Abstract:

This paper explores the new methodology to provide the meteorology data and heterogeneous sensor data products .Semantic sensor and meteorology data based system transmit data in heterogeneous locations. These system maintain a centralized data management system disseminates to various research communities .In this work, meteorology data and sensor data are being addressed through ontology. A five phase methodology has been implemented to address the meteorology conceptual data. These methodology provide capability to build knowledge framework for information (data) retrieval by developing an effective vocabulary through the domain ontology.
The efficiency of the methodology is been tested by taking the Kalpana and INSTA-3A satellite data from MOSDAC and weather ontology.

Keywords: INSTA-3D,Kalpana,Sensor data, satellite data, ontology, heterogeneous and meteorology.

Introduction:

The various semantic sensor data and satellite data produce the large volumes of data in regular intervals. These volumes of data are used by various scientific, researches and remote sensing environments. Presently, the satellite data products are coming in heterogeneous vocabulary. These differences leads to difficulties in the use of data among research community and remote sensing environments. Data products from satellite observations have become an essential source of information to address and analyze in different applications such as natural resource management, disaster management, meteorology. As a result of the meteorological data are retrieval for research community because they are required to know 1) which data are available and 2)which data having the desired information 3)how such data can be accessed and queried. These system stores, classifies and retrieves the satellite data based on satellite, sensor, date, time, latitude, longitude .The processing and retrieval of these scientific data is based on the observation parameters, and has got a strong retrieval system, which can address queries like:

(i) Temperature data
(ii) Sea surface temperature based on date, time
(iii) Wind profiles from a satellite for a particular period
(iv) Open geo spatial location based data
(v) Units
(vi) Measurement

Hence there is a need to develop a methodology that allows access to heterogeneous data residing in different locations and in different vocabulary .The availability of data must adhere to various standards like vocabulary, data sharing and data exchange.

We describe the two major approaches for data exploitation using semantic technologies:1)the semantic sensor data format 2)ontology based data format.

Ontology is the one of the mostly used technology to develop a new methodology. It captures the structure of the domain (i.e.) conceptualization. Here the ontology driven for meteorological conceptual data is to describe the vocabularies of any domain with heterogeneous data format.

Ontology is mainly for define 1) rules that involve multiple input entities 2)one or more ontology classes 3)additional information for input data. An ontology driven meteorology conceptual data is a formal description of knowledge as a set of concepts with in a domain and fills the gap between satellite observation parameters. The importance of ontology is like,

- Reusability,
- Enhancement and
- Extensibility.

Ontologies can be energize and enhancing the descriptions with satellite observation parameters. Ontology based data structure can be used for creation of a centralized repository of metadata system of spatial resources useful of ISRO and other research community. Ontology driven meteorology conceptual data is the emerging methodology for knowledge based decision, management and interoperability. To achieve meteorology conceptual data based retrieval of satellite data:

- Ontology driven meteorology conceptual data need to be defined the satellite observation parameters.
- Satellite data storage.
- Facilitates semantic heterogeneity across Multiple observation parameters from multiple sources
- In most cases, access to the data parameter is made possible by the deployment of a spatial data infrastructure provides accessed and distributed to heterogeneous data resource to various sectors.

We present an approach for the transformation and integration of heterogeneous vocabulary or data with the objective of generating meteorological conceptual data in semantic web formats. The worldwide web consortium has developed a semantic web standards for exchanging data(e.g.RDF)for representing their semantics(e.g:OWL). The conceptual data using the query based systems for access through OGC CSW, WMS and WCS services. These services provide the data interoperability for various sectors.This analysis leads to propose a new approach for support in the interconnection of geospatial resources from various communities in order to manage large sets of heterogeneous and distributed resources and cover critical-use cases for environmental and researcher practices. The software component is designed and implemented to create a various satellite observation parameters to ontology concepts. This paper is further shows the details of the methodology.

Representation of Satellite Input Data Format(Hierarchical Data Format 5)

Hierarchical Data Format 5 (HDF5) is a unique open source technology suite for managing data collections of all satellite data. HDF5 files are self-describing and allow users to specify complex data relationships and dependencies.

HDF5 includes the following improvements in older hdf4,hdf3:

- ✓ A new file format designed to address some of the deficiencies of HDF4.X particularly the need to store larger files.

- ✓ More comprehensive data model
- ✓ A grouping structure
- ✓ A multidimensional array structure.

Some organizations uses HDF5 :

The Example are follows:

1. AEC,inc- In satellite meteorology (NPOESS).

2. Aqualinc Research Ltd- In field of groundwater hydrology.

3.Australian Nuclear Science and Technology Organization- In field of Neutron and . X- Ray Scattering.

4.Cardiff University- Division of Engineering at Cal Tech, is using HDF5 in the field of Ferroelectric materials.

5.C.I.R.A- In field of Computational Aero Acoustics**.**

Here INSTA-3A and Kalpana satellite using the data file format in HDF5 file format. The HDF5 Technology suite includes tools and applications for managing, manipulating, viewing, and analyzing data in the HDF5 format. The file structure of the sample input INSTA-3A satellite is shown below:

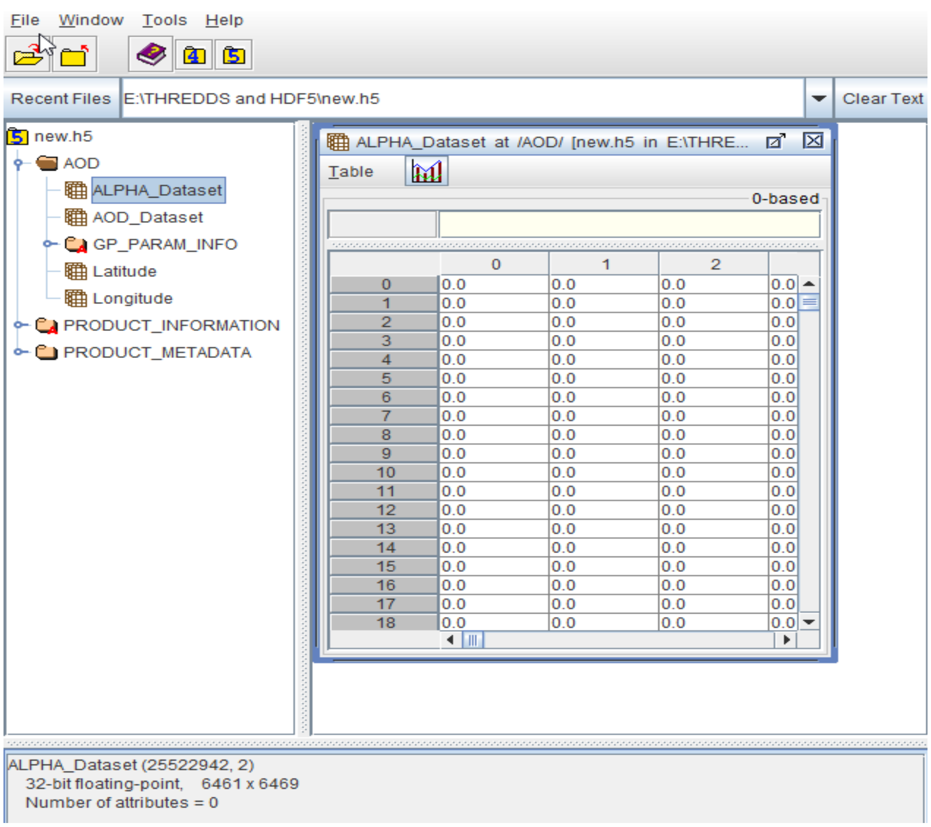

Fig: 1.1. The File Structure of INSTA-3A Satellite

Semantic Web Representation of Resource Description Framework for Satellite Data

Natural language (NL) is not appropriate for environmental issues and research sectors, but reference to Natural language. NL is a key factor for the design of program instructions that are both machine-ready for processing and understandable to humans. So we go for a web service (WS) is defined by the W3C as “a software system designed to support interoperable Machine to Machine interaction over a network and semantic web standards. Web services are used for small software and addressed in complex tasks over heterogeneous data and distribute data sources.

RDF is a framework for describing resources on the web. The RDF language is a part of the W3C's Semantic Web Activity.RDF information can easily exchange between different types of operating systems and application languages. These are used in various satellite data parameter.RDF identifies things using Web identifiers (URIs), and describes resources with properties and property values .Here the example of RDF document could describe the resource of satellite: "http://www.satellite.com/RDF":

```
<?xml version="1.0"?>
<RDF>
<Description about="http://www.satellite.com/RDF">
<Latitude>0000456</latitude>
<Longitude>100532</Longitude>
<Date>    08/07/1988</Date>
<Time>    05:20:40</Time>
<homepage>http://www.satellite.com</homepage>
</Description>
</RDF>
```

RDF is a data model used for metadata is a web resource, and then generalized for satellite data parameter. In RDF model, the base element is a triple. Here triple is used for one resource is linked to another resource. **The INSTA 3A satellite** using triple element in following representation :

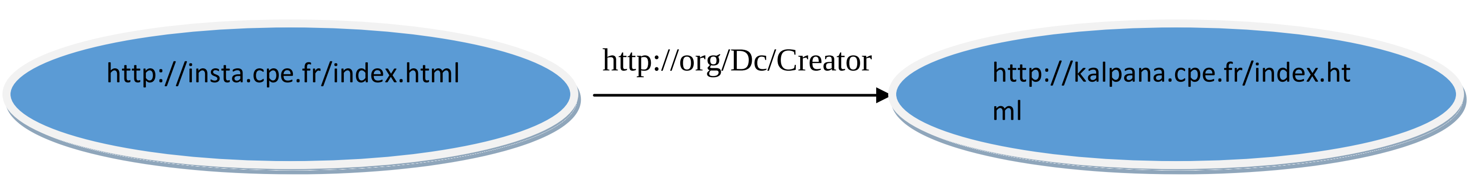

Fig: 1.2. Triple Representation of Satellite data

First resource triple element: http://insta.cpe.fr/index.html

Property: http://org/Dc/Creator

Another resource triple element: http://kalpana.cpe.fr/index.html

In RDF schemas using for new resources can be defined as specialization of old data(satellite data) .Schemas also constrain the context in which defined resources may be used in satellite data ,including the notation of schema validity. For example of the schema notation rule in RDF format of INSTA -3A is follows:

$$\forall s,p1,o,p2 \;\; T(s,p1,o) \wedge T(p1,rdfs{:}SubPropertyOf,p2) \Rightarrow T(s,p2,o).$$

Property – It denotes the relationship between resource data.

For example, if "**Temperature**" is sub property of "**INSTA-3A**" and triple having "**Temperature**" as predicate must also considered as having "**INSTA-3A**" as predicate.

This Example structure describes how input data convert to RDF using interfaces:

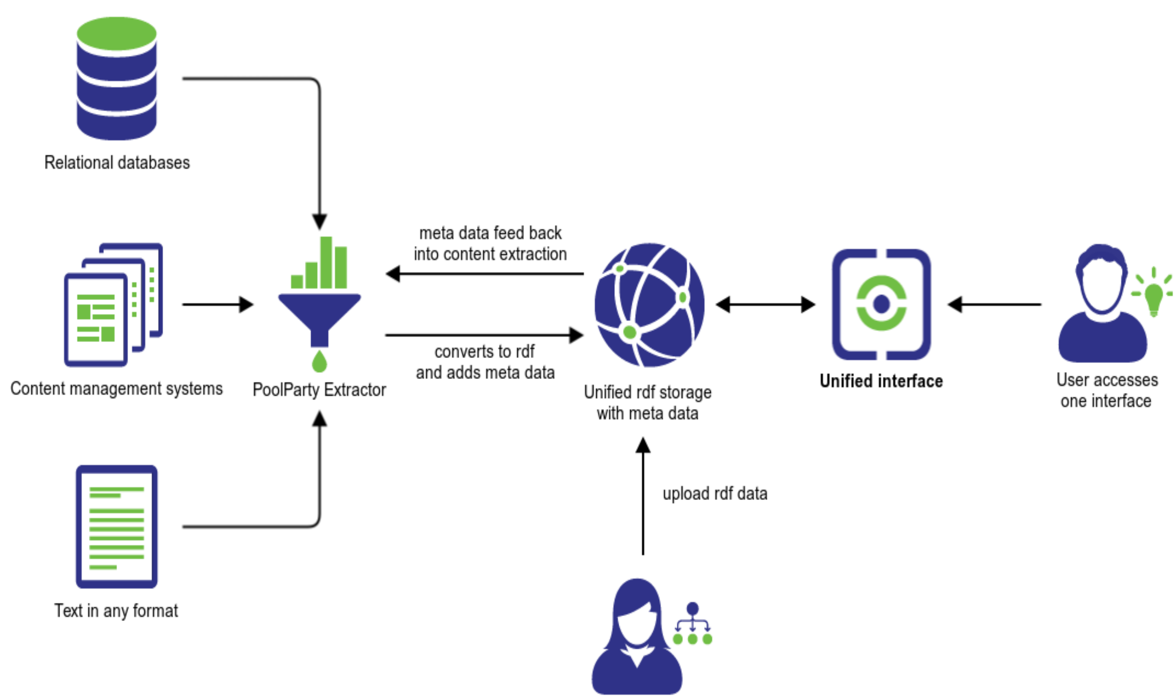

Fig: 1.3. The File Structure of upload RDF Satellite data using Interface

Ontology for Meteorological data

Meteorological conceptual data pertaining the atmosphere, such as wind, temperature, air density and other phenomena that affect the operations. Meteorological parameter normally caused by air movements within the atmosphere. All meteorological data are influenced by satellite directly or indirectly and this results in daily or weekly or monthly or yearly trends.

Meteorologists use a variety of tools to use for gather information about weather and climate. The weather fore cast, or reanalysis of meteorological fields are collections of meteorological parameters that characterize the state of the atmosphere. During the reanalysis of a meteorological data parameters corresponding to measurements at weather stations are usually taken into ontology. All large meteorological data center uses original meteorological models for calculation of climate and meteorological parameters, which can differ both in the level of detail and set of calculated values of physical parameters. These data are represented by data arrays in common formats, e.g., grib,netCDF,Hdf5. Every resource in our dataset is identified using a URI (Uniform Resource Identifier). The ontology for meteorological data collections in the form of a simplified formal OWL-ontology.OWL is for processing information on the web. This form was created for the selection of data collections within system. The OWL DL developed the ontology for climate and weather information resources. The OWL DL describes the collections of data arrays of the data processing environment.

The ontology of climate information resources object property table is given below:

Domain	Object Property	Range	Id
Spatiotemporal object	has_longitudes_array	Longitudes array	o10
Spatiotemporal object	has_latitudes_array	Latitudes_array	o11
Spatiotemporal object	has_height_levels_array	Height_levels_array	o12
Spatiotemporal object	hat_times_array	Times array	o13

Next, summarize some of these operations are important for maintenance and integration of **ontology for meteorology:**

- **Merge of ontologies**-The creation of a new ontology by linking up the existing ones.
- **Mapping** - From one ontology to another one is expressing of the way how to translate statements from ontology to the other one.
- **Alignment**-It is a process of mapping between ontologies in both directions whereas it is possible to modify original ontologies so that suitable translation exists (i.e., without losing information during mapping).
- **Refinement**-This is mapping from ontology for existing meteorology data to another ontology of new meteorology data so that every concept of ontology existing data has equivalent in new data.
- **Unification** - It is all of the concepts and relations in ontology for meteorology.
- **Integration** – It is a process of looking for the collection of meteorology data.

The software is used for processing spatial datasets, including observation and reanalysis data. The ontology forms a vocabulary and axioms that can be used to express knowledge base and that can be used for sharing knowledge between different systems.

Semantic web is an enhance to current web so that computers can process the information presented on WWW, interpret an connect it, to help researchers and other organization of peoples are to find the required knowledge about domain in easily. In other words, it is a project that should provide a common framework that allows data to be shared and reused across application.

Defining a Basic Weather Data Ontologies:

- **Geo Location ontology:** First define a common location models then proceed to show how they can be formally defined within the framework of ontology and applied to the integrated management of heterogeneous location information. The location information has been used the geo position and defining a mapping between the relationship like,

  ocean: located In and wgs86_pos:location.

- **Date and Time ontology:** The ontology provides a vocabulary for expressing about topological relations among instants and intervals, together with information about durations, and about temporal position including date- time information.

  Ontology representation of time consist of four things:
  - **Time-interval :** The Constant amount of time can be defined
  - **Time-duration:** The length of the time interval are used to define time duration.
  - **Time-point :** The position in temporal coordinate system which has no duration and is useful in locating event on the time-plenum.
  - **Time-dimension:** Time is considered a physical dimension such as length, mass or voltage ,with unit and physical properties.

OWL(Web Ontology Language):

OWL is a part of the "Semantic Web Vision". OWL comes with a larger vocabulary and stronger syntax than RDF. OWL and RDF are much of the same thing, but OWL is a stronger language with greater machine interpretability than RDF. The Set of technologies and frameworks that enable such integration (the Web of Satellite Data).

Desirable features identified for Web Ontology Language:

- ✓ Extends existing Web standards

  •Such as XML, RDF, RDFS

- ✓ Easy to understand and use .
- ✓ Formally specified –

  • Describes the meaning of knowledge exactly and fully sufficient of relating to the power Possible to provide automated reasoning support.

Example: Defining Terms and a Subclass Relationship Of Meteorology Data In OWL Language

Define the term “**Meteorology Data**”

<owl: Class rdf :ID=” Meteorology Data”>

Define term “**Temperature**” and state that a Temperature is a type of Meteorology Data.

<owl: Class rdf :ID=”Temperature”>

<rdfs: SubClassOf rdf: resource=”#Meteorology Data”/>

The actual technology used to attribute RDF data models with semantics. RDF data can be encoded with semantic metadata using two syntaxes: RDFS and OWL. Define our semantic terms, or classes, in a hierarchy. In the semantic web world, this hierarchy of terms is called a “**taxonomy**”. Here's a graphical illustration the taxonomy hierarchy have defined:

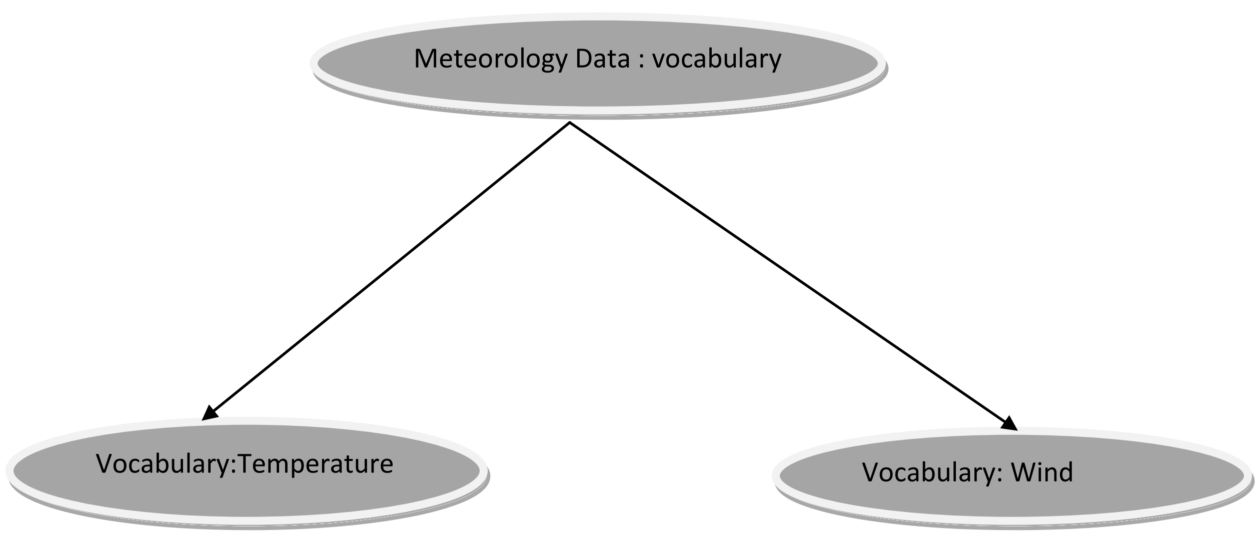

Fig: 1.4. The example of a Meteorology Taxonomy

The Review of Meteorology data in OWL Language:

Meteorology data in OWL comes with a larger vocabulary and stronger syntax than RDF. Its primary aim is to bring the suggestive and reasoning power of description logic to the semantic web. The OWL review describes the class,individuals and properties of Meteorology Data is follows:

- **Classes** **:** Relations between classes.
- **Individuals** **:** Instance of a Class
- **Properties** **:** Characteristics of properties.

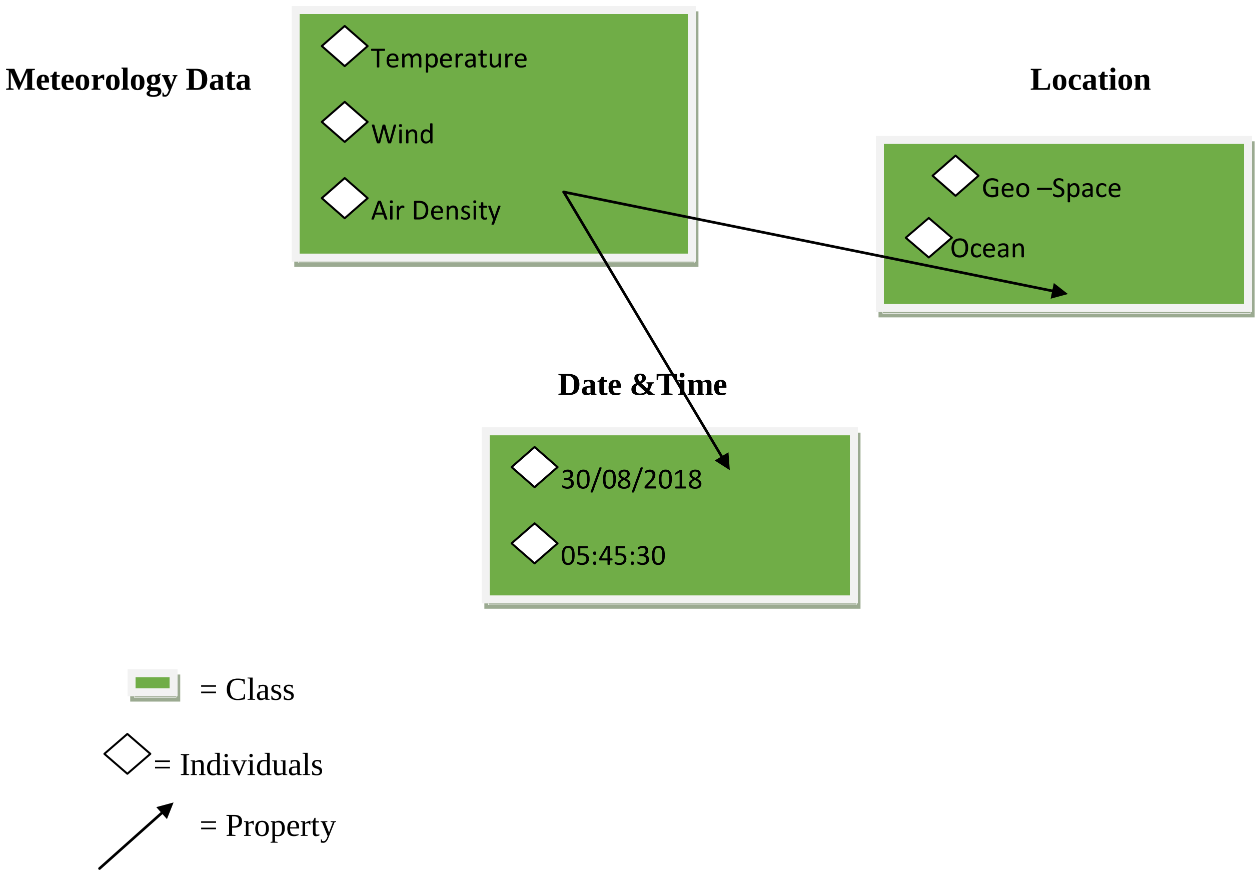

Fig: 1.5. The OWL Review of a Meteorology Data

Protégé:

Protégé is a free, open-source ontology editor and framework for building intelligent systems. Protégé is supported by a strong various sectors like academic, government, and corporate users, researchers who use Protégé to build knowledge-based solutions. Protégé is a GUI to help the editing of ontologies creation, modification, reasoning, debugging. Protégé is need to add

- Object properties
- Relations between classes
- Definable classes

In Protégé, the manually constructed class hierarchy is called the asserted hierarchy. The automatically computed by the reasoner is called the inferred hierarchy. Computing the inferred class hierarchy is also known as the classifying the ontology. An OWL ontology consists of Individuals, Properties, and Classes, which roughly correspond to Protégé frames Instances, Slots and Classes. An important difference between Protégé and OWL is that OWL does not use the Unique Name Assumption (UNA). This means that two different names could actually refer to the same individual.