

Will the Semantic Web deliver Information Interoperability?

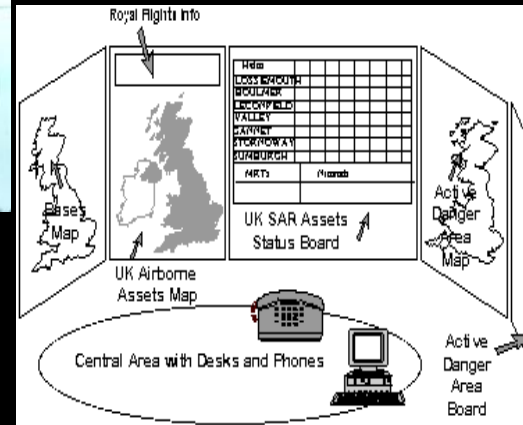
Professor Nigel Shadbolt FBCS
School of Electronics and Computer Science
University of Southampton
nrs@ecs.soton.ac.uk



Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 01 DEC 2005		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Will the Semantic Web Deliver Information Interoperability?				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) School of Electronics and Computer Science University of Southampton Intelligence, Agents, Multimedia Group Electronics and Computer Science Southampton, Hants SO17 1BJ UK				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM202135, RTO-MP-IST-042. Coalition C4ISR Architectures and Information Exchange Capabilities (Les architectures C4ISR et les capacites d'echange d'information en coalition), The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 29	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Some Personal Experiences

- Industrials
 - CCL
 - Epistemics
 - Rolls Royce
- DERA
 - SA for SAR
 - FOAEW
 - With USAF Cognitive Cockpit
- DTC project
 - KB SA for OOTW
- DSTL
 - IM in NEC MPA
 - CBM



Network Enabled Capability: e-Defence

- Key Drivers
 - not just plumbing legacy systems!
 - achieving shared understanding & decision-making – semantic interoperability
 - enabling two types of networks: people & equipment
- Key NEC Themes
 - Effect Synchronisation
 - Agile Mission Groups
 - Dynamic Collaborative Working
 - Shared Understanding
 - Full Information Accessibility
 - Resilient Information Infrastructure
 - Inclusive Flexible Acquisition



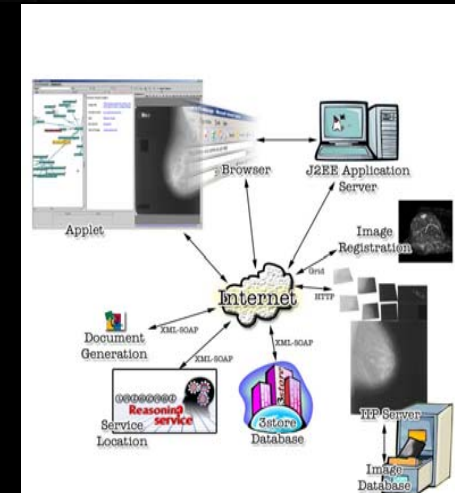
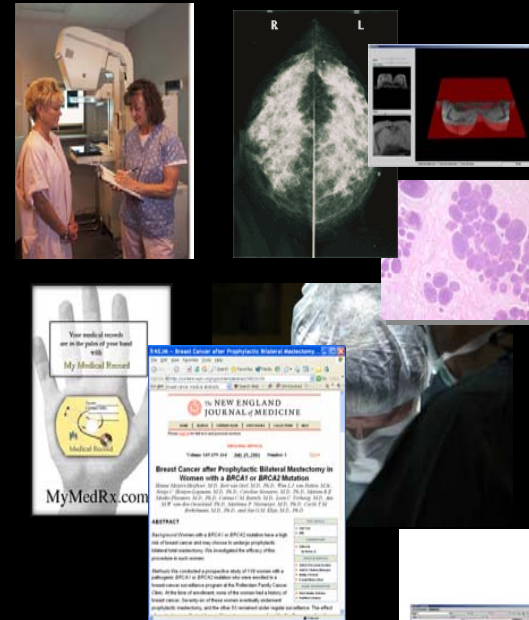
**Specifying the
information required
and using it better**

**Getting information
to the right place and
sharing it**



Network Enabled Healthcare: e-Health

- Key Drivers
 - not just plumbing legacy systems!
 - achieving shared understanding & decision-making – semantic interoperability
 - enabling two types of networks: people & equipment
- Key NEH Themes
 - Effect Synchronisation
 - Agile Medical Teams
 - Dynamic Collaborative Working
 - Shared Understanding
 - Full Information Accessibility
 - Resilient Information Infrastructure
 - Inclusive Flexible Acquisition



Putting Semantics on the Web

[http://
www2002.org](http://www2002.org)



WWW 2002

**THE ELEVENTH INTERNATIONAL
WORLD WIDE WEB CONFERENCE**

Sheraton Waikiki Hotel
Honolulu, Hawaii, USA
7-11 May 2002

CONFERENCE ORGANIZERS



International World Wide
Web Conference Committee

1 LOCATION. 5 DAYS. LEARN. INTERACT.

[Conference
Proceedings](#)

[Call for
Participation](#)

[Program](#)

[Registration
Information](#)

[Hotel
Accommodation](#)

[Conference
Committee](#)

[Sponsorship/
Exhibition
Opportunities](#)

[Volunteer
Information](#)

[Information
about Hawaii](#)

[Previous & Future
WWW Conferences](#)

Registered participants coming from:

[Australia](#) · [Canada](#) · [Chile](#) · [Denmark](#) · [France](#) · [Germany](#) · [Ghana](#) · [Hong Kong](#) · [India](#) · [Italy](#) · [Ireland](#) · [Japan](#) · [Malta](#) · [New Zealand](#) · [The Netherlands](#) · [Norway](#) · [Singapore](#) · [Switzerland](#) · [The United States](#) · [Vietnam](#) · [Zambia](#)

REGISTER NOW

On 7-11 May 2002, Honolulu, Hawaii will provide the backdrop for The Eleventh International World Wide Web Conference. This prestigious series of the International World Wide Web Conference Committee (IW³C²) attracts participants from around the world, and it provides a public forum for the World Wide Web Consortium (W3C) through the annual W3C track.

The conference is being organized by the [International World Wide Web Conference Committee \(IW³C²\)](#), the [University of Hawaii](#) and the [Pacific Telecommunications Council \(PTC\)](#).

FEATURED SPEAKERS (CONFIRMED)



Tim Berners-Lee, inventor of the World Wide Web and Director of the W3C who now holds the 3Com Founders chair at the Laboratory for Computer Science (LCS) at the Massachusetts Institute of Technology (MIT).



Richard A. DeMillo, vice president and chief technology officer for Hewlett-Packard Company.



Ian Foster, guru of "Grid Computing", associate



Samuel J. McArthur, Prize Winner,

Machine Readable....

<http://www2002.org>



WWW 2002

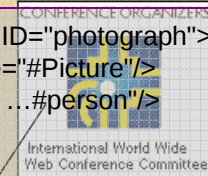
THE ELEVENTH INTERNATIONAL WORLD WIDE WEB CONFERENCE

Sheraton Waikiki Hotel
Honolulu, Hawaii, USA
7-11 May 2002

Event:WebPage

1 LOCATION. 5 DAYS. LEARN. INTERACT.

```
<daml:ObjectProperty rdf:ID="photograph">
  <rdfs:domain rdf:resource="#Picture"/>
  <rdfs:range rdf:resource=...#person"/>
</daml:ObjectProperty>
```



Conference Proceedings
Call for Participation
Program
Registration Information
Hotel Accommodation
Conference Committee
Sponsorship/Exhibition Opportunities
Volunteer Information
Information about Hawaii
Previous & Future WWW Conferences

Registered participants

Australia · Canada · Chile
Netherlands · Norway · Singapore

On 7-11 May 2002, Honolulu, Hawaii, the prestigious series of the International World Wide Web Conference provides a public forum for the exchange of ideas and information.

The conference is being co-located with the Pacific Telecommunications Conference (PTC) at the Sheraton Waikiki Hotel.



Tim Berners-Lee
and Dan Connolly
Founders chair at the Laboratory for Computer Science (LCS) at the Massachusetts Institute of Technology (MIT).

Ian Foster, chair of "Grid Computing" association

```
< > rdf:type photo:Photograph,
Photo:File
http://.../images#image1,
Photo:topic
:event1#event:speaker.
```

```
Event1 a Event:event;
date "May 7-11",
speaker http://...#timbl.html
Title "WWW 2002..."
```

```
TimBL rdf:type w3c-ont:person;
name "Tim Berners-Lee"
```

```
<rdf:Description rdf:about="http://www.w3.org/2001/03/earl/0.95#Person">
  <rdf:type rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
  <rdfs:subClassOf rdf:resource="http://www.w3.org/2001/03/earl/0.95#Assessor"/>
</rdf:Description>
```

```
<s:Class
  rdf:about="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.dam#Conference">
  <s:comment>
    describes a generic concept about events
  </s:comment>
  <s:subClassOf
    rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.dam#Event"/>
  <a:disjointFrom
    rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.dam#Workshop"/>
  <a:restrictedBy
    rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.dam#genid18"/>
```

Italy · Japan · Korea · Mexico · Norway · Singapore · Sweden · The Netherlands · United Kingdom · United States

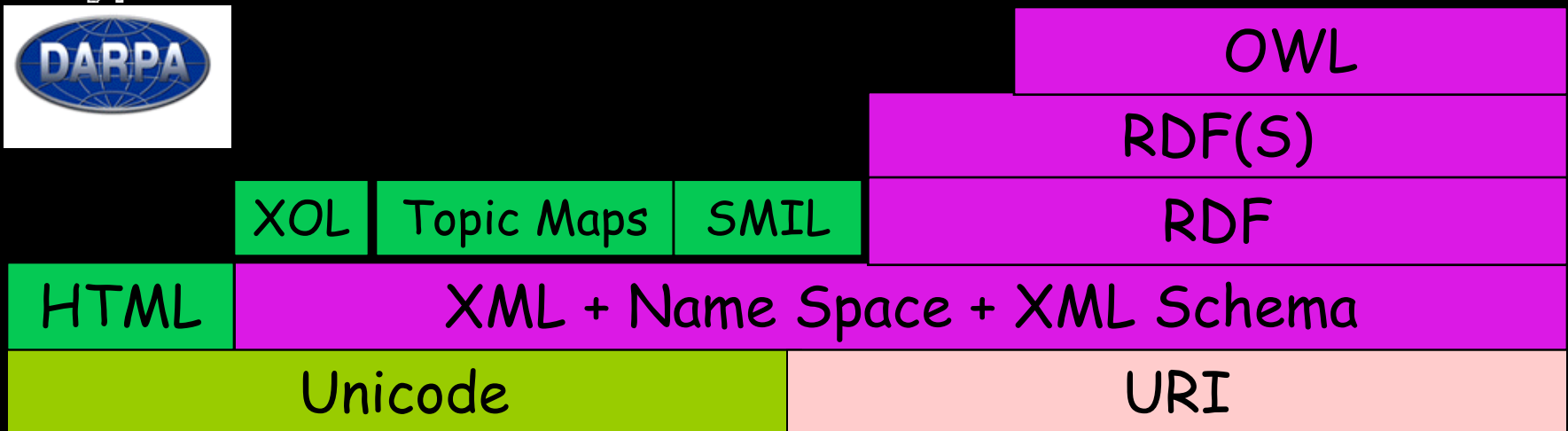
International World Wide Web Conference. This conference is the largest and most prestigious series of the International World Wide Web Conference, attracting participants from around the world, and providing a public forum for the exchange of ideas and information.

The conference is being co-located with the Pacific Telecommunications Conference (PTC) at the Sheraton Waikiki Hotel.

Richard A. DeVillo, vice president and chief technology officer of Hewlett-Packard Company

McArthur Prize Winner, 1996

Standards are fundamental



Ontologies: Fundamental Building Blocks of the Semantic Web

Perspectives on ontologies

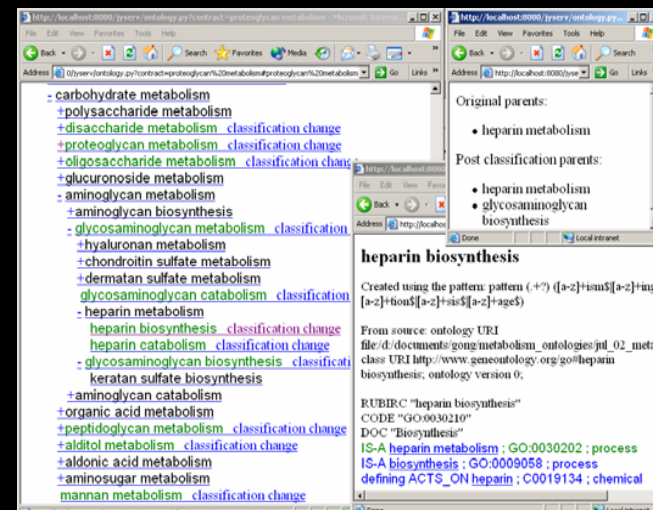
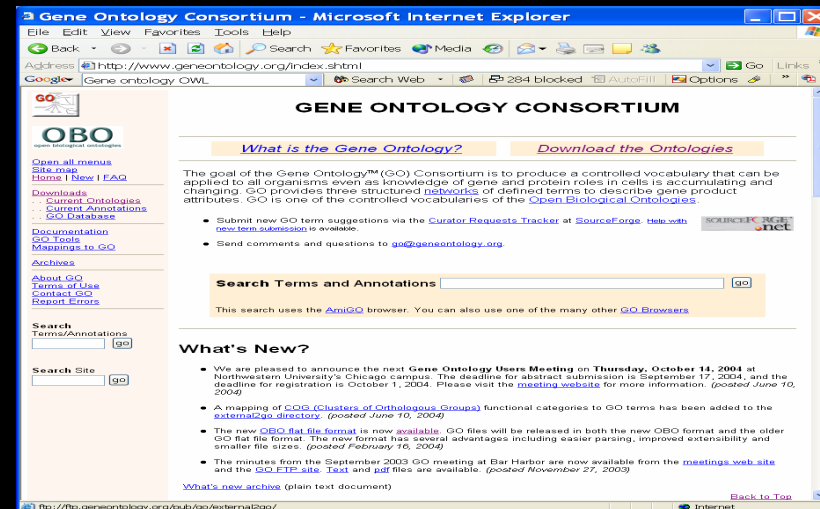
- A shared and agreed conceptualisation
- Agreed terminology
- The salient concepts and relations between them
- **The semantic view:** An ontology is the context needed to understand a specification, model, or other communication in the way that was intended.
- **The specification / reference view:** "An ontology is an explicit specification of a conceptualization."
- **The modeling view:** An ontology is a metamodel.

Ontologies offer....

- Communication
 - Normative models
 - Networks of relationships
 - Consistent and unambiguous
 - Integrate multiple perspectives
- Inter-operability and Integration: Sharing & Reuse
 - Inter-lingua
 - Specifications
 - Reliability
- Control
 - Controlled vocabularies
 - Accurate data collection or retrieval
 - Classification
 - Finding, sharing, discovering, navigation, indexing

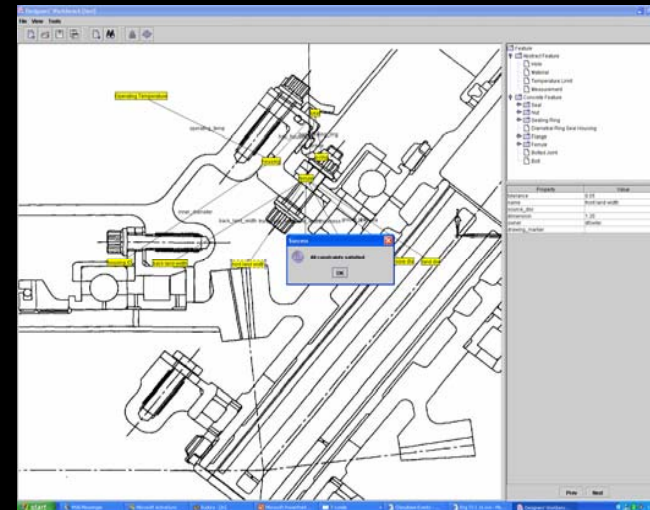
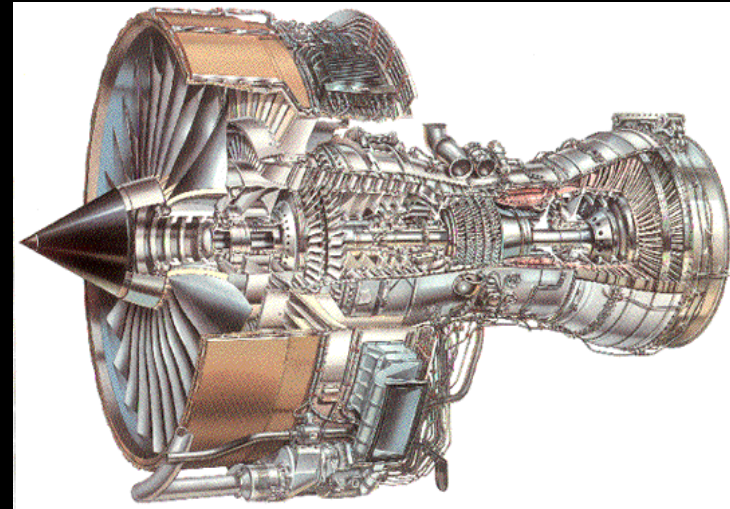
Genetics: Gene Ontology

- One of the earliest examples of the benefits of ontologies
- Integration and interoperability were big wins
- Specific tool support
- Considerable resources invested and continuing in maintenance
- Translated into Description Logics to provide formal semantics
- Spawned more generic biological ontology efforts



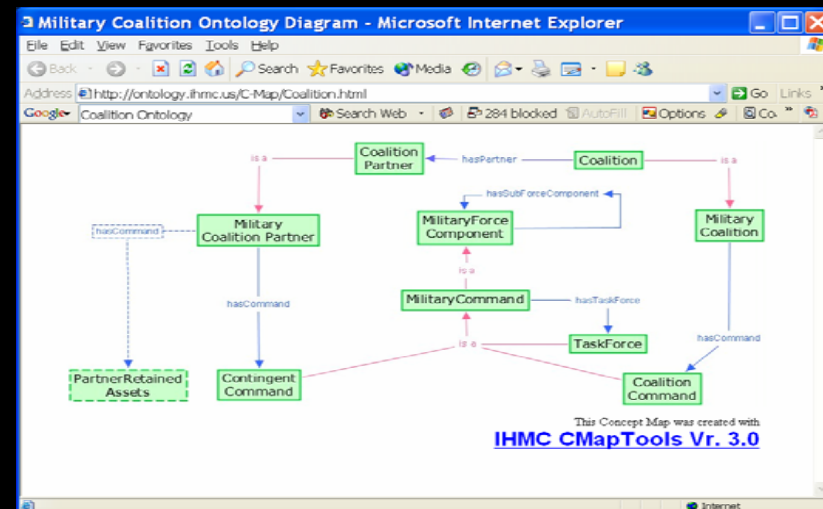
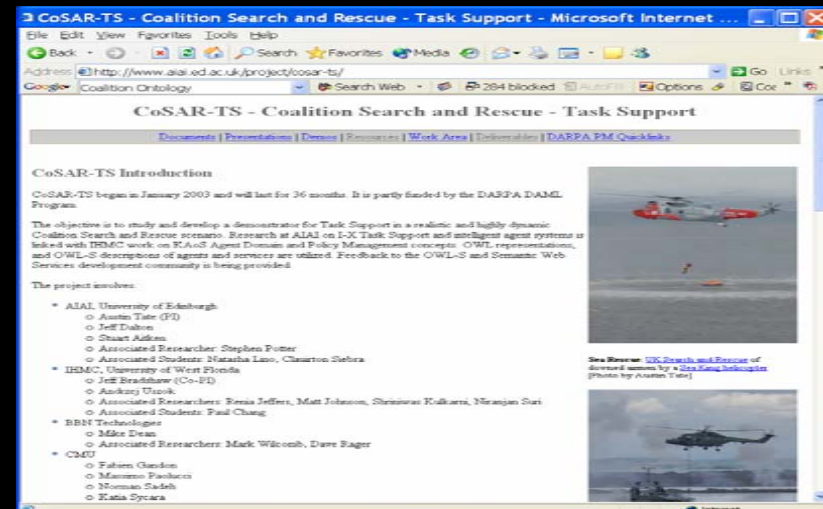
Manufacturing: Aerospace

- Considerable work on ontologies for products and components
- Used in all stages of the life cycle, from design to in service maintenance
- Need for multiple perspectives e.g.
 - Whole engine
 - Heat transfer
 - Cost model
 - Manufacturing
 - Assembling/Maintenance



Military: Coalition Operations

- Some of the original motivation behind DAML work
- Lots of activity to build ontologies in a range of contexts
- Particularly important in coalition operations
- Central requirement for the concept of Network Enabled Capability



Ontologies: Observations

- In any domain
 - Usually highly implicit
 - Poorly documented
 - Likely to be ambiguous, vague, inconsistent
- When modelling
 - Interaction Problem: tasks influence ontologies
 - Integration Problem: integrating multiple ontologies
 - Modularity Problem: how to modularise and what grain size?
- Maintenance
 - Ongoing maintenance overhead
 - Ontologies evolve and change
 - Design rationale is important
- Upside
 - They do facilitate interoperability
 - They do enhance reuse
 - They are becoming part of the infrastructure

Advanced Knowledge Technologies IRC



AKT started Sept 00, 6 years, £8.8 Meg, EPSRC
www.aktors.org

Around 65 investigators and research staff

Ontology Mediated Information Interoperability: An example from Medicine

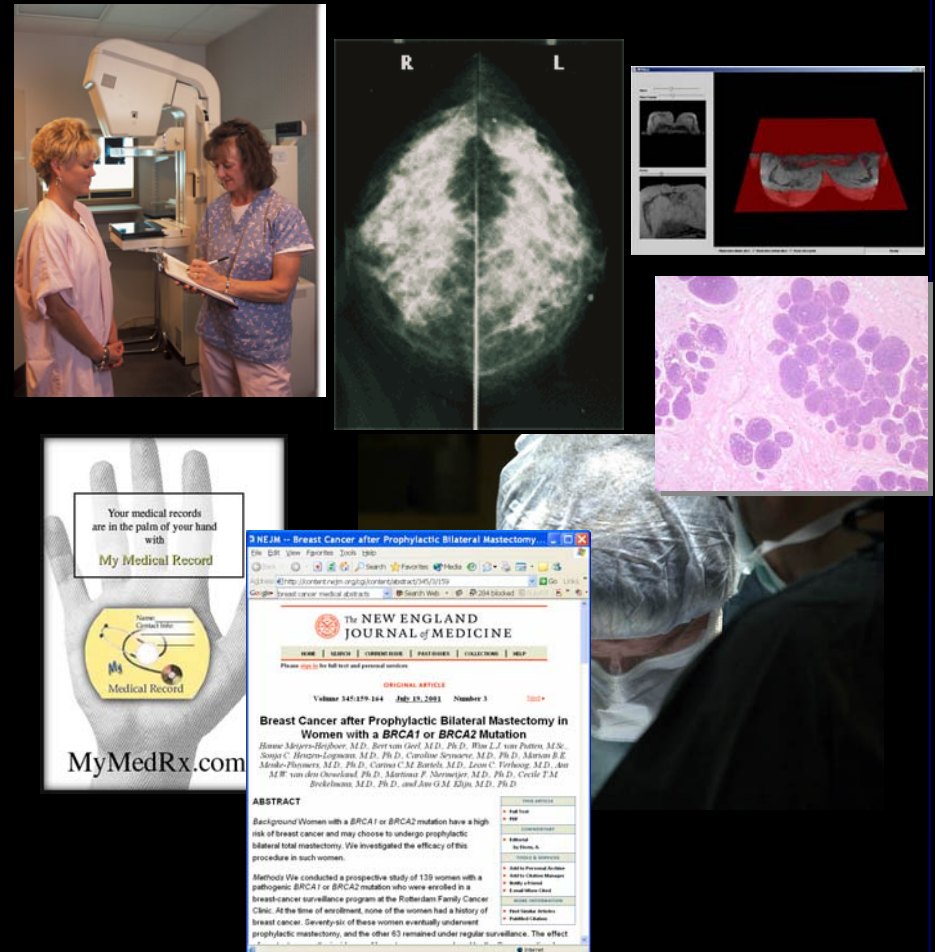


Professor Nigel Shadbolt
The University of Southampton

Professor Sir Michael Brady
Oxford University

Multi-disciplinary Assessment: Multiple Ontologies and Multiple Information Sources

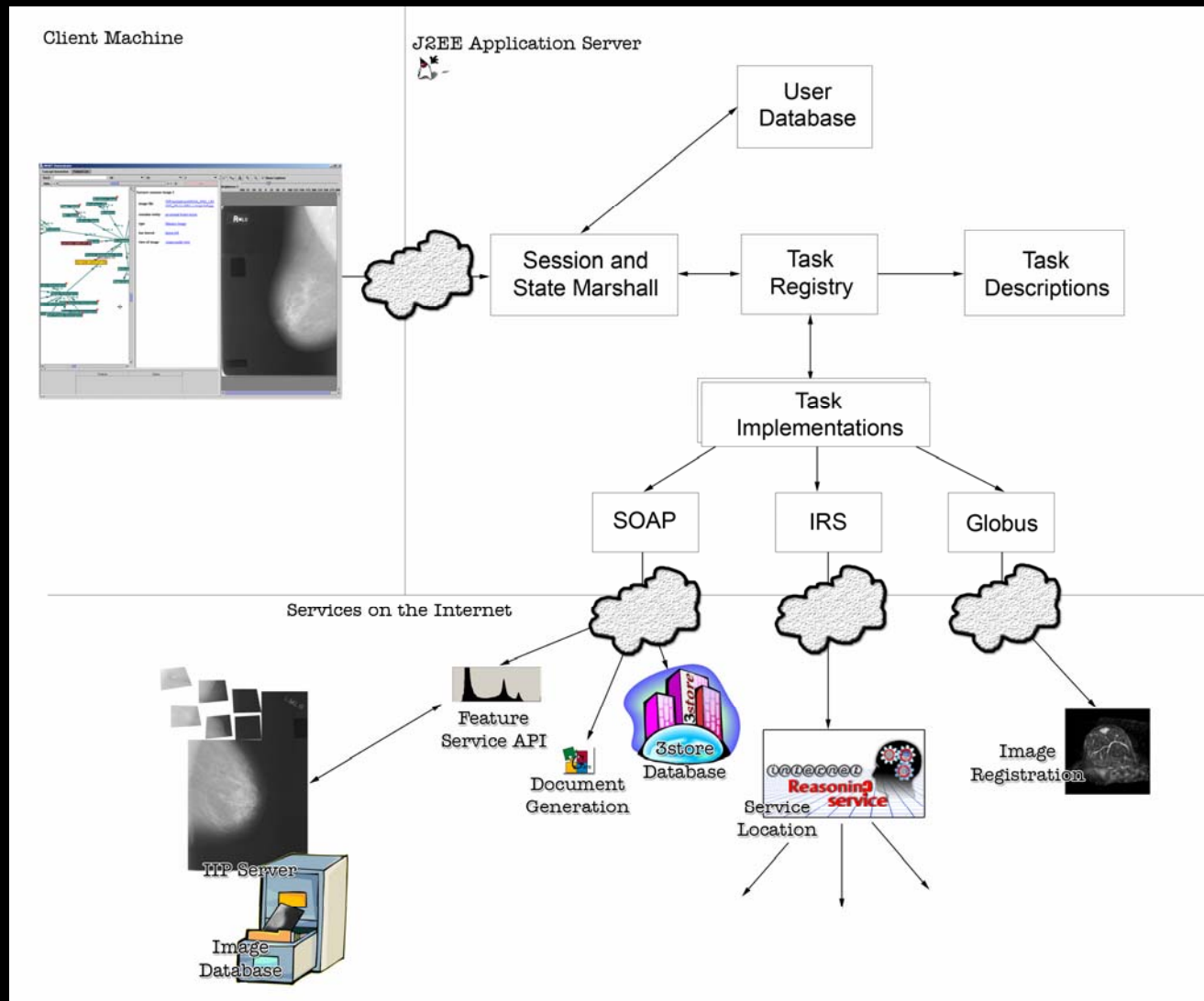
- Diverse and heterogeneous content
- Clinical examination
 - Notes
- Imaging
 - X-ray,
 - Ultrasound
 - MRI
- Microscopy
 - Histopathology
- Treatment
 - Protocol Records
 - Re-assessment
- Medical Records
 - Case sets
 - Individual patient records
- Published background
 - Epidemiology
 - Medical Abstracts



MIAKT Services

- Image Analysis Services
 - Oxford's XRay Mammogram Analyser
 - KCL MRI Mammogram Analyser/Classifier
- Classification Services
 - Abnormality Naïve Bayes Classifier (Soton)
 - MRI Lesion Classifier (KCL)
- Patient Data Retrieval Services (OU)
 - For example, "Find Patients With Same Age"
- Image Registration (KCL)
 - GRID service invoked via web-service
- Natural Language Report Generation (Sheffield)
 - Generate a patient report from RDF description
- UMLS Lookup (Sheffield)
 - Lookup term definitions in the UMLS
- Patient Records also accessed through web-service (Soton)
 - Web-service enabled AKT 3store

The MIAKT Framework is Ontology Based



Knowledge-Intensive Fusion for Situational Awareness

UK DIF DTC Project 8.14



Professor Nigel Shadbolt et al
The University of Southampton

Desired Outcome

- a knowledge-guided environment to accomplish intelligent information...
 - FUSION
 - using formal knowledge models (inc ontologies) of the sources, user roles and tasks to perform the aggregation task
 - PROCESSING
 - using the knowledge models to integrate and reason over the incoming streams of information, generating new knowledge, summaries, predictions, guidance, and direct attention
 - INTERACTION
 - supporting effective visualisation of and interaction with diverse information sources as a decision-making aid

The Domain

OOTW Humanitarian Relief

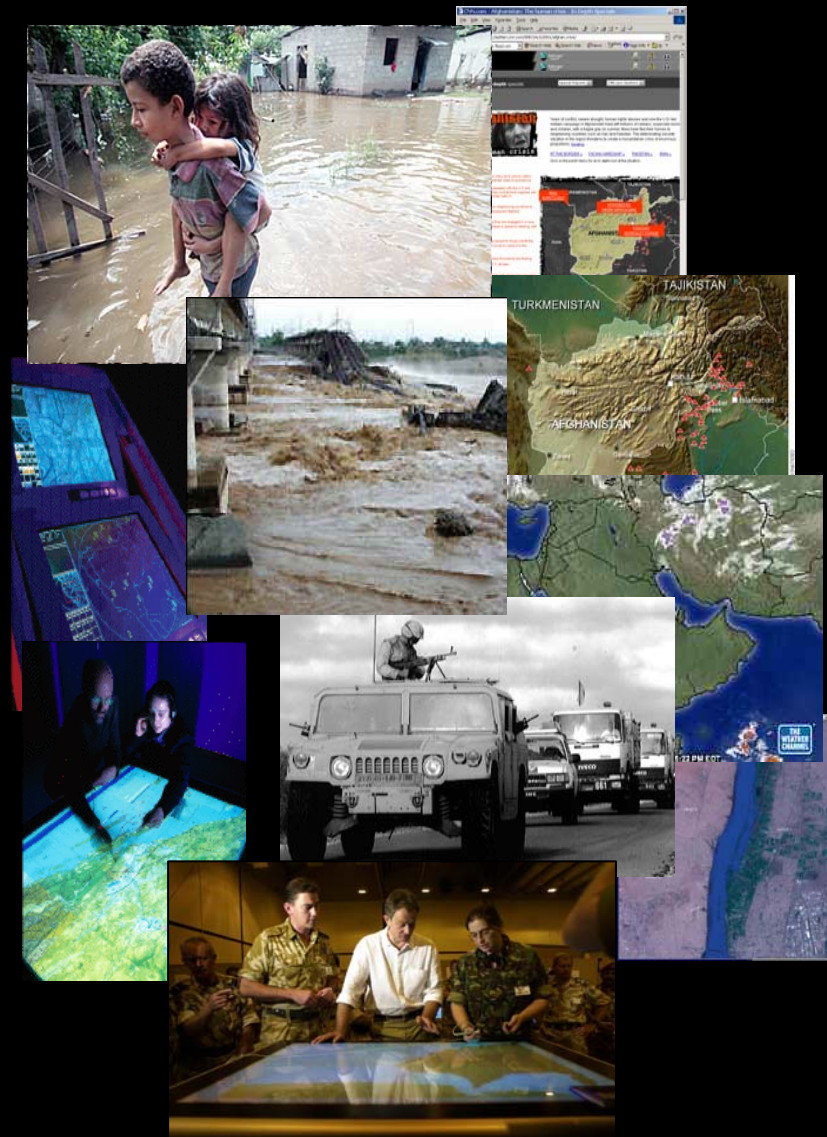
Number of possible data sources

- Media reports
- Meteorological forecasts and reports
- ELINT
- Reports from NGOs
- Other field reports

Multiple foci of situational awareness

- Refugee concentrations and movements
- Communications and transport infrastructure
- Weather conditions, water levels, current and predicted
- Hostile Militia Activity

Views on data and information for needs of different users

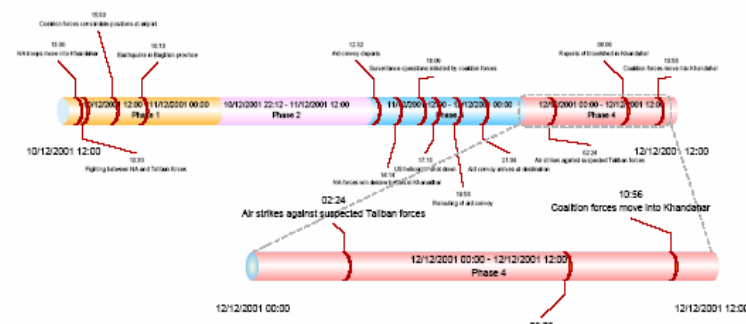


The Scenario

- Comprehensive Afghanistan scenario
- Based on recent available historical data
- Rich source of information feeds
- Ample scope for key properties of KBSA to be demonstrated
- Basis for ontologies

Epistemics Ltd MILITARY (UNCLASSIFIED) DTC/WP100/Scenario
Version 1 / 26 March 2004

4.2.4 Phase 4: 36-48 Hours



4.1.1.1.5 Humanitarian Aid Initiative

Description	The humanitarian aid-initiative concept subsumes the various types of humanitarian aid programme that are delivered to target groups .	
Subtypes	○ Emergency Assistance ○ Refugee ○ Food Aid ○ Search and Rescue	
Attributes	○ resource ○ aid-orga ○ duration ○ start-dat ○ trigger: t ○ status: tl ○ equipme ○ impleme	2.8 IDP and Refugee Settlements

2.8 IDP and Refugee Settlements

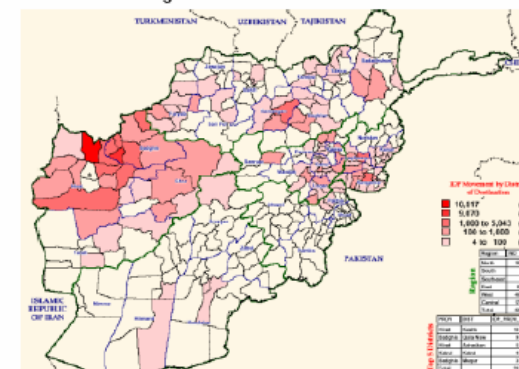
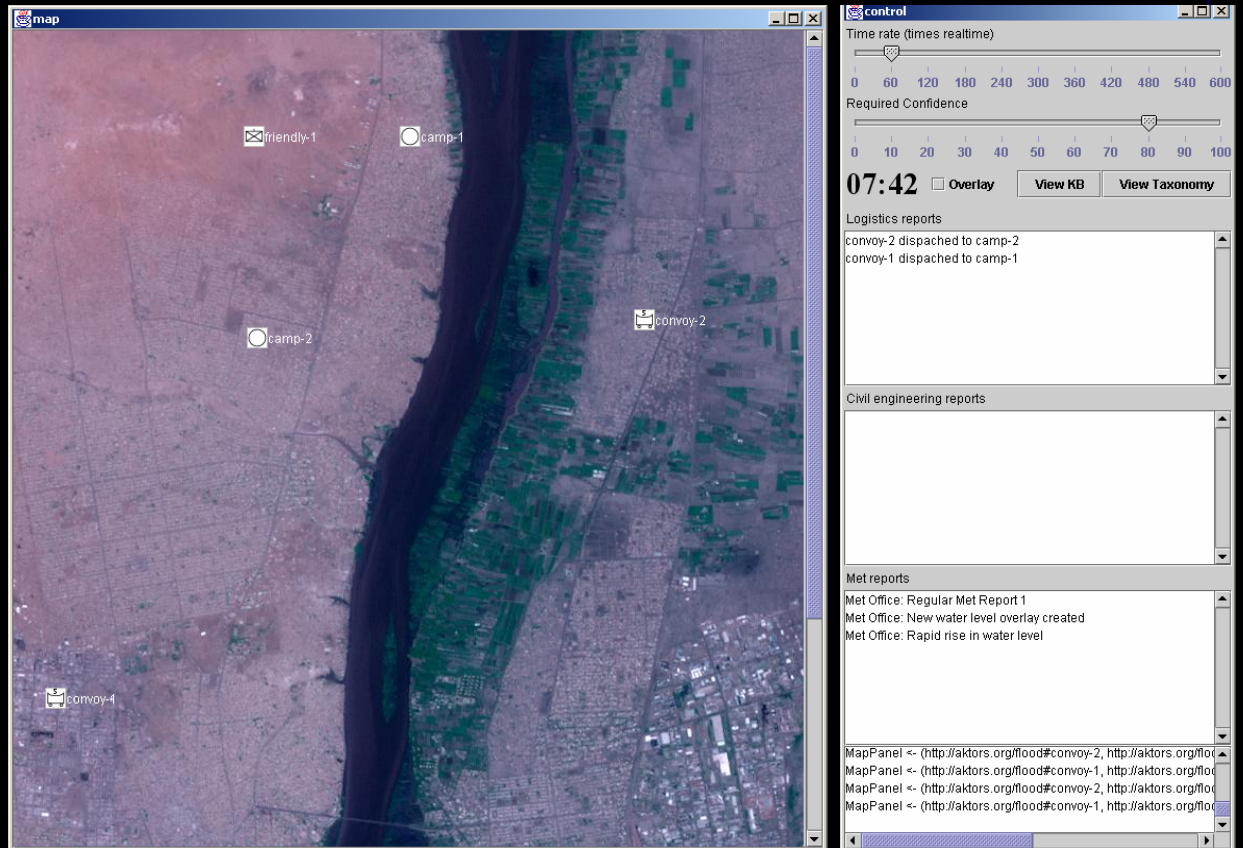


Figure 2-58: IDP Movements by District of Destination

Knowledge Processing and Information Fusion

- Processing rules and strategies for low level and high level interpretation
- *Semiometrics* – measures of what is semantically important
- Who is doing what where?
- What impact is this having?
- What other information should therefore be attended to?



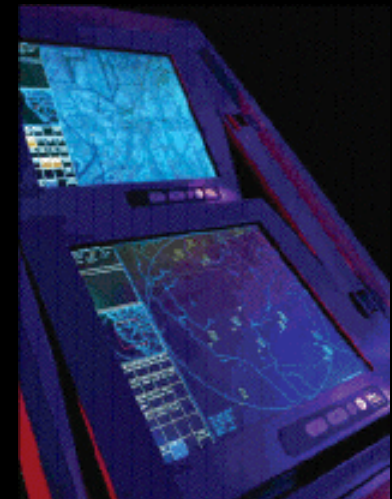
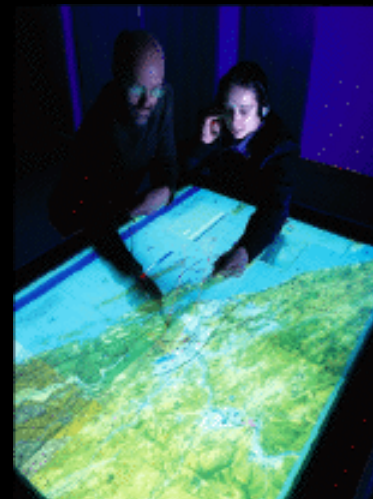
Interaction and Visualisation

Content Streams will be

- Multiple User
- Machine assisted
- Rapidly changing
- High-volume
- Multi-source

Need to support content affordances

- Seeing the big picture
- Zooming in on appropriate detail
- Swapping viewpoints and content feeds
- Changing user perspectives
- Avoiding einstellung “functional fixity”



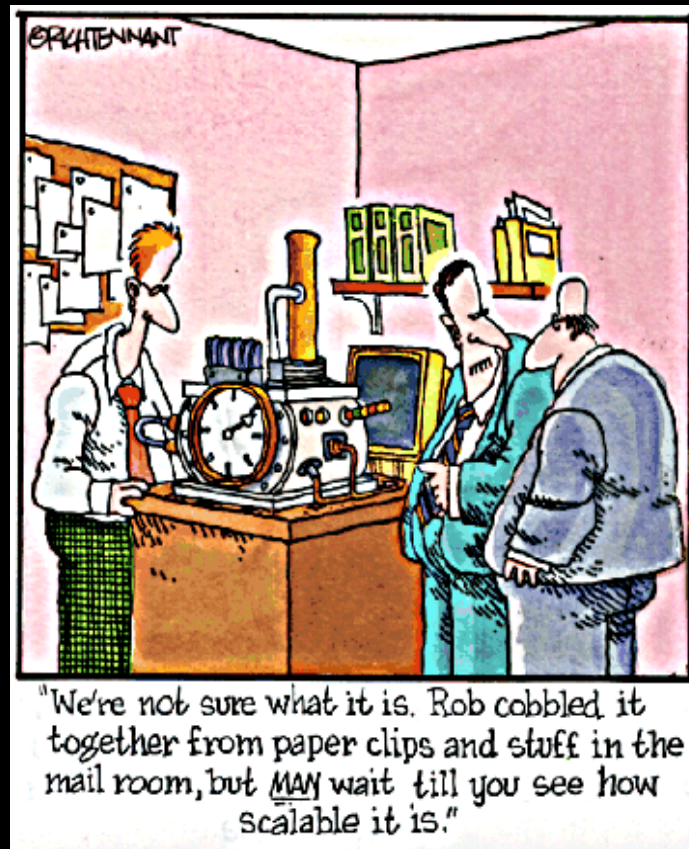
Novelty & Invention

- Group represents leading edge in Semantic Web research and application
- Research and development in this context is new
- Extends work on ontologies for Situation Assessment
- Exploiting semantic annotation for information fusion and selective attention is novel in this context
- *Semiometric* approach novel in context of military information fusion
- Potential to relates to work in US and DSTL interest in information management

The Semantic Web: Will it happen?

“Is this rocket science? Well, not really ... We are not inventing relational models for data, or query systems or rule-based systems. We are just webizing them. We are just allowing them to work together in a decentralized system – without a human having to custom handcraft every connection.”

*Tim Berners-Lee, Business Case for the Semantic Web,
<http://www.w3.org/DesignIssues/Business>*



Will the Semantic Web Deliver Information Interoperability?

Professor Nigel Shadbolt

School of Electronics and Computer Science
University of Southampton
Intelligence, Agents, Multimedia Group
Electronics and Computer Science
Southampton, Hants SO17 1BJ
UK

nrs@ecs.soton.ac.uk

*This paper was received as a PowerPoint
presentation without supporting text.*

*Presented at the RTO IST Symposium on “Coalition C4ISR Architectures and Information Exchange Capabilities”,
held in The Hague, The Netherlands, 27-28 September 2004, and published in RTO-MP-IST-042.*

Will the Semantic Web Deliver Information Interoperability?

