictions up to 24 hours after birth.¹⁷

5.1.1 First case: Nondum Conceptus

The *nondum conceptus* is a legal figure that allows addressing future rights to a child that may be possibly conceived and born in the future. Legal personality is unthinkable at this stage. Indeed, the particular human being must at least be created to some extent; this is a fundamental prerequisite to be recognized as legal subject.¹⁸ Nevertheless, *nondum concepti* have some limited opportunities to gain rights, in particular as a possible heir or beneficiary of a third party's contract.¹⁹

At the time of observation, the physical entity involved is still a cell in the ovary of the mother, a maybe still to become sperm cell or may be a fertilized cell (zygote) outside of its mother's womb. These circumstances raise the difficult question as to whether there is a physical entity at all and at which stage of development we could speak about the beginning of a personality. However, the proposed model of virtual persons may be able to leave this philosophical and theological question open.

¹⁵ See FIDIS deliverable D2.13 "Virtual Persons and Identities" p. 35.

¹⁶ Gödde 2000; for examples see Germany, § 1 BGB (Bürgerliches Gesetzbuch).

¹⁷ In Spanish law gaining legal personhood requires a human shape (*figura humana*) and survival over at least 24 hours after cutting the umbilical cord, art. 30 Código Civil. See also Mahr 2006: 256-260. For an analysis of legal personhood in the context of the model of virtual persons, we refer the reader to FIDIS deliverable D.17.2 "New (Id)entities and the Law: Perspectives on Legal Personhood for Non-Humans".

¹⁸ This holds true for all jurisdictions. Heldrich, Steiner 1995: para. 2-7.

¹⁹ Most jurisdictions accept *nondum concepti* as beneficiary of a bequest; civil law countries also allow rights of third party's contracts, and in common law jurisdictions *nondum concepti* may become the beneficiary of a trust. For further information see Heldrich, Steiner 1995: para. 7-5 including many references to European and North and South American legal regulations. For Germany see §§ 2101, 2106 sec. 2, 2109 sec. 1, 2162, 2178 BGB.

The legal concept of the *nondum conceptus* maps rights and duties to a not yet (really) existing physical entity. The legal concept therefore postulates a virtual entity which is capable of bearing rights. This however, is the exact definition of a virtual person and it is possible to describe the legal concept of a *nodem conceptus* as a virtual person. The raised question as to whether a not yet created human being constitutes a physical entity does not need to be answered as the model can flawlessly describe the legal fiction within the virtual world. It is interesting to note that, contrarily to the model based on virtual persons, traditional ID-models have difficulties to represent such a legal fiction.

John I's potential first grandchild

In this case-study, John I wishes to become grandfather and hopes that his line of blood will be perpetuated. His three daughters are over 30 years old already, well established and successful in their jobs. Therefore John I decides to set up a will in which he divides his property among his daughters. Regarding his stock portfolio however, he stipulates the following clause in his will: "The stock portfolio shall be administered by my daughters and shall be given to my first grandchild upon its birth. If no grandchild is born by the 40th birthday of my youngest daughter, the money shall be transferred to the kindergarten of the local church."

We may assume that such a stipulation is legally valid. As the stock portfolio cannot be without an owner and the not yet conceived baby does not have legal personhood, the legal systems stipulate different solutions for the time until birth: some trust construction, some kind of agency or stipulating a preliminary heir which is subject to restrictions and obligations in regard to the respective legal estate.

The traditional one-to-one, or one-to-many, or even many-to-many models cannot catch this reality, as initially a physical person is missing and it is unclear whether there will be a physical person matching the stipulations in the will of John I at any given point of time. No link might ever exist to the physical world, as no physical person linkable to the described identity might ever exist, even though the possibility of that person's existence has been accounted for.

The model based on virtual persons is a time-dependent m-to-n model, where null is a possible value both for m or n. The model differentiates between the physical and virtual world. For any specific point in time, the collection of all existing physical entities is called *physical world* and the collection of all virtual entities is called the *virtual world*.²⁰ The dualistic separation between the worlds is interconnected by individual links between physical and virtual entities, which may appear or disappear over the course of time. Due to its time dependency, the model of virtual persons is able to appropriately describe this use-case. Even if at the time John I drafts his will it is not yet foreseeable whether he will ever have a grandchild, the virtual person describing the entity that might become John I first Grandchild, i.e., "The first grandchild of John I", already exists as a virtual entity.

²⁰ FIDIS deliverable D2.13 "Virtual Persons and Identities", p. 41

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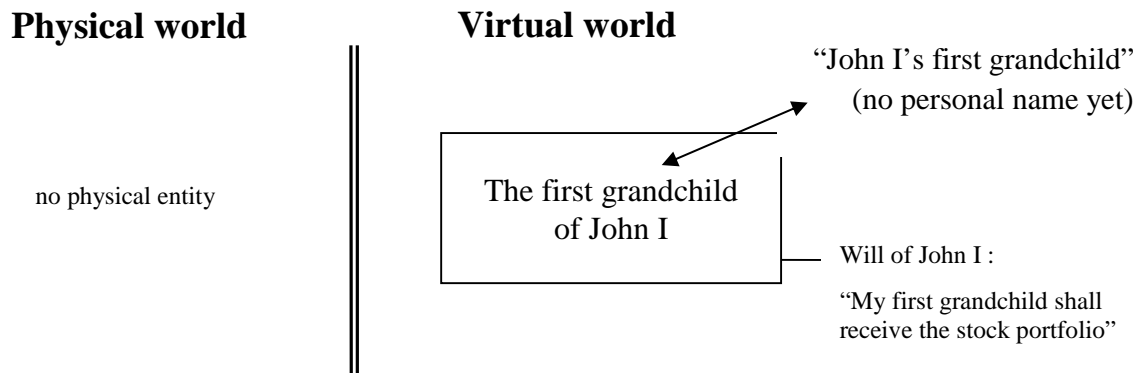


Figure 17: Nondum conceptus at the time of John I's will being drafted

The ethically and legally difficult question as to when a human being (physical entity) comes into existence is not of relevance when applying the model based on virtual persons. The law provides a solution as it provides for a fiction which means in legal terminology that the law assumes a fact (here: that there is a child at the time when it is not even conceived) while the law is well aware that the fact is not necessarily true (here: there is actually no child at that time). The model based on virtual persons offers a satisfactory solution to describe the legal concept of a fiction. Thus neither the law nor the model based on virtual persons need to address the difficult question regarding the beginning of human life as a physical entity.

Upon the birth of John II, the first grandchild of John I, a physical person appears that is linkable to the already existing virtual person. As soon as John II has gained legal personhood, the right to receive John I's stock portfolio can be granted to the virtual person "The first grandchild of John I".

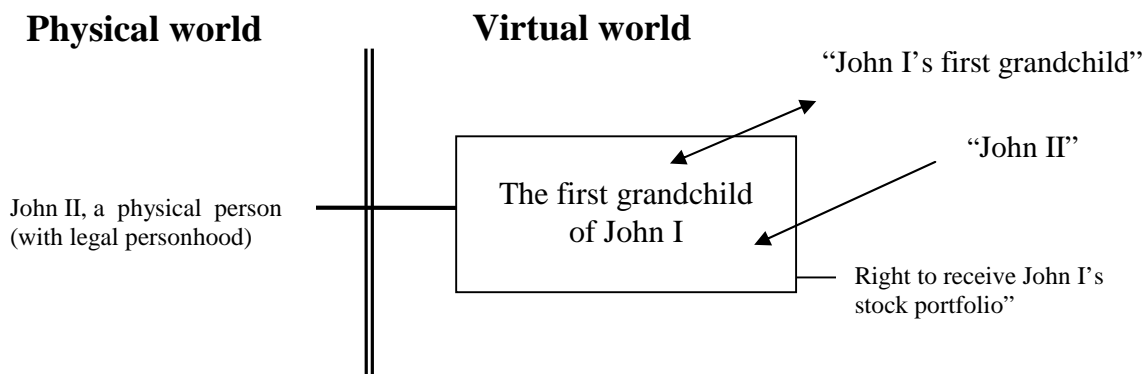


Figure 18: After John II has gained legal personhood

Even if John II happens to die quickly after having gained legal personhood, the right to receive John I's stock portfolio can stay attached to the virtual person "The first grandchild of John I" until it is transferred to John II's heir.

5.1.2 Second case: Nasciturus

The *nasciturus* is the legal figure for the conceived but yet unborn child. In all relevant jurisdictions a *nasciturus* lacks legal personhood but is capable of acquiring rights when it is born alive later.²¹ The *nasciturus* is in particular capable of inheriting,²² and tort law grants damages to a child when prenatal injuries caused by third parties such as motor accidents or medical errors cause the child to be born impaired. For this use-case, we assume that one of John I’s daughters becomes pregnant. During her pregnancy, John I dies in a car accident. The future John II is not born yet. As said before, a legal fiction enables the baby to be heir of John I.

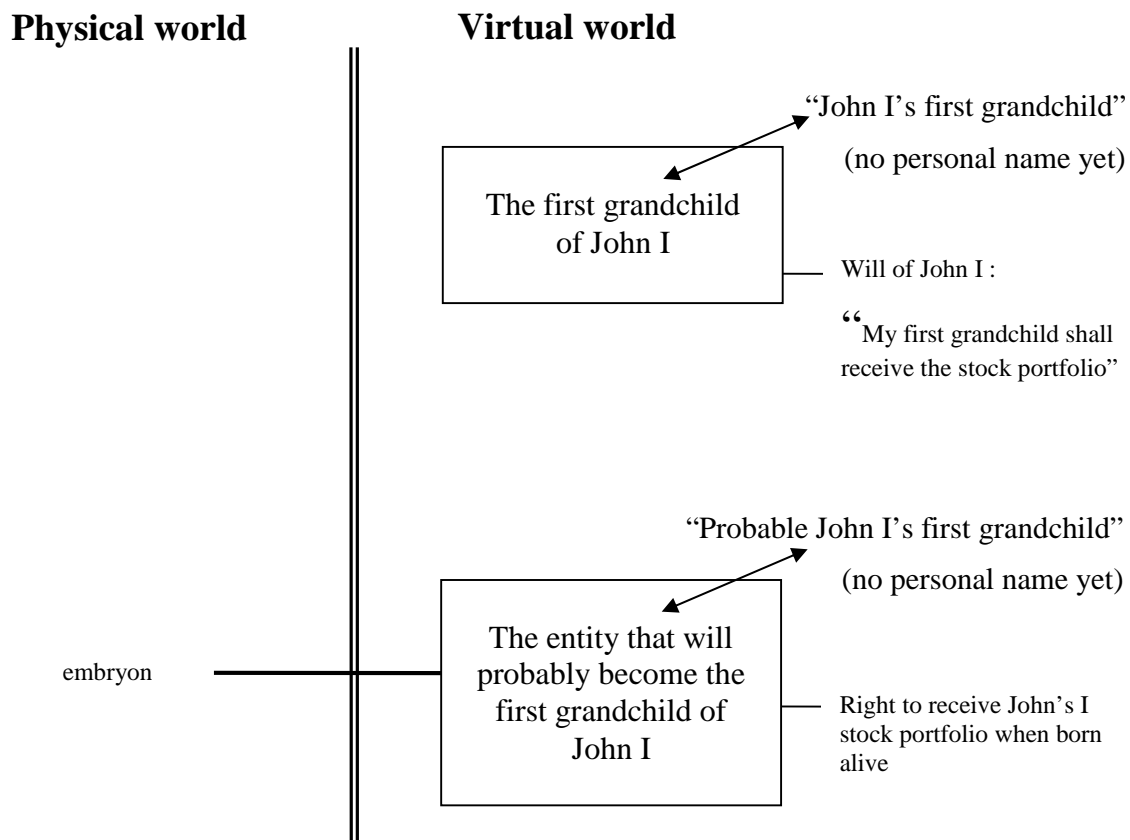


Figure 19: Nasciturus

With the embryo in the mother’s womb, there is at least some physical entity existing. Usually, traditional ID-models link identities to persons.

In order to be applicable, these traditional models need to assume that the embryo has reached a level of development that makes it “human enough” to be considered as a legal subject. This is a difficult medical and ethical question.

²¹ Heldrich, Steiner 1995, para. 2-3.

²² For references to various European and international jurisdictions see: Heldrich, Steiner 1995, para. 2-4.

However, the model based on virtual persons does not require a different approach as the embryo is developing. Indeed, as already set forth for the *nondum conceptus*, the virtual persons that allow describing this situation already exist in the virtual world, just as the law assumes them to be. Those virtual persons are “The first grandchild of John I” and “The entity that will probably become the first grandchild of John I”. The later one is linked to the embryo in the physical world.

5.1.3 Third case: Born child before gaining legal personhood

In some jurisdictions a human baby does not gain legal personhood with the end of the birth process (i.e. when the baby completely left her mother womb or when the umbilical cord is cut). These jurisdictions require some extra condition for the baby to gain legal personhood such as a human shape (*figura humana*), be able to live (*viabilité*) or that the baby survives at least 24 hours after his/her birth.

The use-case on the nasciturus is about a baby, born by a Spanish mother in Spain. The mother dies shortly after giving birth and the baby dies within its first 24 hours. Here a speciality of the Spanish law of legal personhood and law of succession comes into place. According to Spanish law a baby is not treated to be born unless it survived for more than 24 hours after cutting the umbilical cord, art. 30 CC.²³ However, once the baby survived more than 24 hours it is treated as a legal subject from the time of its birth and, in regard to all advantageous legal consequences, the nasciturus is treated as if it was born and alive at the time it received the benefits, art. 29 CC. In the given case this leads to the result that the baby was legally never existent and therefore could not have inherited its mother after she died; therefore the husband and the other relatives of the mother share the heritage. In other jurisdictions, such as Germany, the husband would become the only heir of his wife’s legal estate as the baby would inherit its mother together with the husband by ½ each²⁴, excluding other relatives of the mother. The estates of the baby would then be inherited by the father alone and consequently the father would inherit the complete wealth of his wife, just as if the Spanish baby would have survived more than 24 hours.²⁵

This raises the question of the “identity” of the baby in regard to the Spanish law of succession during the first 24 hours.

The born (but yet rightless) physical entity “Baby John” has the identity “The human baby named John, son of ...”. The fact that rights arising from civil law might not be associated with John until 24 hours have passed does not raise problems. This case can be treated as any other acquisition of rights during the lifetime of a person by associating the acquired rights to the respective subject. However, here the acquisition takes place *ex tunc*, meaning that after 24 hours the law assumes that all rights are gained retroactively from the second of birth, not in the second the 24th hour of life has passed.

The one-to-one model is capable of describing the paradigm: During the first 24 hours, a physical entity exists (Baby John). This entity is mapped to the identity “The human baby

²³ Spanish Código Civil. For a translation of the relevant articles in German see Ferid et. all 2008.

²⁴ According to German law of succession the spouse inherits ¼ when children are present, § 1931 BGB and another ¼ according to German family law, § 1371 BGB.

²⁵ See for this example Kegel, Schurig 2004: Chapter § 17 I b.

named John, son of ...”. Within the scope of private law no rights and duties are assigned to this physical entity during the first 24 hours, but only after that time John bore the rights from the time of conception i.e. as a nasciturus.

The one-to-many model is also capable of correctly describing the use-case; it even allows a refinement of the representation. After 24 hours, the physical entity “Baby John” is granted a second (partial) identity, a role-based identity, describing him as heir of his mother. There might be other partial identities connected with the baby, but this does not interfere with the (partial) identity of being the heir of his mother.

In the one-to-many model, one might also think of limiting the view to the context of the rules of succession. While Baby John of course has human rights and is protected by criminal law forbidding other to harm or kill him right from the second of birth, he does not have rights under the law of succession. The one-to-many model is better apt to describe this circumstance, attributing context-dependant partial identities; similarly to pseudonyms depending on a context, one might see Baby John either in the context of private law or as a subject of human rights, with partial identities depending on these contexts.

The model based on virtual persons is able to even better describe the use-case. As both worlds – the physical and the virtual one – are time-dependent²⁶ the occurring changes can easily be described. The time-dependency and the dynamic of the links between physical and virtual entities is very useful to faithfully describe the *time conditions*. The birth brings the physical person Baby John into existence within the physical world. Both the virtual persons “The one called *John*” and “Heir of Baby John’s mother” already exist as concepts in the virtual world, as well as “The one called *John*, when Baby John living < 24h” and “The one called *John*, when Baby John living ≥ 24h”. After 24 hours the right to inherit his mother is granted to Baby John *ex tunc* from the second of his birth.

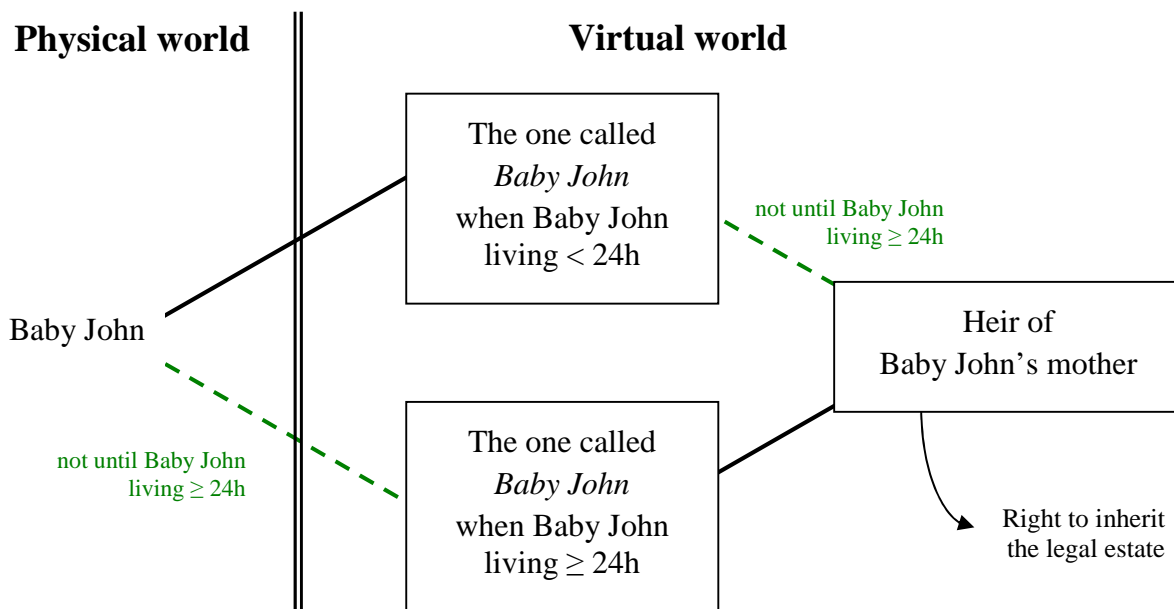


Figure 20: Identity as heir of a Spanish child during and after the first 24 h of its life

²⁶ See above 2.2.5.

5.2 Dead Entities

After exploring examples related to unborn entities, we decided to also study dead entities in the light of virtual persons, i.e., entities that are declared dead from a legal point of view. Related topics comprise:

- Lost and missing persons: Such an entity is treated as dead but may in fact live somewhere.
- Normal heritage of claims that had been acquired by the deceased at his lifetime.
- Post mortal personality in German law and parts of the copyright law in the German tradition: The dead entity is still subject of the right, i.e., “holder of the copyright”. But a third party is needed to enforce the rights, which is done in some cases by the state but usually by the closest relatives (not the heirs). Similarities in criminal law: desecration of graves.

Results of this study appear to be very similar to those already described in previous examples. We consider that including these results in details would not give any significant added value for this deliverable. Therefore, in order not to repeat ourselves, we only present our conclusions.

On the one hand, neither the traditional one-to-one, nor the one-to-many models can convincingly describe situations related to dead entities as the former identity of the previously living person does not represent any living physical entity anymore (except in the case of missing persons that are declare legally dead while being still alive).

On the other hand, the model based on virtual persons has no problem to describe these situations in the virtual world. The representations are similar to the one described previously either in the section of the pseudonym (see, for example, Figure 6) or in the section of unborn entities.

6 Software Agents

6.1 Introduction

In the information society, more and more tasks are facilitated, and indeed increasingly performed by software. As the software program becomes more autonomous, we can speak of software agents.²⁷ These are sometimes also referred to as intelligent agents or softbots (software robots), although some scholars use these terms for specific kinds of software agents.

To illuminate the concept of software agents, it is useful first to look at the concept of agent. An 'agent' can roughly have two meanings:²⁸

1. an entity capable of action;²⁹
2. someone (or something) who acts on behalf of another person.³⁰

In the first, most general, sense, the class of agents can be divided into biological agents (such as human beings or viruses) and non-biological agents, which include both hardware agents or robots and software agents. All of these are capable, to a larger or smaller degree, of action. If the action is performed on behalf of another entity, the second, more restricted, sense is activated: the agent then functions as a representative of another entity. In this section, we focus on software agents, in both senses of the term.

Not all software is an agent: in order to be capable of action, it requires a certain level of autonomy. 'Software agents are programs that react autonomously to changes in their environment and solve their tasks without any intervention of the user.' (Wettig and Zehendner 2004: 112) Because of this characteristic, software agents are sometimes also called autonomous agents³¹.

Various kinds of software agents exist. A distinction can be made between stationary agents and mobile agents. Stationary agents move only in their original environment (e.g., their owner's computer), whereas mobile agents 'move around (migrate) independently in heterogeneous computer networks' (Wettig and Zehendner 2004: 112).

Agents can also be classified according to their function. There are basically four types of software agents:³²

1. user agents (personal assistants);
2. buyer agents (shopbots);

²⁷ For a general overview and definitions of software agents, see Bradshaw 1997.

²⁸ <http://en.wikipedia.org/wiki/Agent>

²⁹ Cf. Webster's Online Dictionary: 'An active and efficient cause' or a 'substance that exerts some force or effect'.

³⁰ Cf. Webster's Online Dictionary: a 'representative who acts on behalf of other persons or organizations'.

³¹ 'An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future.' Franklin and Graesser 1996.

³² http://en.wikipedia.org/wiki/Software_agent. Of course, other classifications are possible, for example, reactive versus cognitive agents, see Nabeth, Angehrn & Roda 2003.

3. monitoring or surveillance agents;
4. data mining agents.

It is because of their relative autonomy that software agents are relevant to study from the perspective of virtual persons: they are (normally) related to physical persons, but at a distance, and hence their actions cannot, or not always, be seen as the actions of the human beings 'behind' them. The issue whether and to what extent rights and obligations can be attributed to software agents is therefore relevant in an information society in which these agents become increasingly autonomous. Indeed, if we are to believe – with considerable suspension of disbelief, since it refers to theory rather than practice – Willmott (2004), 'it may now be possible (...) to construct wholly independent autonomous electronic entities able to act for themselves in the real world: sustaining themselves financially, possessing their own identity and surviving unaided for periods of up to several years'.

User agents are typically stationary and restricted to personal use; as a result, they raise fewer questions with regards to duties and obligations than the other types, which are usually mobile and therefore more distant from their owners. In this section, we will therefore focus on the mobile types of agents to look at more in detail. How can we conceptualize these autonomous software agents?

6.2 A conceptualization

In the FIDIS deliverable D2.13, autonomous software agents are mentioned as a virtual entity, i.e. an entity which is or has been the product of the mind or imagination (p. 40). This depends on the perspective, however. Software is a virtual entity when it is seen as an idea, for example, functional specifications for a computer program, or the generic computer program WordPerfect 4.2. When it is encoded in machine code as a concrete product (or service, depending on the legal classification), however, it is an *embodied* product of the mind and hence can be seen as a physical entity: the *physical* version of WordPerfect 4.2 on my computer is a physical entity consisting of a collection of electric potentials on my hard disk.

For software agents, it is therefore important to distinguish between several sorts of entities. We have a first virtual entity: the class to which the software agent belongs, i.e. a certain type of agent. Then we have to distinguish between a specific instantiation of this class (e.g., the specific software agent that I use) – another virtual entity – and the numerous physical entities in which this virtual entity is embodied (for example, when my specific software agent is moving on the Internet). These physical entities can be seen as subjects of the virtual entity instantiating the generic type of software agent. When discussing whether rights and duties can or should be attributed to software agents, it will probably not be the concrete physical entities that we are considering, even though they perform actions with possible legal effects in real life. Rather, it will be the virtual person representing all the physical embodiments of a specific software agent that is the potential bearer of rights and duties.

Most relevant in this report, however, is to explore the relationship between software agents and legal subjects – human beings or legal persons – in order to be able to answer questions on contracting, liability and personhood that will be dealt with in the FIDIS deliverable D17.2. Here, we can use the concept of principal: 'a person who has controlling authority or is in a leading position' of a certain process, in this case, of the agent (De Groot and Brazier 2006). This may be a natural person or a legal person. It will often be the owner of the software agent, but it might also be the user of the agent (if this is someone else than the

owner), its developer, or the owner of an agent platform,³³ depending on who has the largest amount of influence over the agent’s actions. In the following discussion, we shall call the principal Alice, and suppose her to be the user of the agent.³⁴

What are the links between software agents and Alice? The simplest situation is when Alice has one agent, called Bob, and this agent is only used by Alice. If Bob represents Alice on the Internet, he is a virtual entity who is controlled by Alice.

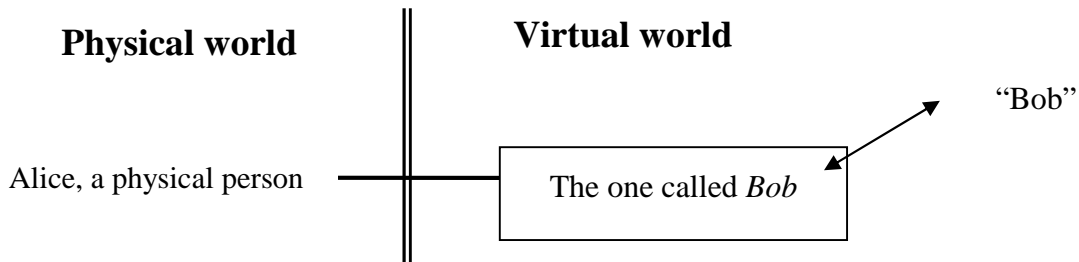


Figure 21: Alice and her only agent Bob

Of course, Alice can also use multiple agents, Bob and Daryl, who might be shared with other users, for example Alice’s wife Carol. This cannot be modelled by the one-to-one model, but is easily pictured in the model based on virtual persons.

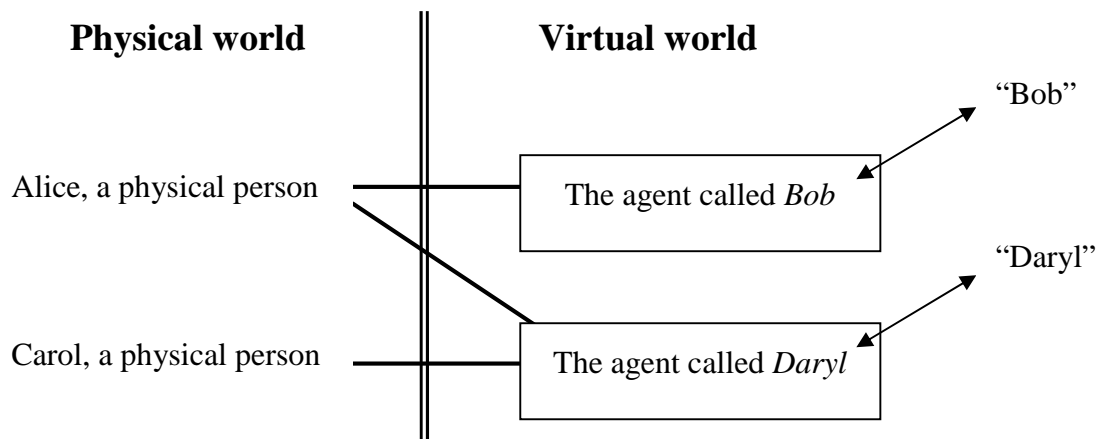


Figure 22: Alice and Carol with Daryl controlled by both and Bob controlled by Alice only

6.3 Case: Shopbot Bob

Let us look in more detail at one specific type of software agent, a shopping bot. This is a hypothetical example, based on existing technologies. Alice has bought Bob, a shopping agent who will help her to buy share certificates. She has no time to continuously monitor the

³³ An ‘agent platform is an environment that hosts agents and services. It is, in fact, middleware, i.e., a software layer between the operating system and the application programs’. De Groot and Brazier 2006.

³⁴ The various roles of the principal in light of legal consequences will be explored further in the FIDIS deliverable D17.2.

Dow Jones Index or the stock value of her favourite brand, Ben & Jerry’s. Bob, on the other hand, never sleeps or tires, and his only work is to roam websites of stock exchange markets around the world in search of cheap B&J shares. He can be programmed to send an SMS message to Alice as soon as he spots a bargain, but since Alice has full confidence in Bob’s wisdom, she programs him to buy B&J shares for up to 1000€ if the exchange rate drops with 5% or more in the course of 2 days, and to sell B&J shares if the rate rises with 5% in the course of a week. Agent platforms of the Tokyo, Singapore, London, and Los Angeles stock markets support Bob’s interface and allow him to do business with them.

In the default case, Alice uses Bob and is responsible for his actions. We can represent this as follows:

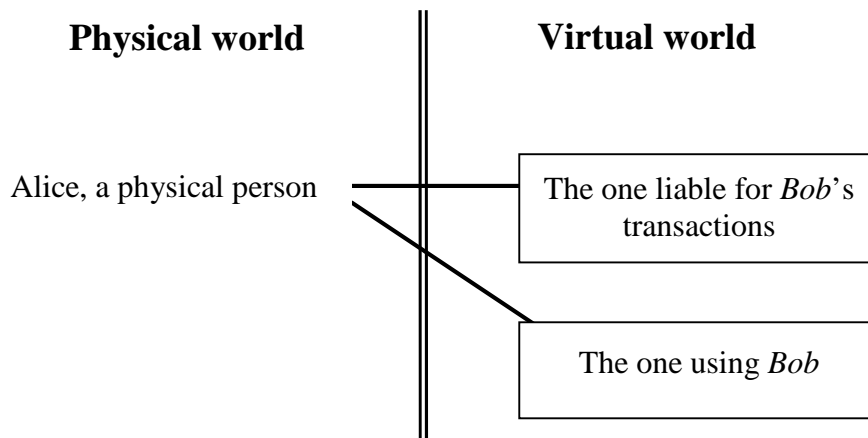


Figure 23: Responsibility

However, Alice’s wife Carol also has access to her computer, and she programs Bob to buy Chanel shares in Paris when they drop below €40 per share. Now, both Alice and Carol use Bob. Whom Bob represents, however, now becomes unclear: is Alice liable for Carol’s programming? That will depend on a legal assessment of the circumstances, for example, whether Alice explicitly consented to Carol’s using Bob, whether they have the same Internet user account and password, and whether Carol used Alice’s bank account number or her own.

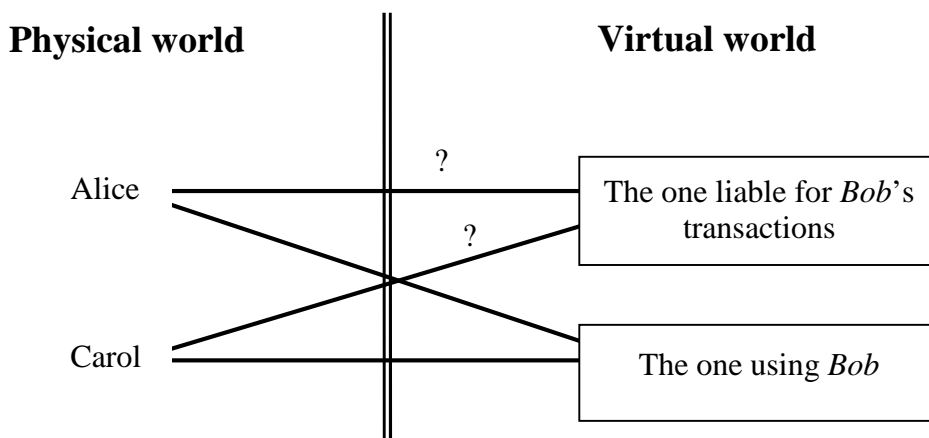


Figure 24: Alice and Carol are both using Bob, who’s liable?

Unfortunately, Bob is attacked by a malicious softbot, who inserts a piece of program code in Bob so that he becomes confused and starts buying Häagen Dazs shares instead, at incredible rates. Before Euronext has detected Bob’s abnormal behaviour and stopped his transactions, he has already bought €20,000 worth of shares. Now, the picture becomes quite complicated. Who is represented by the virtual person “the person responsible for Bob’s transactions” may, depending on the legal system of liability, be Alice, Bob’s programmer, or the retailer who sold Bob may be held responsible for the transaction, or even the unknown person who is responsible for the malware; it might also represent no physical person at all, if Bob’s reprogramming and his actions were unforeseeable for all potential actors. In that case, his buying orders could be considered legally null and void, which means that, legally, no transaction has occurred in the first place.

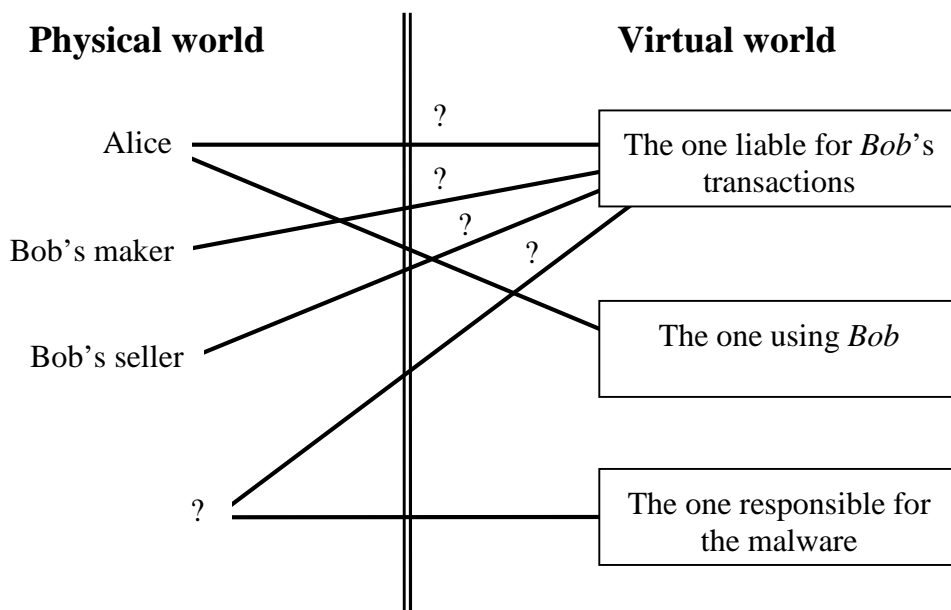


Figure 25: Malware attacks Bob

6.4 Conclusion

Like with pseudonyms, software agents can be described better in the model based on virtual persons than in the one-to-one or in the one-to-many models, since people can have multiple software agents and agents can be shared by several people. The model can be used to illustrate the complex situations that arise when agents become increasingly autonomous, thus complicating the legal attributability of agent’s actions to their principals. This shows the relevance of reconsidering current models of attributing responsibility for software agents’ actions: in case of unforeseen actions, not only is it debatable to whom the action can be legally attributed – the user, owner, maker, seller, platform provider, or modifier of the agent, or combinations of these – but also, it becomes increasingly difficult to link the agent’s action to a human being or legal person in the first place, when agents become ‘wholly independent autonomous electronic entities’ (Willmott 2004). This issue will be explored further in the FIDIS deliverable D17.2 “New (Id)entities and the Law: Perspectives on Legal Personhood for Non-Humans”.

7 UML Models

In FIDIS deliverable D2.13 “Virtual Persons and Identities”, definitions related to virtual persons and identities have been developed in a formal way, as well as in an informal way. These definitions were inspired by previous work done in the FIDIS work package 2, especially in FIDIS deliverables D2.1 “Inventory of Topics and Clusters”, D2.2 “Set of use-cases and scenarios” and D2.6 “Identity in a Networked World - Use-cases and Scenarios”.

In order to clarify even more the notions introduced therein, we go one step further here and use the UML³⁵-notation [Fowler 3rd edition], a well known formalism from computer science to model them. This graphical formalism has already allowed contributors of this deliverable to clarify several aspects during their working discussions. It should as well provide the interested reader with additional perspectives on these notions. This UML-description of the components of the model based on virtual persons is also given in order to show the internal consistency of this model.

This section presents UML descriptions³⁶ for the concepts of entities, virtual persons, identities, etc. based on the definition given in section 5.1 of FIDIS deliverable D2.13. We will not repeat all context information with respect to these definitions, and omit especially all comparisons with related approaches; the interested reader can find these complements in FIDIS deliverable D2.13.³⁷

Note that we implicitly assume all the hypotheses implied by the definitions given in the model.³⁸

7.1 Identity Core Components

The core building blocks of the model based on virtual persons are *entities* (the fundamental things that can be identified) and *identity-related information* (information used to identify entities).

7.1.1 Entities and Identity-related information

Definition An *entity* is anything that has a distinct existence; it is the fundamental “thing” that can be identified.

³⁵ UML (Unified Modelling Language) is a standard from the OGM group. The standard can be found at http://www.omg.org/technology/documents/modeling_spec_catalog.htm#UML (September 2008).

The standard consists in two parts:

- 1) Infrastructure specification: <http://www.omg.org/spec/UML/2.1.2/Infrastructure/PDF/> (September 2008),
- 2) Superstructure specification: <http://www.omg.org/spec/UML/2.1.2/Superstructure/PDF/> (September 2008).

³⁶ For a brief description of the standard notations used in the following models, see Appendix A at the end of this document.

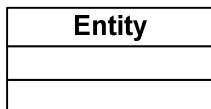
³⁷ See also Appendix A at the end of the present document.

³⁸ Notably the following hypotheses :

- We take an objective view of the context which we define as a set of entities.
- There is a concept of visibility: a link may be seen (known) or unseen (unknown).

Model

Entity



Definitions

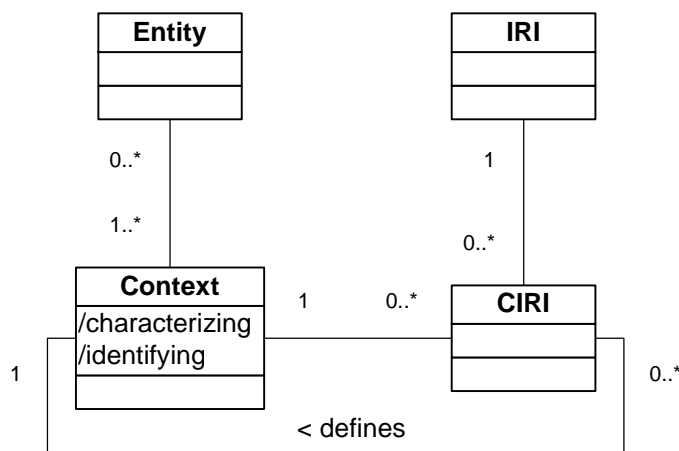
Identity-related information is any information that characterizes an entity.

Identifying information (or a *full identifier*, or simply an *identifier*) is any information which characterizes exactly one entity within a specific context or environment.

A *partial identifier* (or *partially identifying information*) is any information which characterizes at least one entity within a specific context or environment.

Model:

Entity & Identity-related information



In the above model, a **Context** is explicitly viewed as a set of entities. **IRI** stands for “Identity-related information”. **CIRI** stands for “Contextual Identity-related information” and is made of one **Context** plus one **IRI**. Any **CIRI** univocally defines a new **Context**.

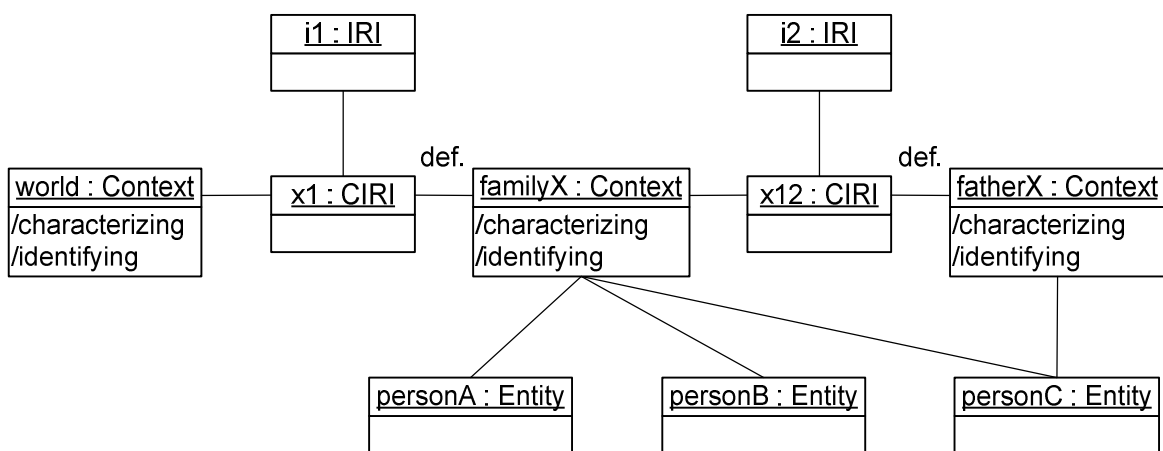
The derived predicates **characterizing** and **identifying** of an instance of **Context** take the following value³⁹:

³⁹ By definition, **identifying** cannot be true when **characterizing** is false so there are only three possible combinations of these attributes.

- characterizing: true if the instance of Context is not linked with any Entity, false otherwise.
- identifying: true if the instance of Context is linked with at exactly one Entity, false otherwise.

As the loop linking Context and CIRI denotes, our model is recursive. The addition of identity-related information within a context gives a new (sub)context, and so on. The starting point is always the world, which is the set of all existing entities. For the sake of clarity, we do not represent all the entities or all the links to them.

Example 1: Contexts included in broader contexts

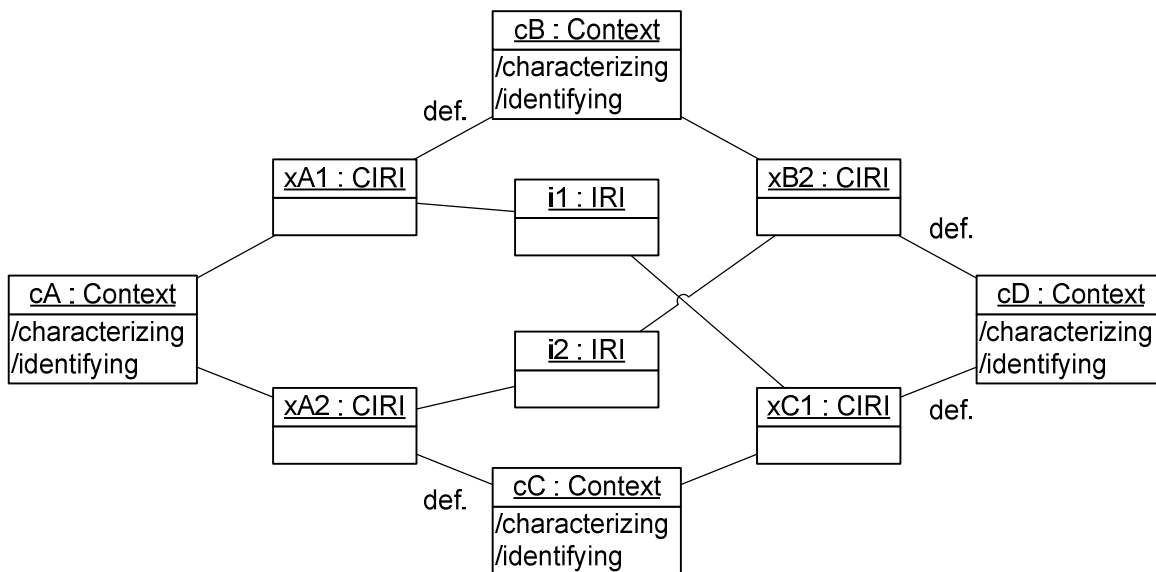


In this example, information i1 in the world context specifies a certain family X comprising 3 persons. Then information i2 narrows this context to its father, leaving only one person. The further addition of information such as “female person” would lead to a new empty context because the intersection of the contexts “father of the family X” and “all female persons” is the empty set.

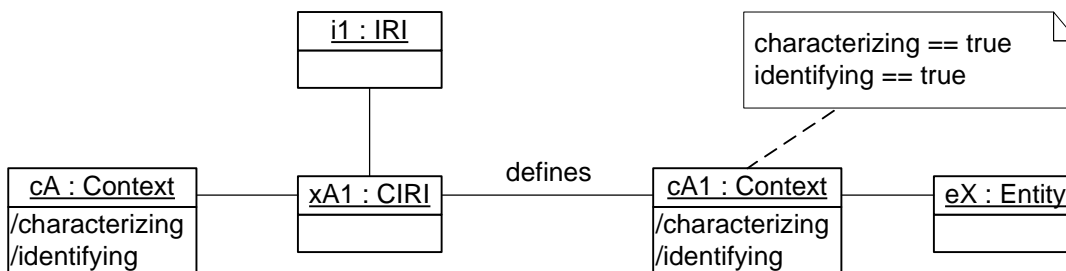
It is obvious that a context can be defined in different ways, i.e. by different CIRI’s. For instance, the context (singleton) of a given physical person could be described by her fingerprint, her social security number or some other identifying information. But the definition of a context from several pieces of information can also take various forms.

Example 2: Commutativity of the addition of identity-related information

The following example illustrates the symmetry of this construction. Context cD can be defined by information i1 followed by i2, or in the reverse order. Note that we could create a combined information $i12 = i1 + i2$ that defines context cD directly from context cA.

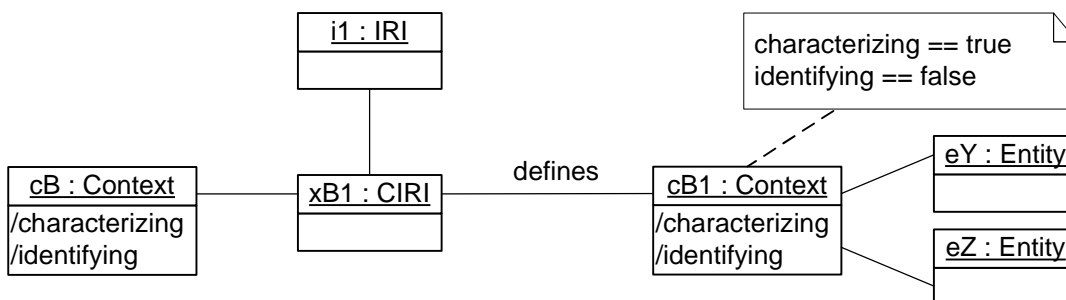


Example 3: (Fully) identifying information



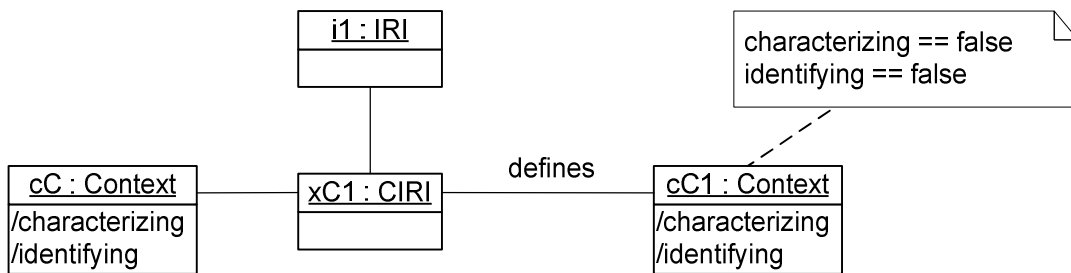
In the above example, context cA1 contains only one entity (eX). Therefore, identity-related information i1 is both characterizing and identifying in context cA (and even more so in context cA1). We say that i1 is an identifier for eX in context cA.

Example 4: Partially identifying information



The same ID-related information *i1* is only partially identifying in another context *cB* because the spawned context comprises more than one entity (*eY* and *eZ*). It is characterizing but not (fully) identifying. We say that *i1* is a partial identifier for *eY* and *eZ* in context *cB*.

Example 5: Identity-related information that is not characterizing



Finally, still the same ID-related information *i1* is not characterizing in yet another context *cC*. No entity of context *cC* matches information *i1*; so context *cC1* is the empty set.

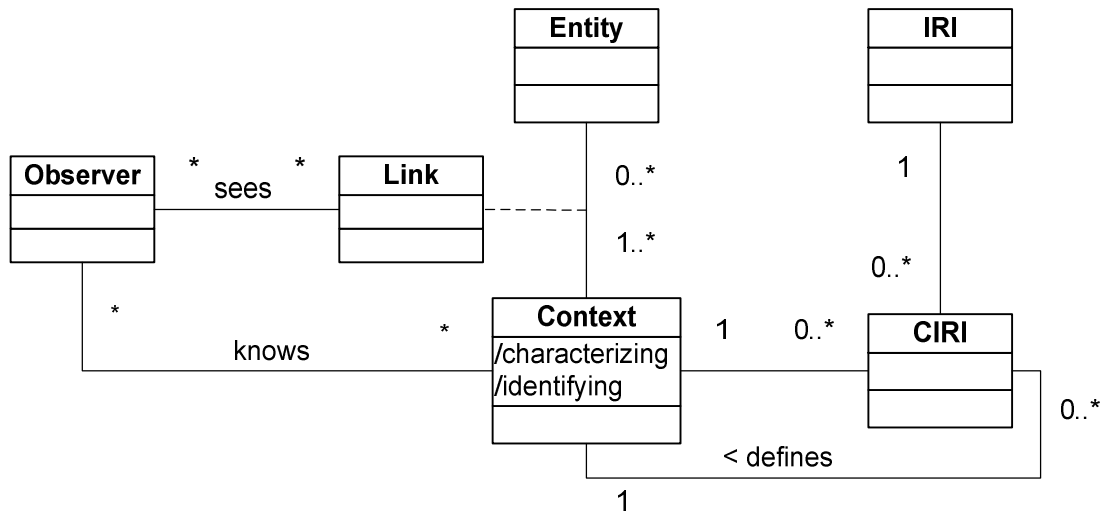
7.1.2 Identities and Observer

In the model based on virtual persons, *identities* strongly depend on the ability of an *observer* to link identifying information to its corresponding entities.

- Definitions** An *identity* of an entity –according to an observer– is identifying information that can be linked to this entity by that observer.
- In general, an identity is not absolute but depends on the ability of the observer to find or verify the link between the entity and the identifying information.
- A *partial identity* of an entity –according to an observer– is partially identifying information (a partial identifier) that can be linked to this entity by that observer.

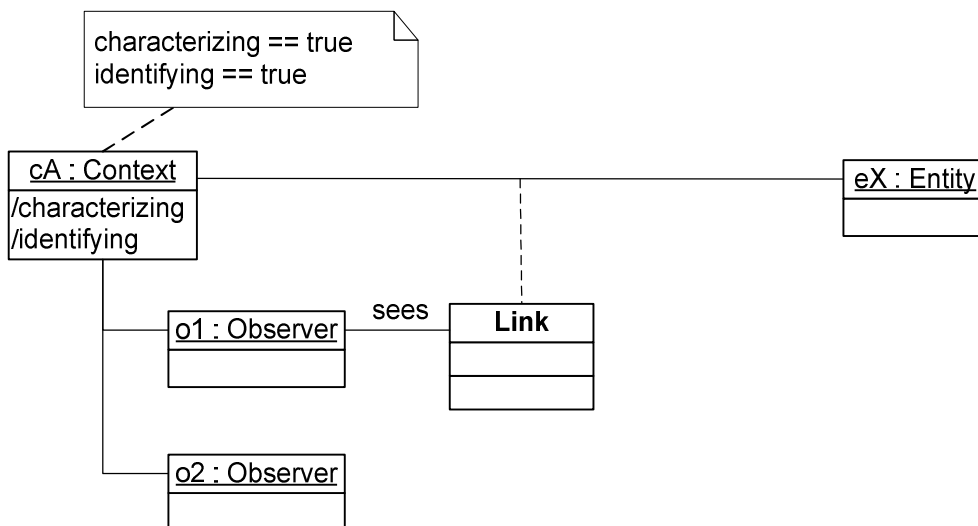
Model

Identity



Now, we add the Observer to the model presented in the previous section. We assume that an Observer can always know whether the identity-related information defining a given Context is identifying, partially identifying or not characterizing. But an Observer may or may not see the Link between this Context and one of its instances of Entity. In brief, the observer knows if a given context contains no entity, exactly one entity or more than one entity, but not necessarily which ones.

Example 1: Identifier versus identity

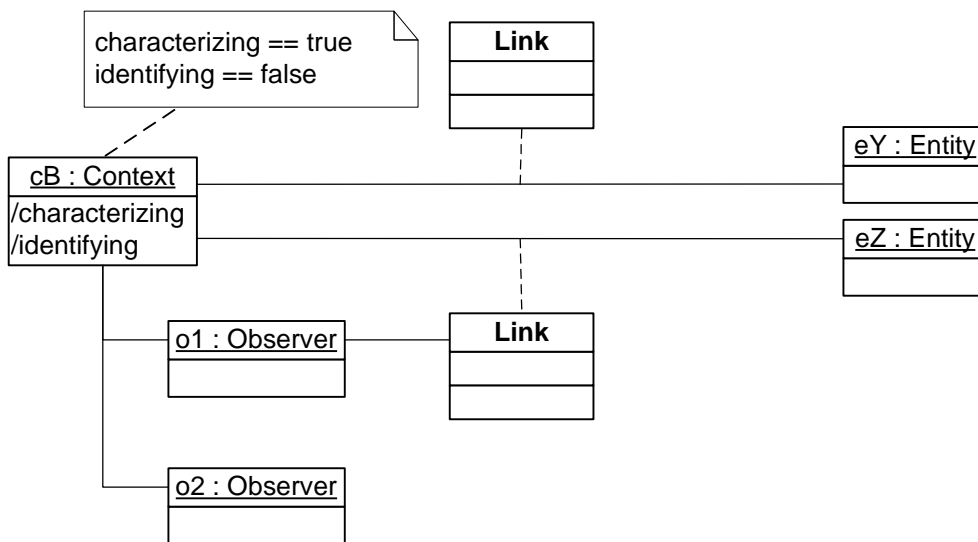


In this example, we take an instance of Context whose defining IRI⁴⁰ is (fully) identifying. For observer o2, this IRI is only an identifier in context cA. But observer o1 sees the link between cA and eX. As a result, the same IRI becomes an identity for entity eX in context cA according to observer o1.

Example 2: Partial identifier versus partial identity

We consider an instance of Context whose defining IRI is partially identifying. For observer o2, this IRI is only a partial identifier in context cB. Indeed, o2 knows that the IRI refers to one or more entities in this context but she does not know which one(s).

Observer o1 sees a link between cB and eZ. For her, the IRI is a partial identity for entity eZ in context cB. There is also a link between cB and eY but it is not currently visible to observer o1. Note that we assume that only true links can be seen.



7.2 Entities and their Corresponding Worlds

An *entity* is anything that has a distinct existence; it is the fundamental “thing” that can be identified. The nature of the existence can be material or abstract. In the former case, in which some sort of physical constituent is compulsory, we call it a “*physical entity*”.

The existence of a physical entity is time-dependant and the lifetime of a physical entity is usually bound in time. At any specific point in time, a physical entity either exists or not.

In case the existence is abstract, which means essentially that the entity is or has been a product of the mind or imagination, we call it a “*virtual entity*”.

Virtual entities are thus entirely detached from any physical reality. They typically belong to concepts, thoughts, perceptions, illusions, categories, or abstractions.

⁴⁰ Remember that any context (other than the world) is defined by a super context and an identity related information. The parent context and IRI are implied in this section’s diagrams.

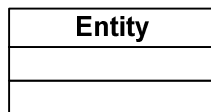
For any specific point in time, the collection of all existing physical entities is what we call the “*physical world*” at that specific time and the collection of all existing virtual entities is what we call the “*virtual world*” at that specific time.

7.2.1 Entity

Definition An *entity* is anything that has a distinct existence; it is the fundamental “thing” that can be identified.

Model

Entity

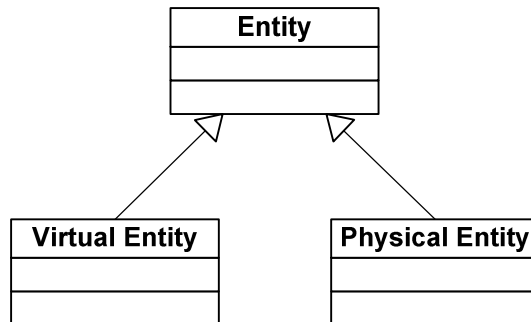


7.2.2 Physical and Virtual Entities

Definitions A *physical entity* is an entity for which some sort of physical constituent is compulsory. A *virtual entity* is an entity which is the product of someone’s mind or imagination.

Model

Virtual & Physical Entities

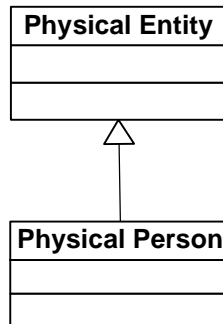


7.2.3 Physical Person

Definition A *physical person* is the legally living body of a human being. Therefore, it is a *physical entity*.

Model

Physical Person

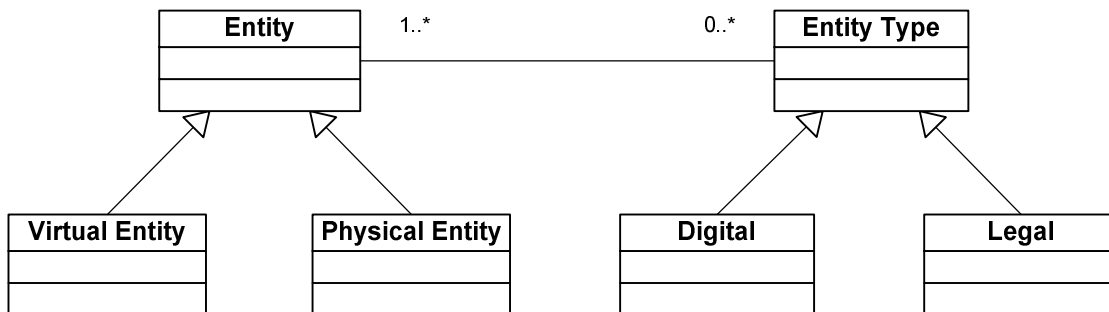


7.2.4 Types of Entities: Legal, Digital, etc.

Description Entities can be of several types: legal entities, digital entities, living entities, inert entities, etc. We model these variants as *types*.

Model

Types: Digital and Legal Entities



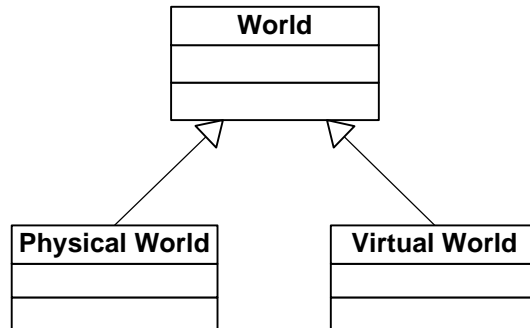
7.2.5 Physical and Virtual Worlds

Definition A *world* is a time-dependent collection of existing entities. The *physical world* at a specific point in time is the collection of all existing physical entities at that specific point in time. The *virtual world* at a specific point in time is the collection of all existing virtual entities at that specific point in time.

The physical world like the virtual world is a persistent singleton class, which means that there exists exactly one instance of it.

Model

Two Worlds

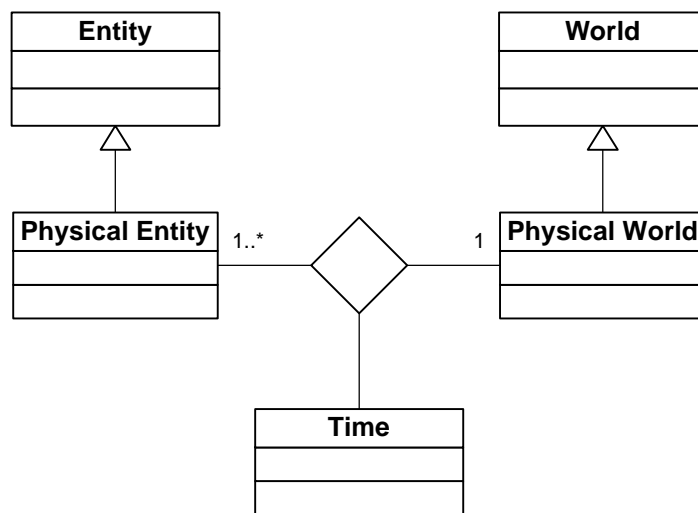


Description

The existence of a physical entity is time-dependent. The physical world, at a specific point in time, is the collection of all existing physical entities at that specific point in time.

Model

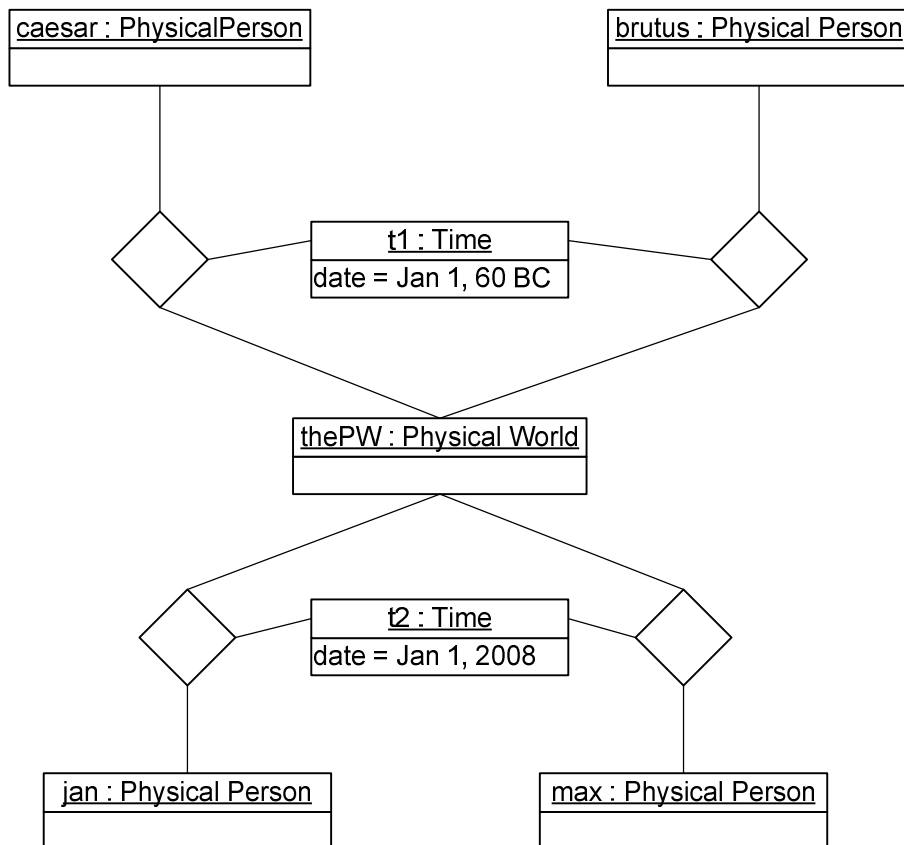
Time-Dependency (Physical Entities)



Example: Time-dependency of the physical world.

At time t1, the two physical persons – a specific case of physical entities – named caesar and brutus belong to the physical world thePW. We also know that at time t2, thePW contains two other physical persons.

Note that this diagram is not exhaustive. At times t1 and t2, the physical world is composed of more physical entities than those represented. Moreover, the four physical persons mentioned are also part of the world at other instants. But in practice, it is impossible to completely describe the physical or virtual world.

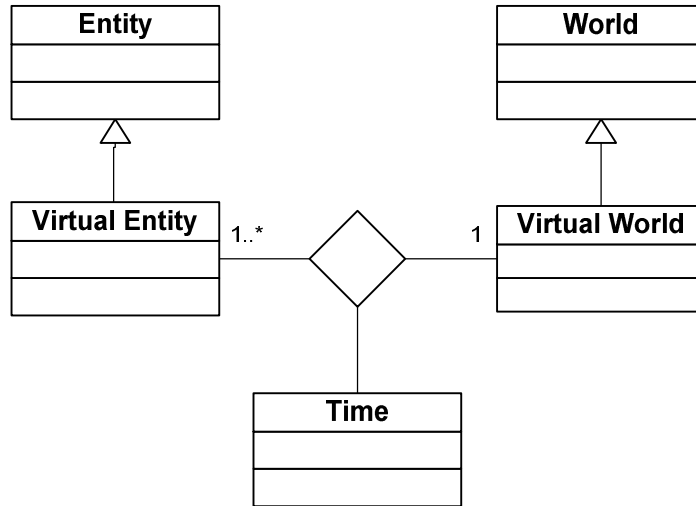


Description

The existence of a virtual entity is time-dependent. The virtual world, at a specific point in time, is the collection of all existing virtual entities at that specific point in time.

Model

Time-Dependency (Virtual Entities)



7.3 Links and Related Concepts

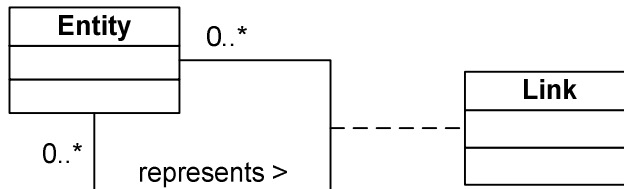
The model based on virtual persons introduces links between entities. These links can be within entities of the same world as well as between entities belonging to different worlds, i.e., between entities of the physical world and entities of the virtual one.

7.3.1 Link

Definition There is a (direct) *link* between two entities, if one entity represents the other one.

Model

Link



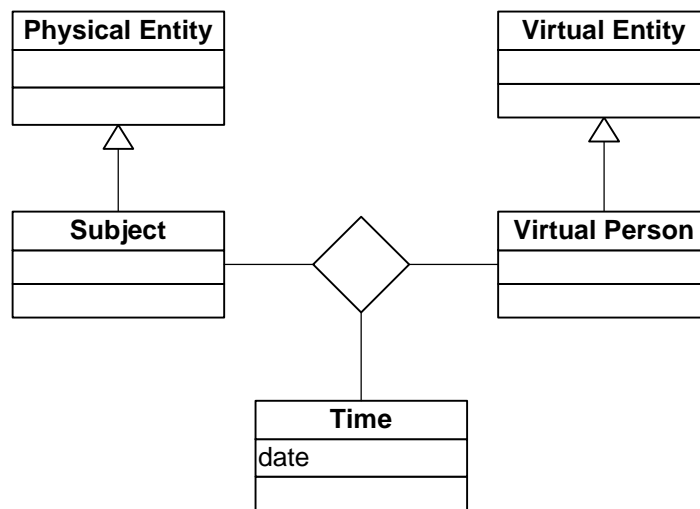
7.3.2 Virtual Person and Subject

Definitions A *virtual person* is a virtual entity that can have rights, duties, obligations and/or responsibilities associated to it in a certain context.

At any specific point in time, a physical entity that is linked to a virtual person is called a *subject* of this virtual person.

Model

Subject



7.4 Identities in the Virtual World

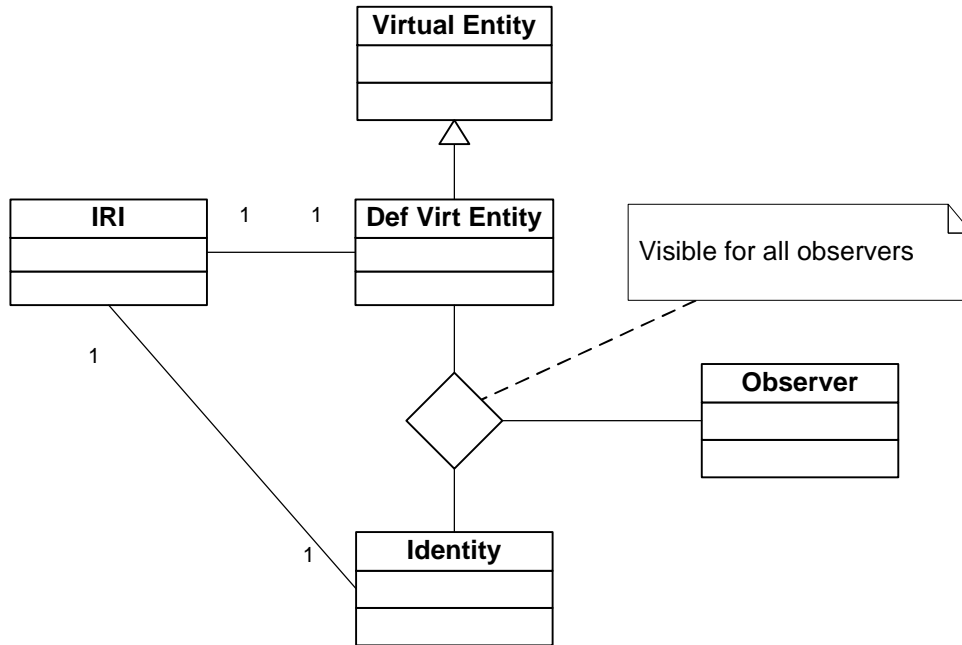
Identities have been generally defined for both the virtual world and the virtual one. A specificity of the virtual world is to allow the association of a unique virtual entity to any *identity-related information*. This identity-related information becomes therefore the *tautological identity* of this corresponding virtual entity.

7.4.1 Defined Virtual Entity

Description Any identity-related information tautologically defines a unique virtual entity: the abstract entity for which this information is tautologically an identity. “Def Virt Entity” stands for defined virtual entity.

Model

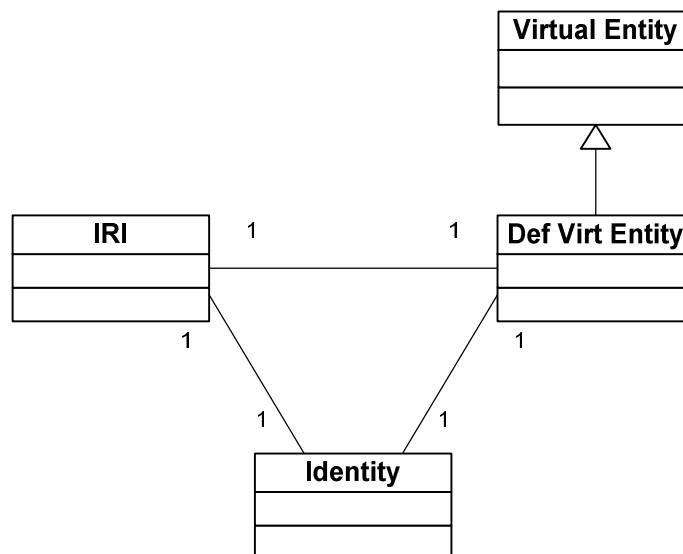
Defined Virtual Entity



The tautological identity of a virtual entity is valid for any observer and becomes therefore independent from the observers.

Model

Tautological Identity



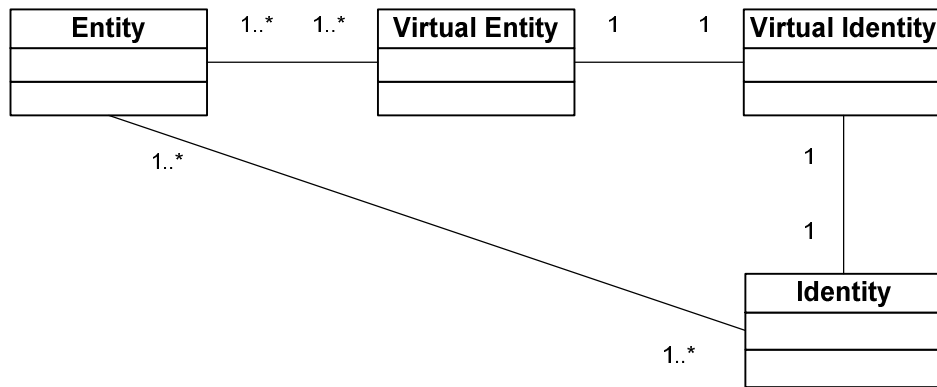
7.4.2 Virtual Identity

Description *A virtual identity, for a given entity, is the identity of a virtual entity linked to this given entity.*

Both physical and virtual entities can have virtual identities.

Model

Virtual Identity



8 Conclusion

This deliverable is a second major step in studying the concepts related to virtual persons. Following the first step consisting of a formal description of the model based on virtual persons in section 5.1 of FIDIS deliverable D2.13 “Virtual Persons and Identities”, we have used the UML notation to re-describe the main concepts related to identities in the light of the virtual persons. While creating the UML description of the model, several hidden or implicit points have been clarified. Moreover, the UML description provided in this deliverable should help to clearly communicate the core concepts to the interested readers (especially the ones used to UML). So far, the internal restrictions of UML itself have not appeared to be a major problem for our modelling approach.

Different typical use-cases have been successfully and accurately described using the model based on virtual persons: pseudonyms, avatars, categories, unborn and dead entities, software agents. In several situations where the one-to-one, one-to-many or even traditional many-to-many models present problems in capturing some of the subtleties of use-cases or real life scenarios, the model based on virtual persons, as a time-dependant m-to-n model (where m or n can even be zero), proves to be very powerful. The descriptions provided appear to be accurate enough without artificially restricting the use-cases. Legal subtleties related to unborn entities or born children not having gained legal personhood yet, for example, require the whole flexibility of the model based on virtual persons to be caught faithfully. These examples push the model to its farthest limits, but without reaching them.

In this deliverable we have modelled *entities* inspired from use-cases and real life scenarios, as well as time-dependant, evolving *relations* between these entities. Our next task is to model *processes* in the light of virtual persons, more specifically authentication and identification processes. FIDIS deliverable D17.4 “Trust and Identification in the Light of Virtual Persons”, will concentrate on the notions of trust, confidence, reliability in the context of virtual persons, as well as on processes that are directly related, namely authentication and identification processes.

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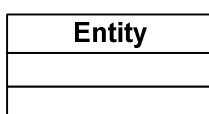
Appendix A: UML Modelling Notations

The annex briefly describes the standard notations used in the UML (Unified Modelling Language) models of this document. As a starting point for further information and references see for example http://en.wikipedia.org/wiki/Unified_Modeling_Language .

Class

Description: A template for objects having all the same set of properties.

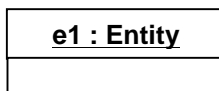
Symbol A rectangle having a name; properties, if important, are modelled as associations, see next.



Instance

Description: A member of a class. It can be regarded as a member of the set denoted by a class. Object is a synonym for instance.

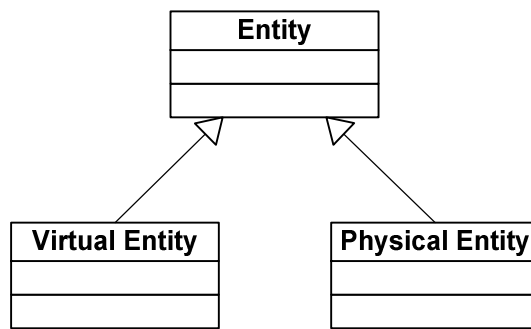
Symbol: A rectangle, too, containing an identifier and a class name separated by a colon; identifier, colon, and class name are underlined.



Binary Association

Description: If an instance of a class is related with one or more instances of another (or the same) class then this instance is linked with the other instance or instances. In that case, an association (a line) is drawn from the first class to the other one (or back to the same one). The relationship between the two classes is referred to as “binary association”. If the association start at one class and ends in the same one then it is called reflexive. Note that, unless told otherwise, an association has no direction. To distinguish the ends of a binary association, a role can be added to either end of the association. An association can have a name. An optional arrow indicates the direction of reading the association.

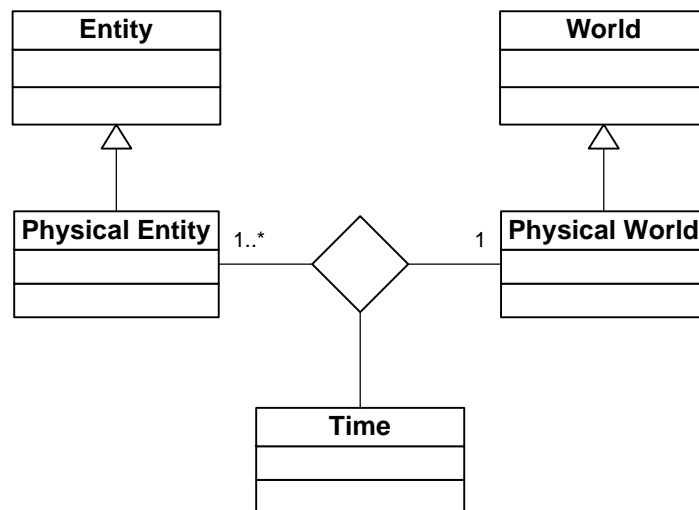
Symbol: A line between two classes (or from one class back to the same one). Optional: A name with optional reading indicator.



Ternary Association

Description: A ternary association relates the instances of three classes with each other at the same time.

Symbol: A diamond between the three classes, linked with three lines to the respective classes.



Multiplicities of a Binary Association

Description: An association denotes the linking of objects of the class at one end of the association, say A, with objects of the class at the other end of the association, say B. An object of class A may be linked with objects of class B in the following way:

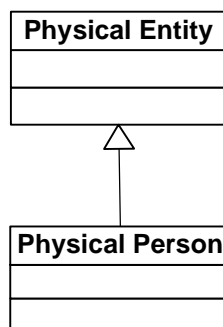
- If an object of class A is always linked exactly with one object of class B then the multiplicity at end of the association at the class B side is called to be *one*, denoted as [1].
- If an object of class A is at most linked with one object of class B then the multiplicity at end of the association at the class B side is called to be *zero or one*, denoted as [0..1].
- If an object of class A is always linked with at least one object of class B then the multiplicity at end of the association at the class B side is called to be *one or more*, denoted as [1..*].
- If an object of class A is can be linked with zero or more objects of class B then the multiplicity at end of the association at the class B side is called to be *zero or more*, denoted as [0..*], abbreviated as [*].

Symbol: Multiplicity range annotations (see above) at each end of an association. The brackets are omitted in class diagrams. The annotation is optional. The multiplicity is undefined if left away.

Specialization, “IS-A”

Description: Relates two classes such that the more specialized class “inherits” the properties of the more general one. If a class can be specialized into two or more special classes then we assume here that the instances of the two specialized classes form two disjoint sets. Things become more complicated if a specialized class inherits the properties of two or more general classes. Then, the instances of the specialized class, say S, which inherits the properties from classes, say A₁ to A_n, can be regarded as members of the more general classes A₁ to A_n, too.

Symbol: A line with a big, hollow arrow between the two classes. The arrow points to the more general class.



Appendix B: Mind Map

