

Semantic Interoperability Community Of Practice (SICoP)
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Knowledge Broker Semantic Integration Prototype

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- **Research Performed**
- **Semantic Integration Architecture**
- **Research Observations**
- **Prototype Demonstration**

Knowledge Broker Prototype

- A prototype evaluating the application of knowledge representation technologies to perform systems of systems integration.

- 1. Created a Reference Architecture Model that mapped KR, EII and UIM technologies across enterprise platforms and information tiers.**
 - Captured core architectural constructs and key technologies.
- 2. Ran several focused technology studies.**
 - Examined functional capability and breadth of several ontology platforms and analytics engines to study elements of the reference architecture.
- 3. Developed a large scale prototype to simulate an information enterprise.**
 - Enterprise knowledge portal with advanced search and link analysis tools.
 - Federated Geospatial data systems.
 - Unstructured data stores.
- 4. Analyzed phase-1 results and re-factored into spiral-2 prototype.**
 - Examined the practicality of knowledge representation platforms as evident in existing academic and COTS products.
 - Evaluated the robustness and stability of supporting standards.

– Platform Analysis

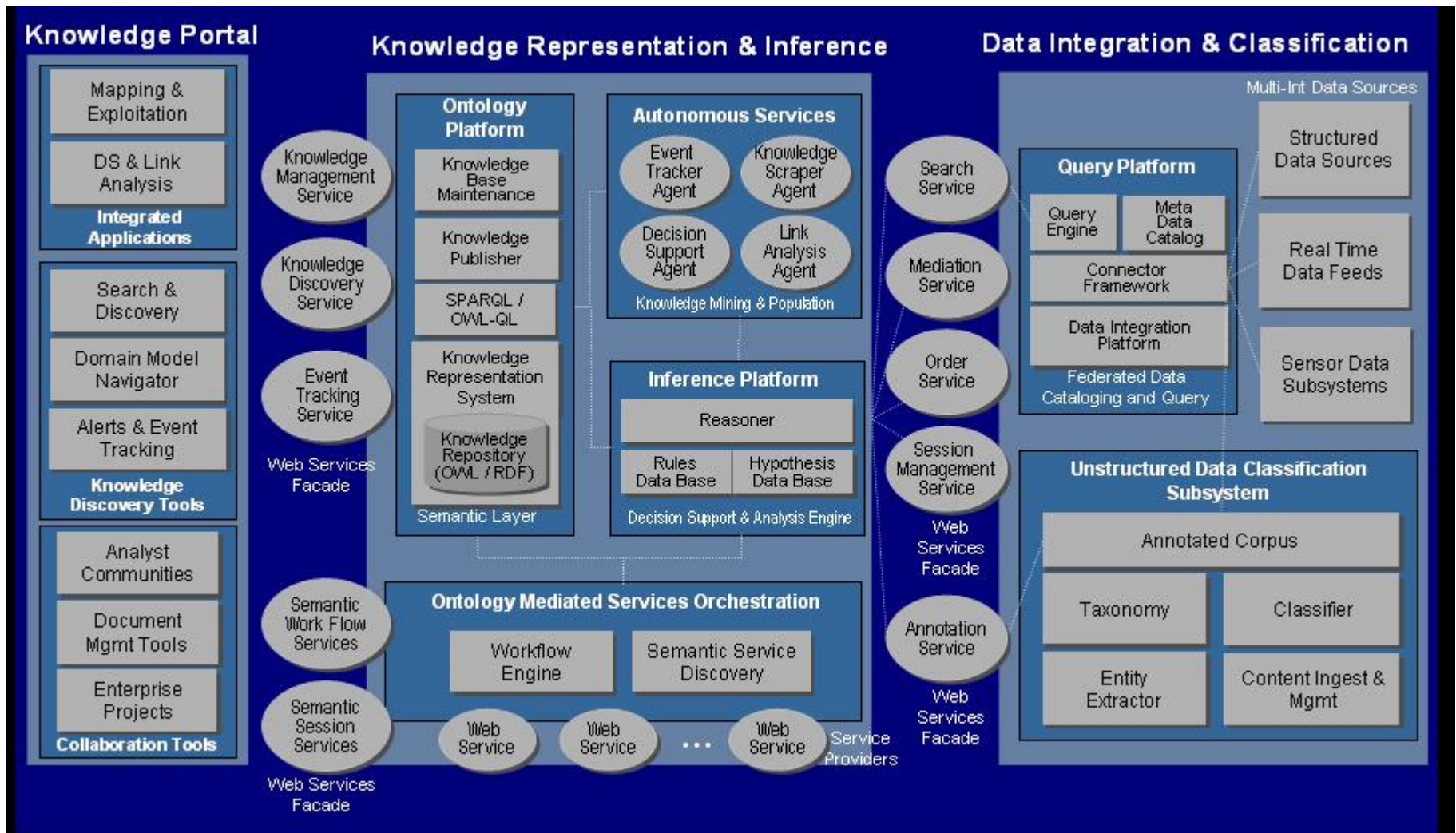
- Ontology: SnoBase, Jena2, TM4J
- EII: MetaMatrix, LiquidData
- Analytics: Gate, UIMA SDK

– Integration Analysis

- Semantic Integration: Used the semantic layer as an integration construct. Mapping a domain vocabulary across the structured and unstructured data sets. (KR to EII connection)
- Structured Data Systems: Federated queries against enterprise metamodel for access to data stores
- Unstructured Data Systems: Performed an entity extraction and classification on data sets and posted annotations to populate ontological instances

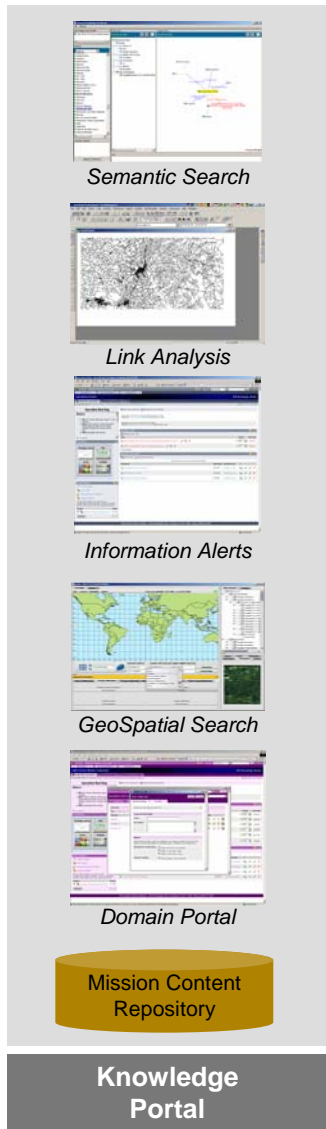
– Ontology Analysis

- Applied a suite of ontology's built for individual communities of interest (COI) rather than a complex and overly generic cross domain vocabulary
- Experimented with model size to determine the practicality of reasoning against varied model complexities
- Compared the end-user “application capability” enabled through a hierarchical taxonomy provided in a topic map against deeper semantic relationships facilitated in OWL/RDF

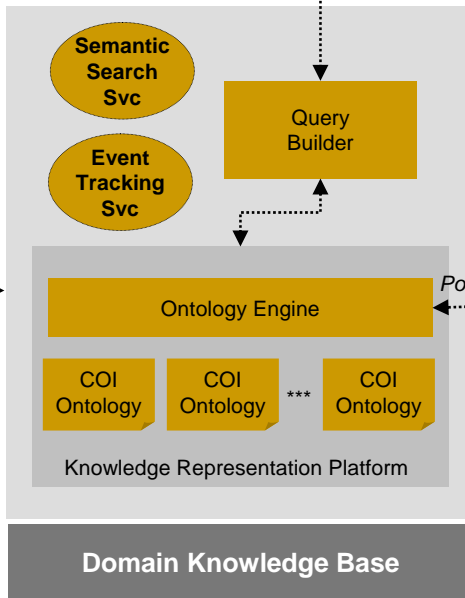


Knowledge Broker Systems Integration Prototype

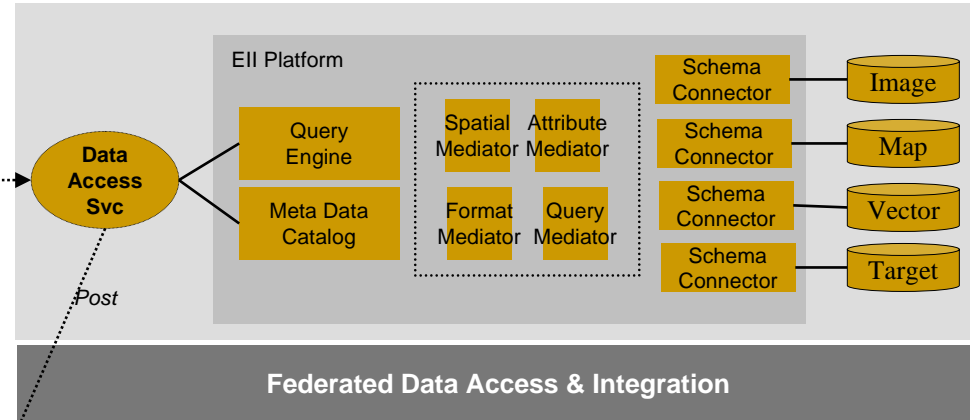
Spiral-1 Components



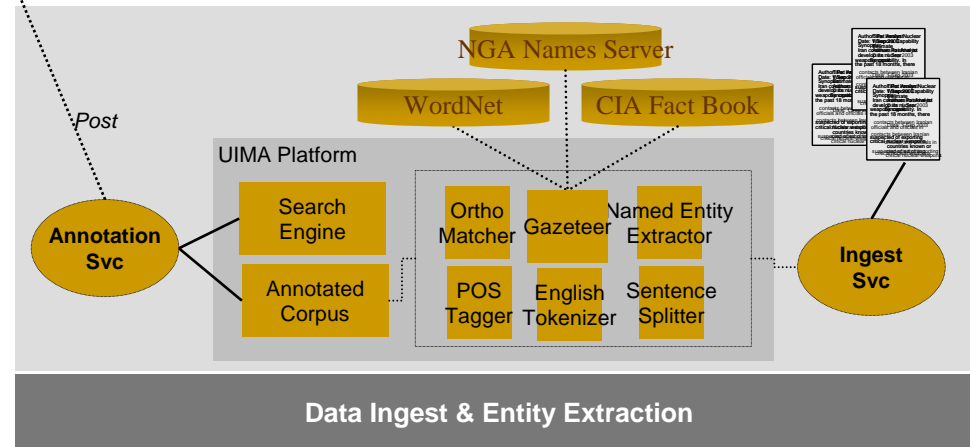
Semantic layer applied as the systems integration construct. Applications searched against the semantic model.



Federated Access to distributed data systems mapped behind a domain focused semantic layer. Classes in the ontology are mapped to elements in the metadata catalog.



Documents and sites ingested. Entities were extracted from unstructured data sets and posted to populate model instances



- **Platform technical issues were faced with even pragmatic prototyping**
 - Encountered memory and performance issues persisting OWL statements when trying to create a model robust enough to do some practical level of reasoning.
 - A modest owl model can be 500K statements. Our tests run with 90K OWL statements hosted on the Jena platform took hours to return a query.

- **Established a semantically rich interface to support discovery of enterprise data.**
 - A semantic layer was developed for a domain specific community of interest not as a unifying ontology for cross domain unification or as an enterprise-wide common vocabulary.
 - A universal semantic layer is not seen as practical nor semantically rich.

- **Model Instantiation**
 - Populating the ontological model with all instances of information across a large-scale enterprise does not appear to be feasible. The model quickly becomes impractically large.
 - Instead of implicit model population a query approach was used.
 - Classes in the ontology were mapped against entities in the enterprise metamodel. Attributes of the classes were mapped against metamodel properties. Upon request a class was populated using a query against the metamodel.

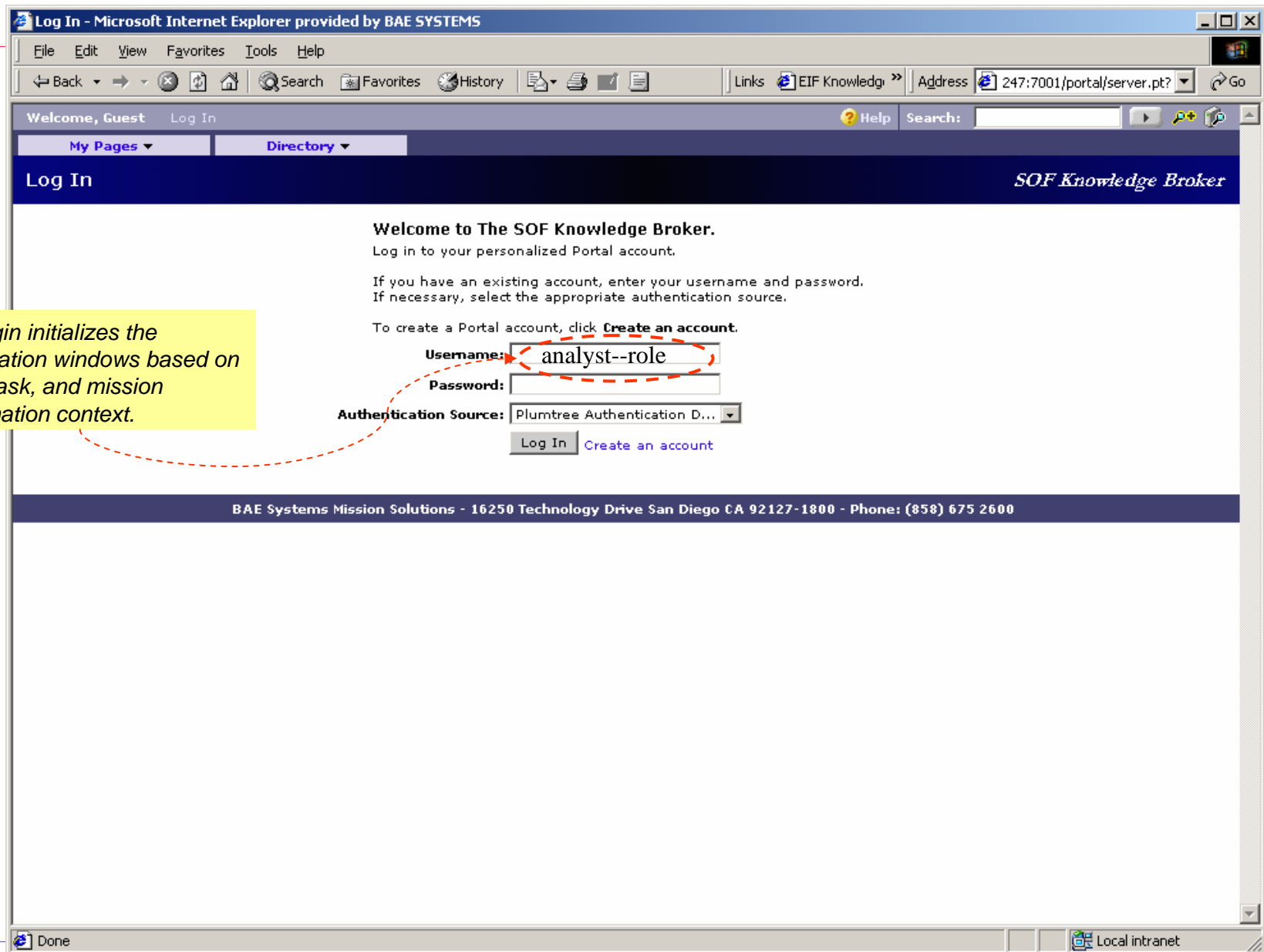
 - Complex integration code is required to interface the ontology layer and the back end data integration layer.
 - Evolving COTS products that move to incorporate both traditional EII and Semantic Markup engines in a single platform will significantly reduce integration glue code (i.e Metamatrix match-it).

 - Significant complexity is associated with creating an ontological model abstracting Temporal and Geospatial types

- **OWL & RDF tests**
 - Although OWL adds ability to specify richer semantic relationships , available platforms and query languages don't offer a corresponding semantic query capability to leverage that information (i.e. Jena with RDF query) .
 - Until OWL-QL arrives one is still operating at the level of extracting an element from a taxonomic hierarchy as opposed to querying for richer semantic constructs such as typed class relationships, cardinality, equality, etc.

Prototype Demonstration

Role Based Login



User login initializes the application windows based on role, task, and mission information context.

Collaborative Knowledge Portal

Combined Joint Task Force - Microsoft Internet Explorer provided by Computer Sciences Corporation

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Links BAE SYSTEMS Knowledge Broker

Address http://bluasaa933247:7001/portal/server.pt?space=CommunityPage&cached=true&parentname=MyPage&parentid=1&in_hi_userid=341&control=SetCommunity&CommunityID=2838

My Home Welcome, intel_officer My Account Log Off Help Search: Everywhere

My Pages My Communities Directory

Combined Joint Task Force Knowledge Broker

Inside this Community Related Communities

Community Home | Calendar page | Community Members and Knowledge Directory

Combined Joint Task Force Mission

New Announcement

Eye On Fallujah

- US Joint Command has established the Combined Joint Task Force - Eye of Fallujah (CJTF-EOF) with the mission to identify and neutralize the vast IED network operating in the region of Fallujah.
- The highly decentralized characteristics of the IED cells makes them nearly impossible to penetrate.

On Wednesday, November 11th, the Intelligence Officer will give a briefing on the latest IED data collected. Posted by mission_commander on 10/19/05 4:10 PM in project IED Network Sweep

HVT Extraction Update meeting set Saturday October 29 at 10:00 AM. Posted by mission_commander on 10/19/05 3:59 PM in project HVT Extraction

Community Tasks

Task	Project	Status
Analyze IED link analysis Analyze link analysis generated by Knowledge Broker's DKA tool to assess the relationships between Abu Musab al-Zarqawi and Hafiz Mohammed Saeed and determine their participation in the IED network...	IED Network Sweep	0% 11/2/05
Assist Operations Group in planning target acquisition. Assist Operations Group in planning target acquisition activities for collection of target information. Coordinate security checks for indigenous personnel. Coordinate with other groups the enemy...	IED Network Sweep	0% 11/6/05
Night Extraction points both prim and sec.	HVT Extraction	25%
Collect, Process, Produce and Disseminate intelligence. Collect, Process, Produce and Disseminate intelligence to the appropriate strategic/operational/...	IED Network Sweep	25%
Deny the reemergence of terrorist cells and activities. Support international agencies working to enhance long-term stability for the region and work with both local military and civil organizations.	IED Network Sweep	0%
Identify and neutralize the vast IED network operating in the region of Fallujah The design for IED and Coalition forces in the Iraqi Theater of...	IED Network Sweep	0% 11/10/05

Tool Selector

Knowledge Assistant iWeb

ArcGis TerraVista

ArcMap

Project Selector

New Project

Manage Project Templates

Analyst Communities

- Enterprise Projects
- Enterprise Calendar
- SME List
- Community Ontology
- COI Announcements
- Discussion Groups

Analysts Forums

- Discussion Threads
- Post Messages
- Group Alerts
- Announcements
- Document Repository

Collaborative Tasks

- Projects
- Tasks
- task Status
- Task Description
- Task Flow

Analyst Tool Palette

- Knowledge Assistant
- Information Search
- Data Access
- Analysis
- Exploitation

Integrated Tool Palette

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Tool Selector

- Knowledge Assistant
- iWeb
- ArcGis
- TerraVista

Project Selector

- New Project
- Manage Project Templates

Start DKA:

- Semantic Search
- Link Analysis
- Event Alert
- Document Browse

Domain Knowledge Assistant (DKA)

The screenshot displays the Domain Knowledge Assistant (DKA) interface with several key components:

- Knowledge maps loaded:** A list of files including `file:/C:/navigator/sofprep.ltm`, `file:/C:/navigator/entity_extraction.ltm`, `file:/C:/navigator/terrorist_knowledge`, and `file:/C:/navigator/unstructured.ltm`.
- Indexes:** A dropdown menu for "Subjects" and a list of terms such as "exitApproach", "Explosive Detection", "Explosives", "Fallujah", "FALLUJAH", "Fallujah Airfield 1", "Feature Attribute", "Feature Type", "Feature Vector Data", "Features Are In", "Federal Response Plan", "FEMA", "Female", "Fenway Park", "Fiji", "Fillee", "Filling", and "Financial Crimes".
- Tree-View:** A hierarchical tree structure for "Abu Musab al-Zarqawi" with categories like "People", "Terrorist", "Is A Citizen Of" (Fallujah, Iraq), "Is Affiliated with Groups" (Al-Qaeda), "Has Purchased" (C4), "Is Trained In" (Demolition), and "Has Links With" (Hafiz Mohammed Saeed).
- Graph-View:** A network graph showing relationships between "Abu Musab al-Zarqawi" and other entities like "Al-Qaeda", "National Metadata", "C4", "Terrorist", "Demolition", "Hafiz Mohammed Saeed", and "Iraq".
- Matching Documents:** A list of search results with URLs and document content, such as `http://duke7001/udcsDocs/Sample_IIR_016.rtf` and `http://duke7001/udcsDocs/Sample_IIR_017.rtf`.
- Alert Notification:** A section showing "4 Alert(s)" with a "Reload" button.
- Alert Table:** A table listing alerts with columns for Priority, Time, Query Type, and Query Name.

Priority	Time	Query Type	Query Name
1	November 1, 2005 6:43:57 PM EST	KEYWORD	Terrorist:"Abu Musab al-Zarqawi" IED Delete
1	November 1, 2005 6:43:58 PM EST	KEYWORD	Terrorist:"Abu Musab al-Zarqawi" Terrorist:"Hafiz Mohammed Saeed" IED Delete

Domain Knowledge Maps

Mission Vocabulary & Taxonomy

Link Analysis Viewer

Document Search

Information Alerts

HyperGraph

Combined Joint Task Force Knowledge Broker

Inside this Community Related Communities

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Start iWeb:

- Reach Back/ Federated Access
- Geospatial data discover, browse and retrieve

Federated Access To GeoSpatial Data Products

The screenshot displays the iWeb MULTI-INT DATA MINING application interface. At the top, there are tabs for 'OpenMap' and 'WebELT', and a menu bar with 'File', 'Control', 'Navigate', and 'Views'. The main map area shows a satellite view of a landscape with several red diamond markers labeled 'SOP' and blue square markers. A yellow callout box on the left states: "Data retrieved from distributed systems and spatially correlated for browsing".

On the right side, there is a 'Data Service' panel with a 'Catalog' tab. It lists various data services under 'BULTS', 'ENTERPRISE', and 'MEDIATED'. A red dashed circle highlights the 'ENTERPRISE' section, which includes 'Image Libraries', 'Feature Data Stores', and 'Target Libraries'. A yellow callout box next to it says: "Enterprise Search Results (image/map/vector/target/documents)".

Below the map, there is a 'Query Parameters' section with tabs for 'General Metadata', 'Feature Metadata', 'Product Metadata - National', 'Product Metadata - Internal', and 'Point Target'. The 'Feature Metadata' tab is active, showing 'Feature Layer (Collection)' as 'No Selections' and 'Feature Types' as 'Airport / Airfield'. A yellow callout box at the bottom of this section states: "Unstructured documents linked to the geospatial data via autonomous information extraction".

At the bottom right, a 'Sample_IIR_006.rtf - Microsoft Word' window is open, displaying a document with the following text:

```
SERIAL: (U) IIR 6-029-0734-05
/***** THIS IS A COMBINED MESSAGE *****/
COUNTRY: (U) FALLUJAH (FA); IRAQ (IZ).
SUBJECT: IIR 6-029-0734-05/Activities in Muallimin District

WARNING: (U) THIS IS AN INFORMATION REPORT, NOT FINALLY EVALUATED
INTELLIGENCE.

-----
DEPARTMENT OF DEFENSE
-----
DOI: (U) 910219-910223
[b.2.]

SOURCES Operation Dawn Patrols

1. On 12 Sep 05, Muallimin District was closed for house sweep
activities; the house sweep activity resulted in the capture
of Fusako Shigenobu. Fusako Shigenobu is classified as a triggerman
within a potential IED cell. In his possession were maps with
multiple x's placed throughout Fallujah, a cell phone, video camera,
and a notebook. On the back of the notebook cover was a name,
Abu Musab al-Zarqawi. The District was reopened on 15 Sep 05.

[b.1. sec. 1.5.(c)]

4. Patrolled locations in Fallujah: The following locations in
Fallujah are regularly patrolled: Jolan, Resafa, Muhandisin
Nazal, Sinai, Shurta, Jeghaifi, Askari, Shuhada and the
Industrial Park.
```

Questions ?