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Compartive Study of Upper Ontologies in Interoperability View

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***Abstract*— Ontology is the philosophical study of nature of being, existence and reality. The concept was originated from philosophy. There are different kinds of ontologies are developed in multiple disciplines. The integration of domain ontologies needs common terminology to share information. Upper level ontologies are widely used in computer applications because of its interoperability nature. Although upper ontologies allows intergrating domain ontolgies, but it has limitations. This paper focuses to anlayse different upper ontologies based on inter operable view.**

Keywords— Ontology, Top level ontologies, Interoperability

I. INTRODUCTION

The term ontology has its origin in philosophy and has been applied in many different ways. In computer science field ontology refers to electronic resource which contains domain semantics. Ontology consists of relatively generic knowledge that can be reused by different kinds of applications. The core meaning within computer science is a model for describing the world that consists of a set of types, properties, and relationship types. There is also generally an expectation that the features of the model in ontology should closely resemble the real world. The Internet made a gateway to access plenty of resources in multiple domains. Ontology is a shared conceptualization of a domain.

II. RELATED STUDIES

In 500 BC Parmenides first coined the word ontology. It is derived from philosophy and metaphysics. Later in 1990s innovation of Artificial Intelligence enabled to combine multiple disciplines. There are many knowledge based ontological models were developed. In 1980 John McCarthy [1][2] proposed computer based environmental ontology. In the year 1993Gruber [3][4] developed a ontology in conceptualisation. In 1995 Guarino[5] and Giaretta[6] proposed ontology for search of essence of beings. In 1998 the formal ontologies was developed based on relationships by Guarino[7] and Smith[8]. In the same year Mosterin[9] developed component based ontology. In the recent years much ontologies developed in different domains. The present problem is diverse of development of various ontological domains to be integrated to solve real world problems. Inorder to build relationships among ontologies, the transformation is the basic phenonomenon for it which is called inter operability.

A. Ontology

Ontologies are used to specify the meaning of the terms in a vocabulary that is used within the domains. It provides structured vocabularies that build the relationships between different terms, allowing humans to interpret their meaning flexibly and unambiguously. Although the information are available in machines but it could not be used by the humans directly.

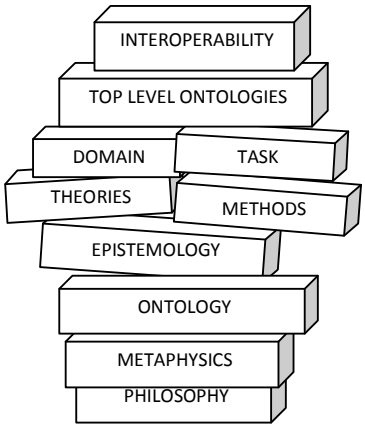

Fig.1 Ontology

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B. Top Level Ontology

Top Level or upper ontology or foundation ontology is a generic form of ontology which enables to connect across various knowledge domains. The primary functionality of top level ontology is to support semantic interoperability. The integration and building up of top level ontology requires similar domains. The fig.1 shows hierarchical view of integration of upper ontologies. The top level ontology requires two things for its structure. First, each domain must be capable to share similar information to build relationships and second each domain can able to transform its structure (contextually) related to specific domain and these two things are known as interoperability. The pre-processing and analysis are required to refine information extraction and exchange of information must be done in understandable manner. Semantic interoperability is the ability to exchange information among separately developed ontology domains, including the understanding of the information's format, meaning, and quality, so that the multiple domains can share the information in meaningful manner. Hence ensuring semantic interoperability is an important task. When different domain-specific ontologies are integrated then it becomes more difficult to achieve interoperability.

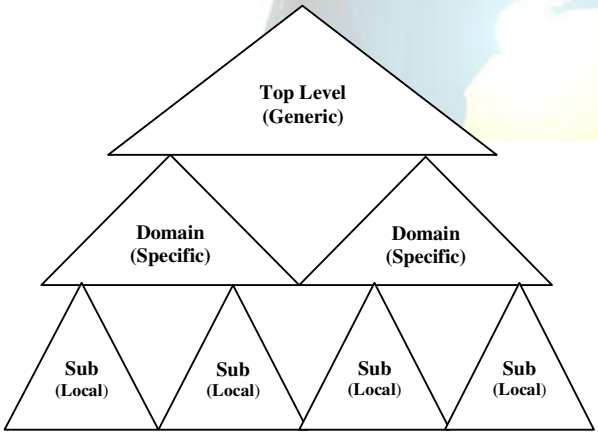

Fig.2 Hierarchical form of Top Level Ontology

C. Need for Ineroperability

The integration of different domains of ontologies requires semi structured form to exchange information. This leads to reduce the complexity in compatibility and enables transformation of information in understandable form. The basic need for semantic interoperability is extensive mechanism in top level ontologies.

III. Comparison of Top Level Ontologies

In world all ontologies were developed in specific domains. The exchange of information between existing domains in meaningful (semantic) manner is too complex. The lack of vocabulary, technical transformations, relations, formats, structure, logical binding are the important factors which are affecting meaningful exchange of information between ontologies. The interoperability allows communicating, exchange and sharing information without change of its meaning. In the year 2004 Poli [10] proposed formal ontology mechanism which enabled to restructure ontologies based on its scope. It builds logical structure to build ontological communication in both local and global view.

A. Ontological Communications

The assumption behind upper-level ontologies is that, when the generalization is performed in ontologies of multiple domains, we will come up with a small set of categories which is the same in all these domains. Most domains will deal with objects, processes, properties, relations, space, time, roles, functions, categories, individuals or similar. Upper-level ontology defines and axiomatizes these most general categories. The table shows various ontologies with its integrations. Based on the extensible mechanism and inherent nature of domains, the interoperability view is categorised as specific and general. The general category shows that the domain have extensible mechanism to include multiple ontologies with specific domains. This extensible mechanism increases the interoperability feature.

Ontology	Domain	Interoperability
BFO	Basic Formal Ontology Collection of Interrelated Sub (Local) Ontologies	Specific
BORO	Business Objects Reference Ontology Collection of Sub Ontologies and availability mechanism for building semantic models	Specific
CIDOC	Conceptual Reference Model	Specific
COSMO	Common Semantic Model Foundation ontology for semantic Interoperability	Semantic
DOLCE	Descriptive Ontology for Linguistic and Cognitive Engineering Natural Language and Common sense	Specific
GFO	General Formal Ontology Integration of Processes and Objects	Specific
GIST	Enterprise Information Systems	Specific
YAMATO	Yet Another More Advanced Top Ontology Process and Events , Medical Ontology	Specific
OCHRE	Object-centered high-level reference ontology Basic Frame work development with conceptual simplicity	Specific

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SUMO	Suggested Upper Merged Ontology Integration of Multiple Ontologies, Extensible , Connected with Wordnet	Semantic
WordNet	Semantic network with extensive mechanism (SUMO, UMBEL)	Semantic
UFO	Unified Foundational Ontology Intergration of foundation ontologies (GFO and DOLCE)	Semantic
Open CYC	Old and very Extensible , Integrated with multiple ontologies (UMBEL etc)	Semantic

Table 1Types Of Top Level Ontologies

With respect to the semantic feature of existing ontologies, COSMO, SUMO, Wordnet, UFO, OpenCyc types are taken in to count. COSMO has the inbuilt mechanism of interoperability which contains semantic relations but it gives common structure for all domains. When same types of ontologies are combined, it will give better results. In the case of interoperability, different ontologies must be related. SUMO and UFO are good ontologies. SUMO is a part of Wordnet and has limited scope when compared with Wordnet. UFO is an integration of foundation ontologies which covers most important ontology domains. The OpenCyc ontology has the comprehensive and integrated with different domains. The knowledge scope wider and by that way it is more interoperable. The coherent and extensible features of OpenCyc enables to compatible with existing domains.

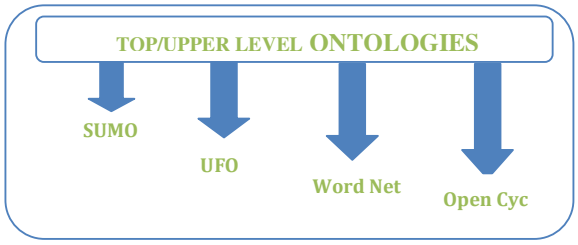

Fig.3 Interoperable View of Top Level Ontologies

IV. CONCLUSION

The concept of ontology has been taken up by Computer Science with a different meaning than it was described in Philosophy. we have done comparative analysis of upper ontologies in interoperability view. Based on the extensible feature, comprehensive nature and integration of existing technologies, the OpenCyc ontology has the higher scope. It has both compatibility and transformation with other ontologies. The work concentrated only with existing domains and a centralised model would be a solution to reach the goal in semantic interoperability.

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