

Ontologies are a formalism widely used in Knowledge Engineering, Artificial Intelligence and Computer Science, which provide a very suitable formal frame to represent the knowledge related to a complex domain, as a qualitative model of the system. Ontologies can be used to represent the structure of a domain by means of defining concepts and properties that relate them.

The ontologies presented in this document are OWL compliant. OWL (Web Ontology Language) is a standard language for ontologies, designed to be used by applications that need to process the content of information instead of just presenting information to humans.

APO: ACTOR PROFILE ONTOLOGY

For any user that has been identified and authenticated to log into a distributed system, such as the K4CARE, the system must know exactly what resources he/she is able to access to. The behaviour of the users must fit their permissions. This is a critical issue in general in any complex organization and particularly crucial in medical applications. Healthcare organisations must follow national and international legal rules. Among others, the distribution of patients' information must always preserve privacy constraints, and the professional liabilities are strictly defined. Defining user profiles is one of the basic pillars to properly manage competencies or information access rights, as well as to define constraints on the actors' behaviour.

In the K4CARE project, an Actor Profile Ontology has been designed in order to store the knowledge that defines the behaviour of every kind of actor involved in the field of HomeCare assistance.

The APO is used to determine the authorized actions and read/write rights of each user in the system as well as the interactions between actors to provide a certain medical service, clearly defining what and how care will be provided.

This guarantees that the behaviour of the users is constrained according to their profile and facilitates the integration and coordination of the different actors required to provide the medical services.

The main concepts of the APO are the following:

Entity: refers to all the people or groups involved in the HC. Entity is subdivided into two main classes: Group for working teams with healthcare liabilities, and Actor, for

individual participants (patient, nurse, physician in charge of the patient, head nurse, social worker, family doctor and additional care givers).

Service: it is defined as a HC activity that involves the work of one or more HC actors in a coordinated way. They are classified into Access Services, Patient Care Services, and Information Services.

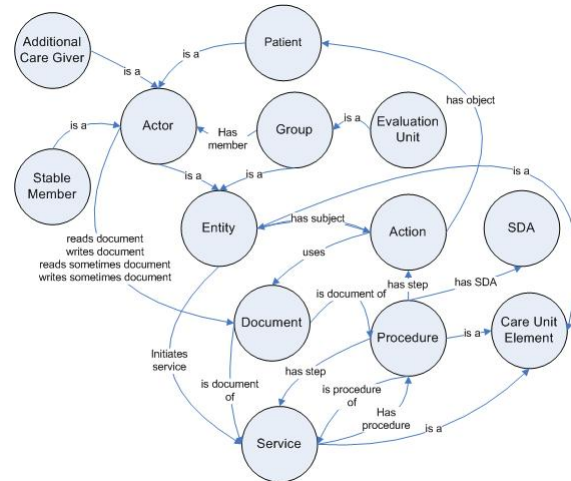
Procedure: it is the representation of the way a Service is provided in terms of a set of the rest of services or available simpler actions.

SDA: it defines how the procedure must be applied, that is, which is the flow of control, because different care units can have different SDAs for the same procedure.

Actions: represent the single steps that should be done to perform a service. The ontology distinguishes many subtypes as social action, case management action, back-office action, nursing action, etc.

Documents: they are used to store the results of the actions and for the communication between Entities all along Service performance. The definition of the access rights on the documents is one of the main issues of the APO, since it is related with privacy protection.

Every class in the hierarchies of the main concepts APO (Entity, Service, Procedure and SDA) inherits also from the **Care Unit Element** hierarchy. This permits to indicate which Care Unit refers every element of the ontology. This hierarchy has always a HC Nuclear Service (HCNS) class with the minimum set of basic services in a HomeCare structure and a class for each HC accessory service (HCAS), e.g. rehabilitation, oncology.



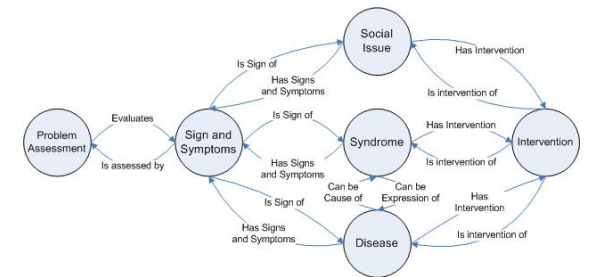
The central part of the APO is storing static knowledge about the HC system related to Nuclear Services. However, the ontology can be enlarged with specialized services (HCAS), which are specific of a certain context (a country, a hospital, etc.). For this purpose, a specific methodology to extend

the APO with consistency and robustness has been developed and, to assist the medical team in this task, a software tool called ISA (*Intelligent Service Adder*) has been implemented. Rehabilitation services have been successfully added to the APO using this methodology.

Once the system incorporates a new user, his/her behaviour is defined by the corresponding profile, specified in the APO. This makes the system very flexible to mid-term or long-term modifications on the legal frame of HomeCare assistance (or any other target domain modelled). Only modifying the APO, the system will adapt his behaviour to new situations.

CPO: CASE PROFILE ONTOLOGY

The **Case Profile Ontology** (CPO) provides a formal representation of all the health care concepts related to the care of the elder at home (i.e., syndromes, diseases, social issues, signs and symptoms, problem assessments, and interventions) and the relationships and constraints between these concepts.



The main concepts of the CPO are the following:

Problem assessment comprises some aspects that assess the condition of the patient during the first encounter and whenever a re-evaluation is required. The ontology distinguishes many subtypes as comprehensive assessment, laboratory analysis, diagnostic examination and consultation.

Symptom is a sensation or change in health function experienced by a patient. Thus, symptoms may be loosely classified as strong, mild or weak. It can be considered as a subjective report as opposed to a **sign**, which is objective evidence of the presence of a disease or disorder. Symptom may be seen as a physical condition which

indicates a particular illness or disorder and it is noticed by the patient, while sign is noticed by the physician or others.

Syndrome is a complex health situation in which a combination of sign and symptoms occurs more frequently than it would be expected on the basis of chance alone and generates a functional decline. The CPO includes the syndromes of Cognitive Impairment and Immobility. These two syndromes have capacity of encompassing - individually or in combination - most of the cases in which home care is required.

In Health care a **disease** is a physiological or psychological dysfunction. There are several international classifications of diseases that consist of an arrangement of the diseases with common characteristics into groups. Among them, the International Classification of Primary Care (ICPC) and the International Classification of Diseases, Injuries and Causes of Death (ICD) are the most commonly used. In K4CARE Project there is used the ICD 10th revision Clinical Modification ICD-10 to codify and structure the diseases.

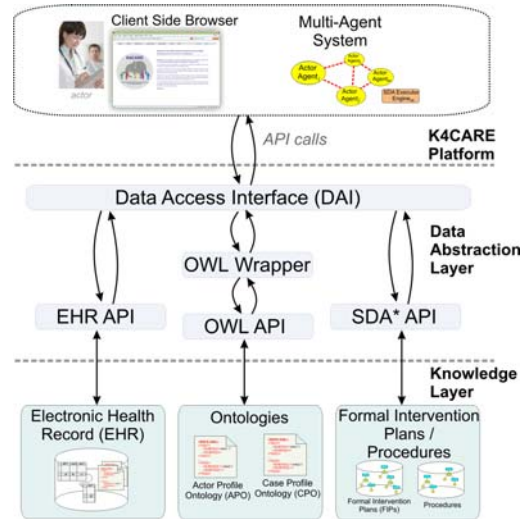
Social Issues are matters that can be explained only by factors outside an individual's control and immediate social environment which affect many individuals and a society. Common social issues include poverty, violence, justice, human rights, equality and crime. They usually revolve around conflicting viewpoints and tensions between people who take different stances.

Intervention is the action or series of actions undertaken to respond to the needs and problems of the HCP. They are classified into pharmacological treatments, non-pharmacological treatments, rehabilitation, nursing care, social care, counselling and special medical services. In addition, for each pharmacological treatment the CPO store the knowledge of dosage, number of times, periodicity, preparation and administration route.

DAL: DATA ABSTRACTION LAYER

The process of parsing the OWL representation of the ontologies is not straightforward. Moreover, other data resources are available in the K4CARE system. For this reason, a three-layer architecture is proposed, as it is shown in the figure below. The Data Abstraction Layer (DAL) provides high-level functions that allow the *agent-based platform*

entities to retrieve the *data and knowledge* they need to perform their tasks. This layer offers a wide set of high-level queries that provide transparency between the data (knowledge) and its use (platform). The DAL is an intelligent layer that implicitly understands the different data languages and also knows where the knowledge is located. Therefore, it is able to manage the communication requirements between the proper knowledge sources and the multi-agent system. It is composed by a set of interfaces. This design provides great flexibility to the system.



K4CARE PROJECT LIST OF MEMBERS

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The K4CARE Ontologies

www.k4care.net

The K4CARE project (IST-2004-026968) is an EC 6FP project aiming at the development, the integration and the use of several Information and Communication Technologies (ICT) and intelligent Computer Science (CS) technologies in the framework of Home Care (HC).

K4CARE is based on:

- a model for HC service which can be shared by the EU countries;
- an Electronic Home Care Record;
- a telematic and knowledge-based CS platform;
- an Actor Profile Ontology for representing the profiles of the subjects involved in the K4CARE model;
- a Case Profile Ontology for representing symptoms, diseases, syndromes;
- Computer-Based Formal Intervention Plans.

The K4CARE project is developed by thirteen EU partners: eight centres with geriatric, medical and healthcare competencies and five ICT and CS centres.

The K4CARE ontologies store the knowledge managed in the K4CARE system. They have been developed by a group of Medical Experts from different countries all over the new and old EU countries, with the help of Knowledge Engineers. The result is two ontologies:

- Actor Profile Ontology (APO)
- patient-Case Profile Ontology (CPO)