Semantic Web Technologies and Applications in e-Biz

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Agenda

- Introduction
  - ⇨ What & Why the Semantic Web?
- Semantic Web Applications in e-Biz
  - ⇨ Weaknesses of the Current Web Technologies
  - ⇨ Potentials of Semantic Web Technologies
- Semantic Web Technologies
  - ⇨ Ontology Representation
  - ⇨ Languages & Tools
- Future of the Semantic Web

The Vision of the Web

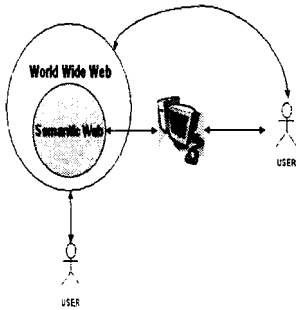
- collaboration between people
- collaborations extend to computers

Everything is connected to the Information Space.

The Bottleneck

- The amount of information accessible from the Web is rapidly increasing.
- The information sources are increasingly complicated.
- The types of information source becomes diverse.

The Semantic Web



The Relationship between the Semantic Web and WWW

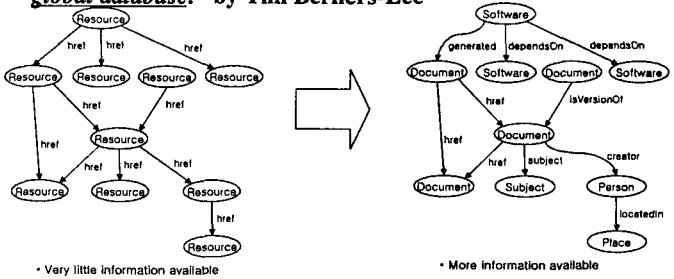
- **A Vision Of Possibilities**
  - **"The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation."**
  - *Tim Berners-Lee, James Hendler and Ora Lassila, The Semantic Web, Scientific American, May 2001*

The Semantic Web

- **enable intelligent services**
  - information broker,search agents, and information filters
- **further levels of interoperability have been established**
- **standard must be defined not only for the syntactic form of documents, but also for their semantic content**

The Evolving Web

- **"The Semantic Web is a web of data, in some ways like a *global database*." by Tim Berners-Lee**



- Very little information available
- More information available

More Intelligent Knowledge Exchange

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- **Semantic Web Technologies**
  - ⇨ **Ontology Representation**
  - ⇨ **Languages & Tools**
- **Future of the Semantic Web**

Interoperability Problem in e-Biz

- The lack of proper standards in the e-Biz world
  - ⇨ HTML does not neither provide syntax and semantics of information
  - ⇨ Lack of integration of data exchanges between online market participants
  - ⇨ Existing standards like EDIFACT are isolated and costly to manage
- XML provides some solutions for B2B
  - ⇨ Human Understandable for Data Description
  - ⇨ Easy and cheap to maintain
  - ⇨ ebXML provides a comprehensive set of standardized XML document formats (Syntactic Interoperability)
  - ⇨ Good tool support for all document processes in e-Biz

Too Many Standards

- There are more "standards" than you would like to have
  - ⇨ UNSPSC, UCES, ecl@ss, RossettaNet, and much more vertical and horizontal standards
  - ⇨ Serious translation problem
- All of the "standards" are based on semi-structured descriptions
  - ⇨ XML based descriptions of products, services, and business processes

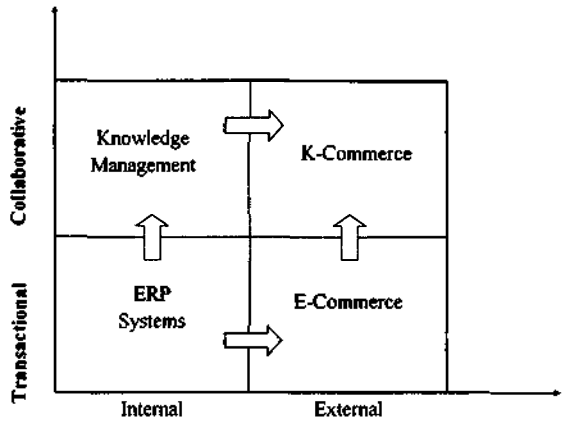
Why Semantic Web?

- Mapping and Integration between different "standards"
  - ⇨ Semantic Interoperability
- Automization of business processes in terms of the formal semantics of descriptions
  - ⇨ Machine Understandability
- So, buying decisions can be based on the whole of the relevant information
  - ⇨ Finding all relevant information sources and online stores for a specific product
  - ⇨ Integrating all information available on the Web, for comparing products and vendors

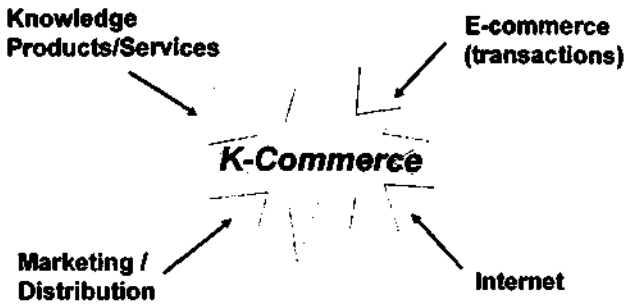
Potentials of Semantic Web Technologies

- Automatic vendor recognition
- Automatic product and service recognition
- Price and quality comparison
- Automatic negotiation protocols
- Automatic coalition forming of vendor groups

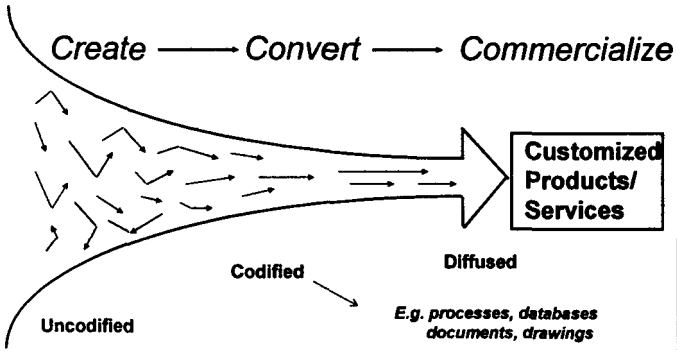
IS Evolution Path



K-Commerce



Knowledge Packaging



The Semantic Web Architecture for e-Biz

- **The use of URIs**
  - ⇨ A global identification mechanism for products and traders
- **The RDF data model**
  - ⇨ The direct publication of data on the Web using XML serialization
  - ⇨ Rich metadata for contents
- **The Web Ontology Language (OWL)**
  - ⇨ The definition of common terms and concepts needed to understand RDF data

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How the Semantic Web Will Be Possible

- Languages
  - Formal Syntax and Formal Semantics
  - Real world semantics → "Ontologies"
- Tools
  - Ontology builders and browsers
  - Ontology integration tools
  - Semantic annotators
  - Reasoners
- Applications
  - Knowledge management systems
  - Natural language search engines
  - e-Biz

Ontology

- Shared understanding within a community of people
- Declarative specification of entities and their relationships with each other
- Syntactically and semantically richer than common approaches for databases
- Providing a domain theory and not the structure of a data container

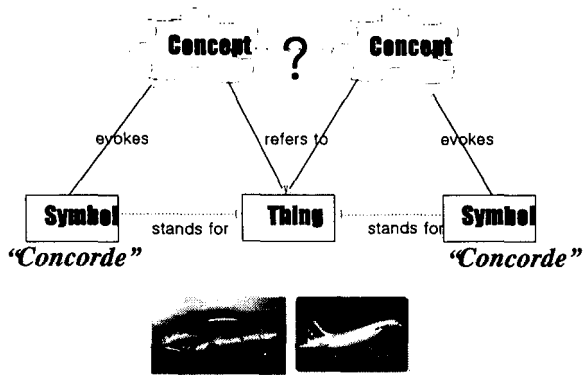
Relational Database Schemas

- Well established technique for specifying the structure of shared data, not for communication between people or agents
- Declarative specification but of tables, not of entities and relationships
- Some constraints are expressible but no significant rules (such as inheritance)
- No explicit behavior
- Standard language is SQL.

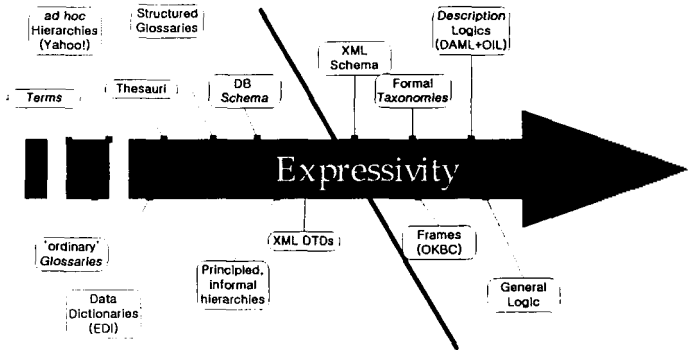
Logic

- Very expressive but very difficult to use. Not designed for communication.
- Most logical languages are not based on entities and relationships.
- Very powerful reasoning capabilities.
- Do not usually have any associated behavior.
- Many examples: Prolog, KIF, Slang, ...

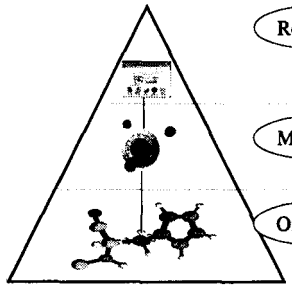
Meaning and Human Communication



Kinds of Ontologies



Information Retrieval Using Ontologies



Resource

http://www.aphis.usda.gov/ns/pubs/qafmd300.html

Metadata

- FMD(Foot and Mouth Disease), Animal Welfare Information Center
- Kanghwado, South Korea

Ontology

FMD is caused by an RNA virus Kanghwado is located in Gyeonggi, South Korea

Neither this particular resource nor its metadata explicitly mention the recent occur of a RNA related virus in Gyeonggi, South Korea

Only an assisted search that maps metadata to underlying ontologies could retrieve this resource in response to the query "***the recent occur of a RNA related virus in Gyeonggi, South Korea.***"

Knowledge Representation on the Web

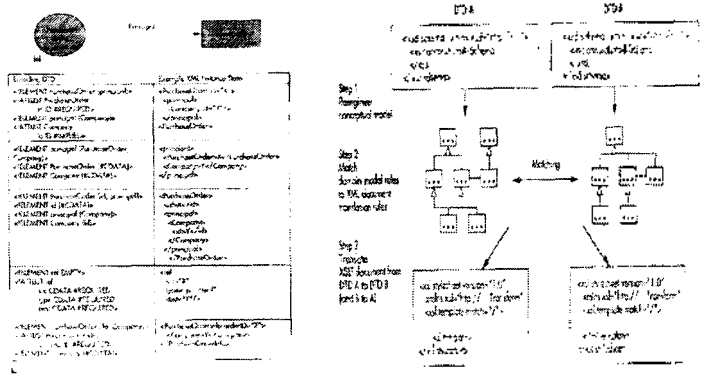
- Universal expressive power
  - A Web based exchange format must be able to express any form of data.
- Syntactic interoperability
  - Applications must be able to read the data and get a representation that can be exploited.
- Semantic interoperability
  - Semantic interoperability is about defining mappings between terms within data, which requires content analysis.

Limits of XML

- How do I know that you mean the same thing by <price> that I do?
  - ⇨ Does that include tax? shipping? surcharges?
- That is, if the computers of two companies are negotiating, they need to know that they truly understand each other.
- XML provides *syntactic* interoperability. There is a need for *semantic* interoperability.
- The semantic web provides this added layer of interoperability through the use of *shared ontologies.*

Using XML

- In semantic interoperability
  - has disadvantages

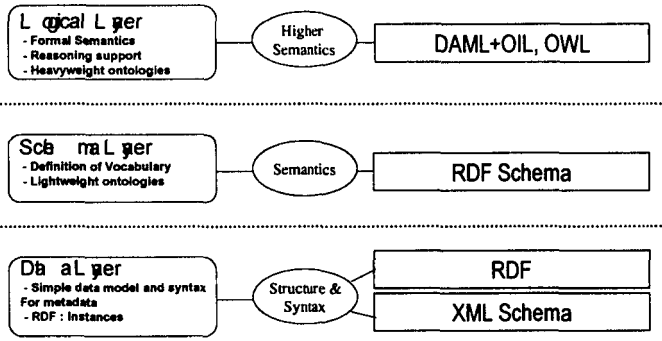


Using RDF

- Expressive power
  - RDF's nested objected-attribute-value structure satisfies our universal expressive power requirement for an exchange format.
- Syntactic interoperability
  - Application-independent RDF parsers are also available.
- Semantic interoperability

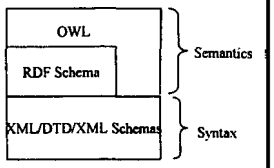
  RDF has significant advantages over XML.

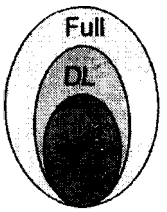
Three Layered Architecture of the Semantic Web



OWL Language

- **Three species of OWL**
  - ⇨ OWL full is union of OWL syntax and RDF
  - ⇨ OWL DL restricted to FOL fragment (¼ DAML+OIL)
  - ⇨ OWL Lite is "easier to implement" subset of OWL DL
- **Semantic layering**
  - ⇨ OWL DL ¼ OWL full within DL fragment
  - ⇨ DL semantics officially definitive
- **OWL DL based on SHIQ Description Logic**
  - ⇨ In fact it is equivalent to SHOIN(D_n) DL
- **OWL DL Benefits from many years of DL research**
  - ⇨ Well defined semantics
  - ⇨ Formal properties well understood (complexity, decidability)
  - ⇨ Known reasoning algorithms
  - ⇨ Implemented systems (highly optimised)



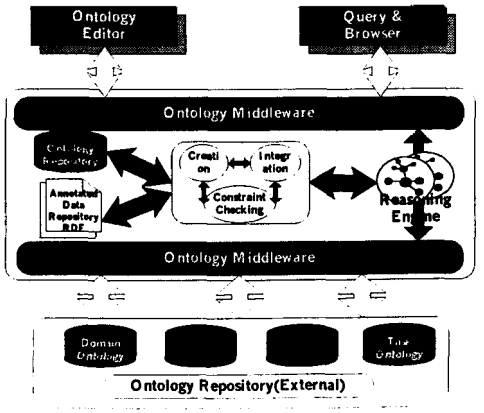


OWL Example (Classes Description)

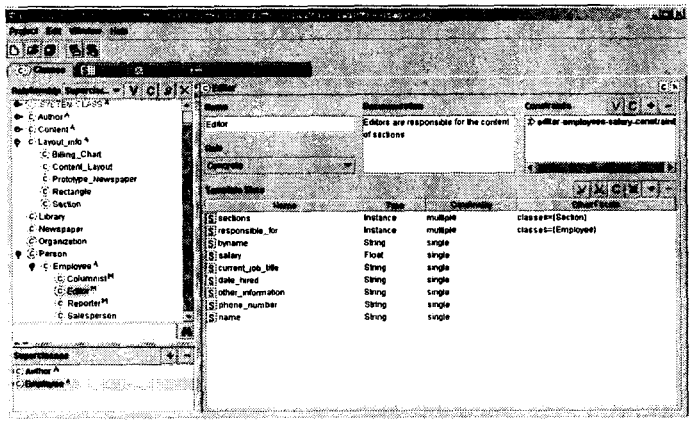
- **WhiteWine ∩ hasSugar.(Dry ∪ OffDry)**

```
<owl:Class rdf:ID="WhiteNonSweetWine">
  <owl:intersectionOf rdf:parseType="Collection">
    <owl:Class rdf:about="#WhiteWine" />
    <owl:Restriction>
      <owl:onProperty rdf:resource="#hasSugar" />
        <owl:allValuesFrom>
          <owl:Class>
            <owl:oneOf rdf:parseType="Collection">
              <owl:Item rdf:resource="#Dry" />
              <owl:Item rdf:resource="#OffDry" />
            </owl:oneOf>
          </owl:Class>
        </owl:allValuesFrom>
      </owl:Restriction> ...
```

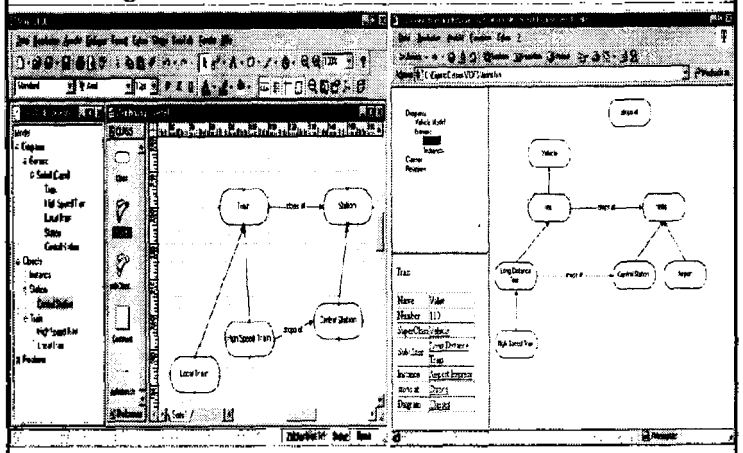

Ontology Tool Architecture



Editor : Protégé-2000



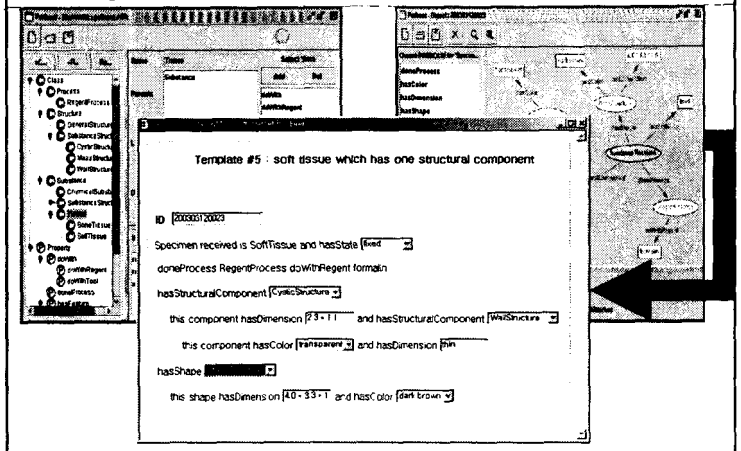
Modeling Tool: SemTalk



Tools

Feature	OILEd	OntoEdit	Ontolingua	OpenKnoME	Protégé-2000	WebODE
Developers	Uni. of Manchester	Ontoprise	KSL(Stanford Uni.)	Uni. of Manchester	SMI(Stanford)	Ontology Group(UPM)
Availability	Open source	Freeware	Free Web Access	Freeware	Open source	Free Web Access
Architecture	standalone	Standalone	Client/Server	Client/Server	Standalone	3-tier
Extensibility	no	Plug-ins	None	None	Plug-ins	Plug-ins
Import for Language	XML RDFS(S) Flogic DAML+OIL	XML RDFS(S) Flogic DAML+OIL	Ontolingua IDL KIF	GRAIL GALEN IR	XML RDF(S) XML Schema	XML RDF(S) CARIN
Export to Language	OIL RDF(S) DAML+OIL SHIQ	XML RDF(S) Flogic DAML+OIL	KIF3.0 CLIPS LOOM OKBC PROLOG	GRAIL CLIPS GALEN IR HTML	XML RDF(S) XML(S) Flogic JAVA	XML RDF(S) OIL DAML Prolog
KR paradigm	DL(DAML+OIL)	Frames+FOL	Frames+FOL	DL(GRAIL)	Frames+FOL	Frames+FOL
Graphical taxonomy	No	No	Yes	No	Yes	Yes
Collaborative working	No	No	Yes	Yes	No	Yes

Knowledge Modeling Tool for Pathological Gross Description



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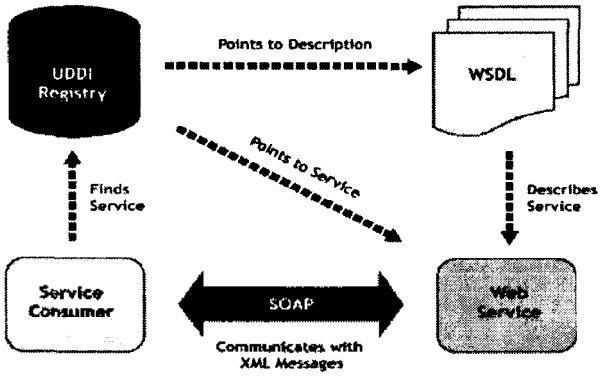
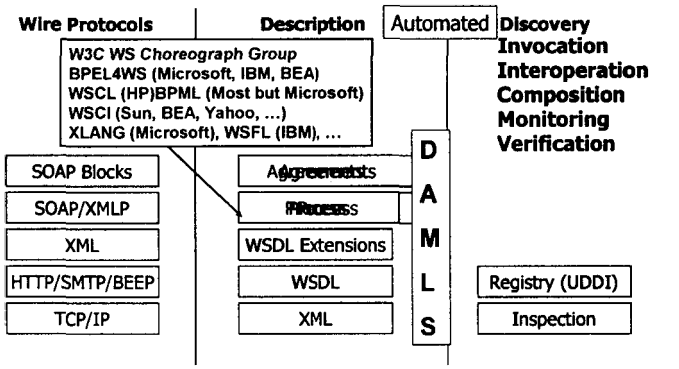
Web Services : current technologies

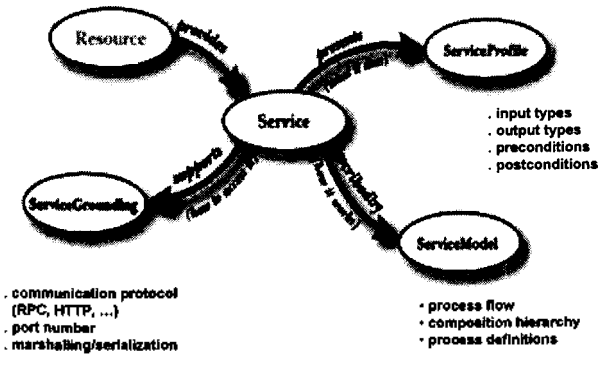


The Web Services Stack

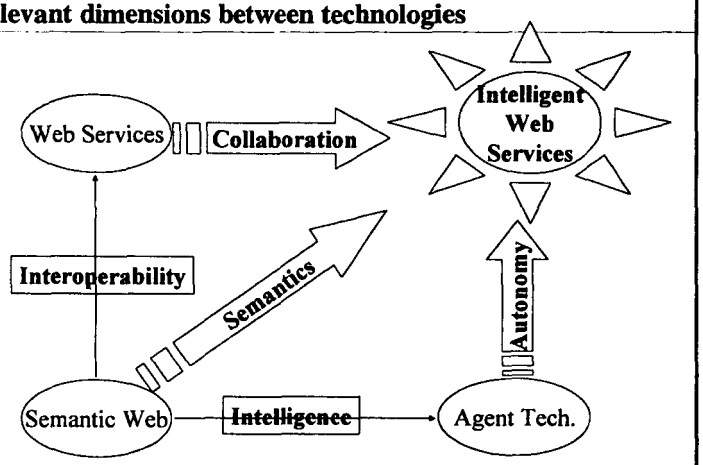


Modification of slide by James Snell (IBM)

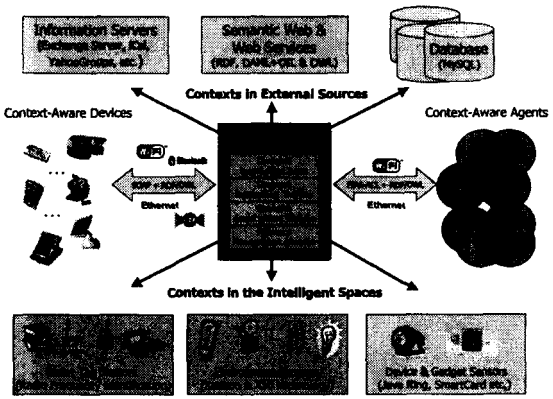
Semantic Web Services (DAML-S Upper Ontology)



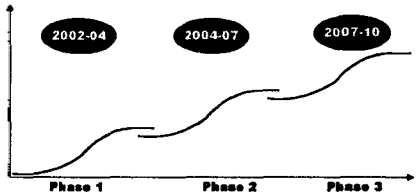
Relevant dimensions between technologies



CoBrA Architecture



Future of the Semantic Web Technology



	Phase 1	Phase 2	Phase 3
시장 확대 단계	기존의 분류체계를 온톨로지화 하고 선도적 사용자들이 조직내외 핵수 중요 온톨로지를 구축하는 초기 단계	시맨틱 웹 기술의 성숙 기로서 각 산업별 다양한 온톨로지가 구축되고 온톨로지 사용이 확산되는 단계	애플리케이션/프로세스 통합을 위한 온톨로지 기반 기술이 광범위하게 사용되는 보편화 단계
설명/예	• 과학 - NIH의 게놈 데이터 온톨로지 • 의학 - SNOMED, GALEN • ISO 표준 분류체계 • SIC 산업분류체계 • 정량급 온톨로지 상품 카탈로그 - 야후 디렉토리	• 온톨로지 저작 및 플랫폼 도구 개발자들이 출현 • EC 애플리케이션에 온톨로지 사용이 보편화 - EIP, CRM, SCM, ERP • First Horizontal apps - proof and trust 서비스	• RDF, 웹기반 온톨로지 언어 사용이 보편화됨 • 각 산업별 표준급 온톨로지 개발이 보편화 • 온톨로지 기반 수평적 애플리케이션 통합 • 지능형 웹서비스, 시맨틱 애플리케이션 에이전트 기술 유비쿼터스 컴퓨팅

Source: Christian Ohms, 2002

Conclusion

- **What the Semantic Web is NOT ...**
  - ⇨ The Semantic Web is not Artificial Intelligence
  - ⇨ The Semantic Web does not allow arbitrary complexity
  - ⇨ The Semantic Web is not something that will ever be complete
- **What the Semantic Web IS ...**
  - ⇨ A great vision
  - ⇨ Something that will be built over time
  - ⇨ An emergent property of the global effort towards standardization around XML

Final Words

"Ask not what the Semantic Web can do for you,
ask what you can do for the Semantic Web"

Hans-Georg Stork