



ACT

Automated Clearance Tool: *Improving the Diplomatic Clearance Process for AMC*

Alice M. Mulvehill

Brett Benyo

David Rager

- BBN Technologies

Edward DePalma

- Air Force Research Laboratory



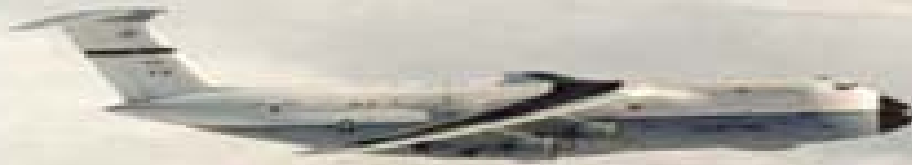
June 2004

ACT

Automated Clearance Tool



ACT is an agent based, decision-support tool that supports the processing of diplomatic clearances at Air Mobility Command (AMC).



By leveraging the *Semantic Web* concept, ACT software agents utilize ontologies to reason about annotated data.



The Problem Domain

Air Mobility Command plans global missions at a rate greater than **300** per day, many requiring a set of diplomatic clearances. Today mission planners must manually calculate lead times, calendar constraints, and country restrictions to determine diplomatic clearance viability. ACT automates much of this process, allowing the human planners to concentrate on the more difficult and timely problems.

Is there HAZMAT aboard? ☣ *What type and category is it?* ☢

Is there enough lead time for a clearance? 🕒

Which countries are you flying over? 🗺️

What is the cargo? 📦 *Who is aboard?* 🛩️

Is this flight part of an accepted mission?

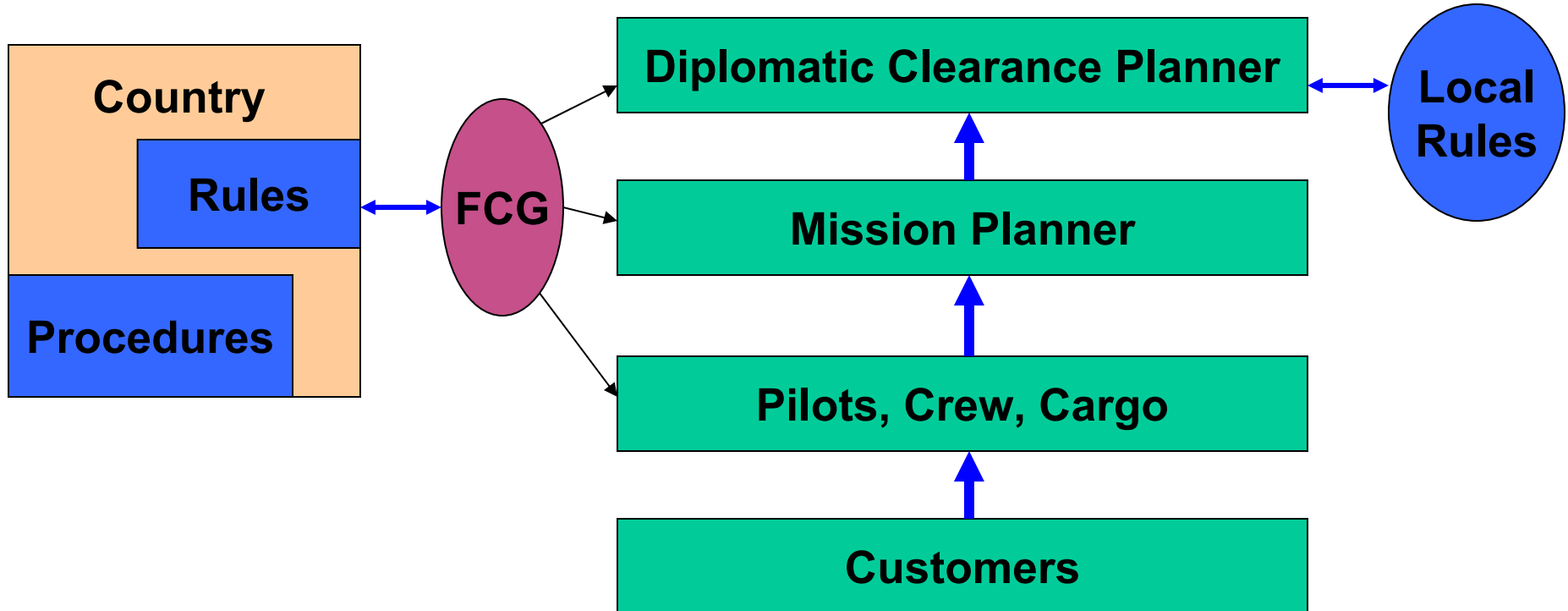
Is a Blanket Clearance needed?



Relevance to Command and Control



Allow planners at different levels of the C2 structure to reason about the requirements of an AMC mission for diplomatic clearances.



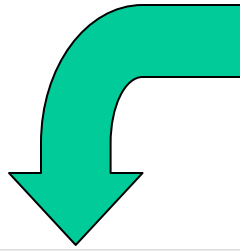
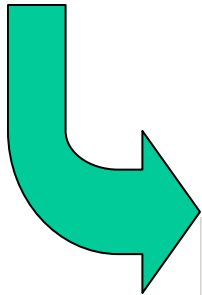


The Automated Clearance Tool

Semantically Annotated Brain Books



Authoritative Data Source
(e.g. Electronic FCG)



Country	Requirement	Requirement	Lead Time	Lead Time	Remarks	Updated	Source
AFGHANISTAN	Overflights	2.3 - Passport	25	working days		2003-03-12	alice
ANTARCTICA	Overflights	3 - All Class	10	working days		2003-03-06	
ARGENTINA	Landings	3 - All Class	15	working days	Failure to sub.	2002-09-28	FCC
ARGENTINA						03-25	FCC
FRANCE						03-07	alice
GERMANY						03-07	alice
ITALY						03-11	alice
ITALY						03-20	alice
SPAIN						03-20	alice
TURKEY						03-20	alice
UNITED KING.						03-20	alice

Contact Folder

Country: UNITED KINGDOM

Business: []

Business Fac: []

E-mail: []

Contacts: []

After Duty Hours: []

Landing Lead Time Qty: []

Landing Lead Time UOM: []

Cell Phone: []

Commercial Phone: []

Days of Operation: []

FAX: []

File As: []

Hours of Operation: []

Landing Validity: []

Office Symbol: []

Overflight Validity: []

Overflight Lead Time Qty: []

Overflight Lead Time UOM: []

POC: []

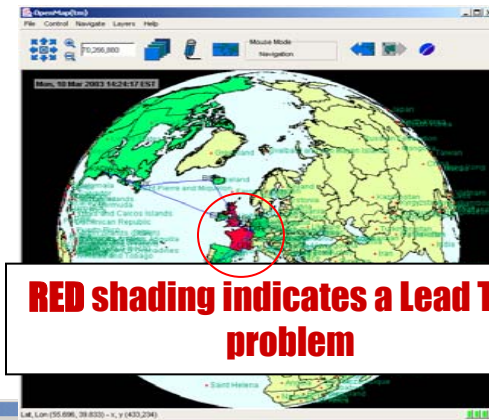
SPIRNET: []

Zulu Time: []

Blankets: []

Hazardous Requirements: []

Remarks: []



DIP Clearance Lead Time Tool

File Edit View Tools Windows Help

GDSS Data | Hazardous Materials | TACC Form | Lead Time | D

Mission Start Date: 28 Sep 2003 (271)

ICAO	Country	Lead Time	Cargo Lead Time
KPMS	UNITED STATES		
CYQX	CANADA	Sep 18, 2003	
EINN	IRELAND	Sep 25, 2003	
ETAR	GERMANY	Sep 22, 2003	
LEMO	SPAIN	Sep 23, 2003	Sep 22, 2003
LFMI	FRANCE	Sep 17, 2003	
ETNG	GERMANY	Sep 22, 2003	
EGLN	GERMANY	Sep 22, 2003	
BKIF	UNITED KINGDOM	Sep 15, 2003	
	ICELAND	Sep 26, 2003	
	ANTARCTICA	Aug 23, 2003	
CYQX	CANADA	Sep 18, 2003	
KPMS	UNITED STATES		
KADWW	UNITED STATES		

Hazardous Cargo

Earliest Lead Time: Aug 23, 2003
 Short Notice: YES Short notice approval required.

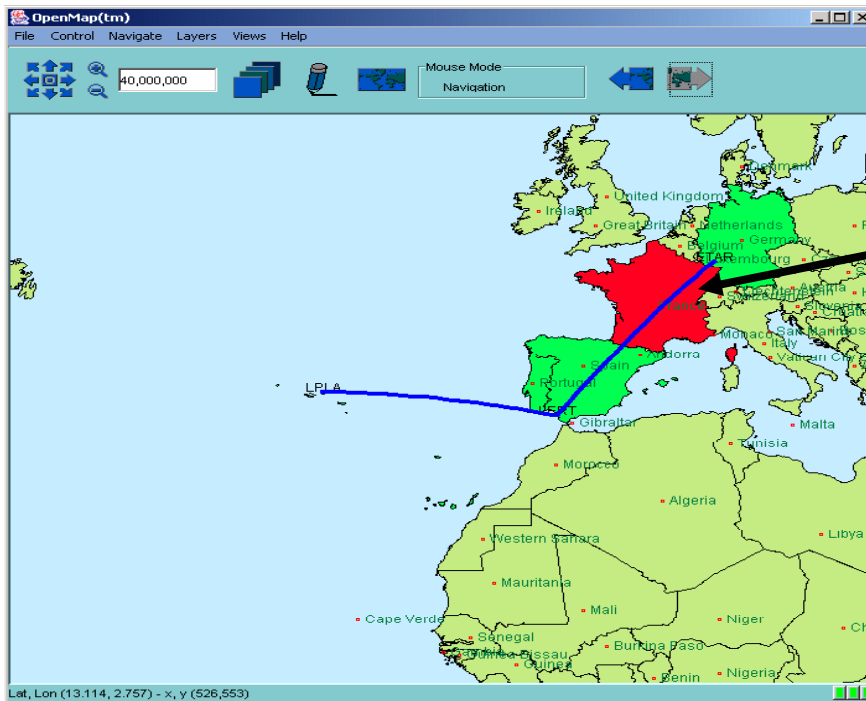
September 18, 2003

Loading Forms

Loaded Forms
 GDSS Data --> Loaded
 HazMat --> Loaded
 TACC Form --> Loaded
 Lead Time --> Loaded
 DIP Clearance Form --> Loaded

Lead Time Compute Agent

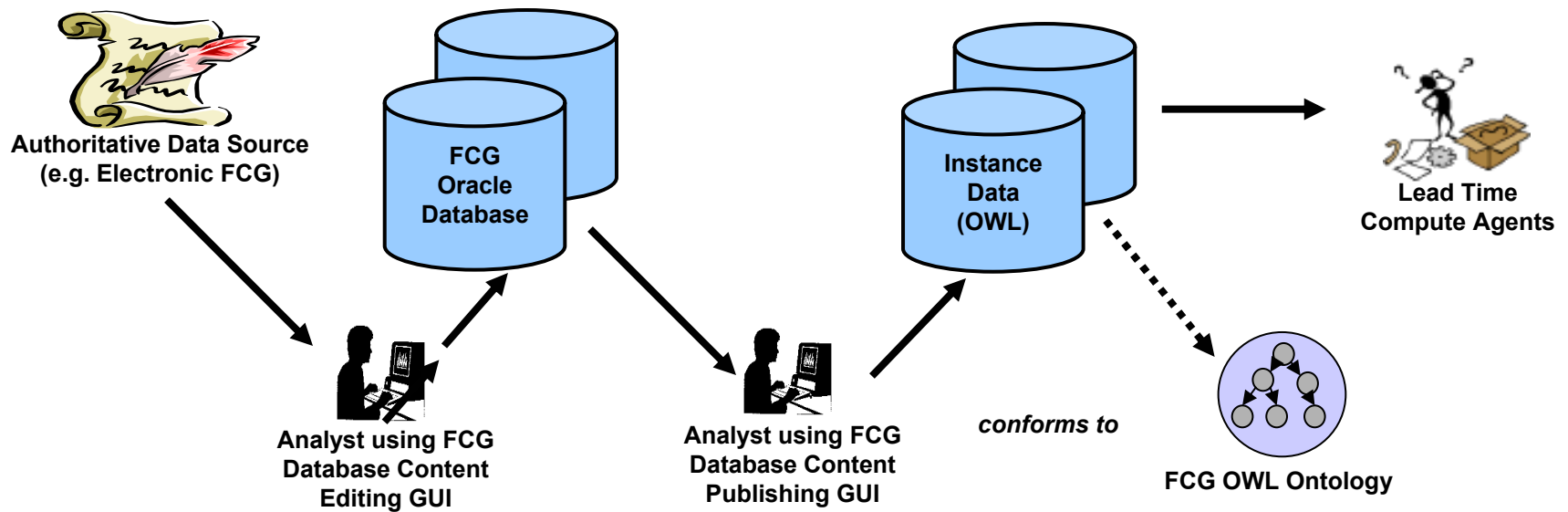
Using Act to Support Diplomatic Clearance Processing



Restriction identified by ACT software agent using rules derived from semantically annotated documents

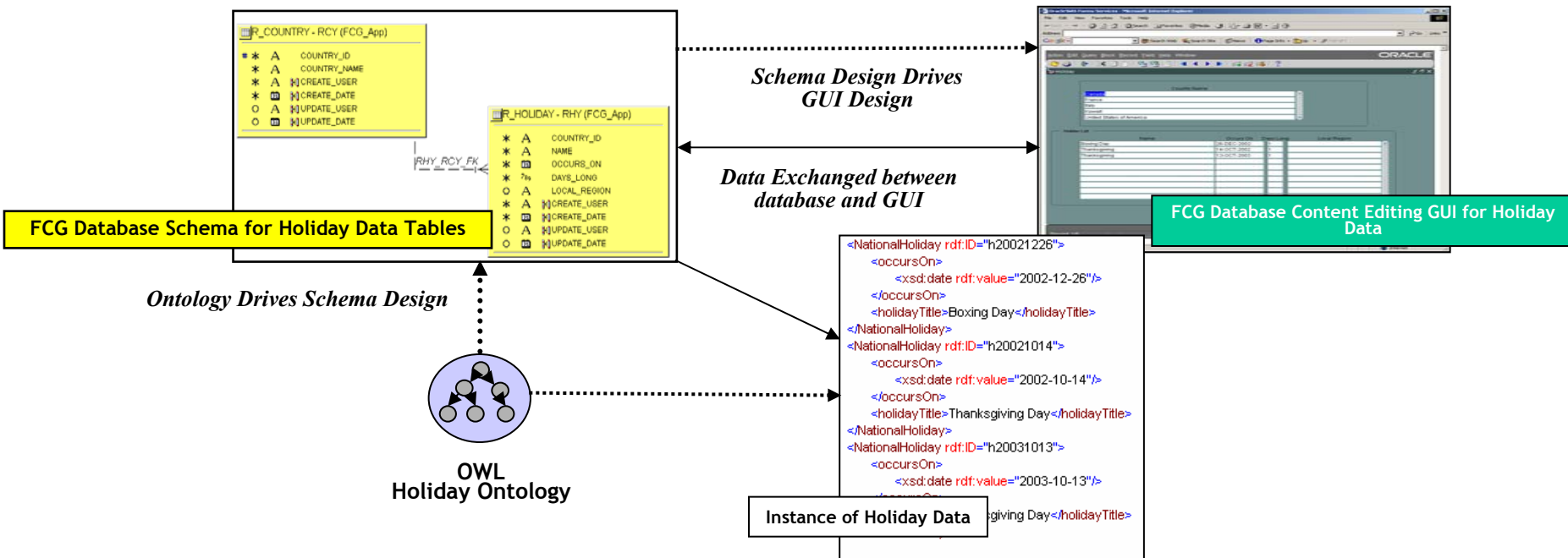


Data Content Markup Process





Ontology Driven Information Processing



Ontologies Developed to Date		
Aircraft Clearance Request	Clearance Option	Holiday
Aircraft Type	Contact	Lead Time
Airport Cargo Exception	Country	Mission
Airport	Hazardous Cargo	



Using Semantic Markup To Support Agent-Based Decision Making



- Ontology inference rules supply reasoning information to the software agents in ACT.
- ACT enables a user to create or modify some of the rules through the use of semantically tagged tools.
- Each tool has an underlying model that describes relationships among its entities.
- Software agents can interpret the rules and use them to make calculations and identify mission restrictions.



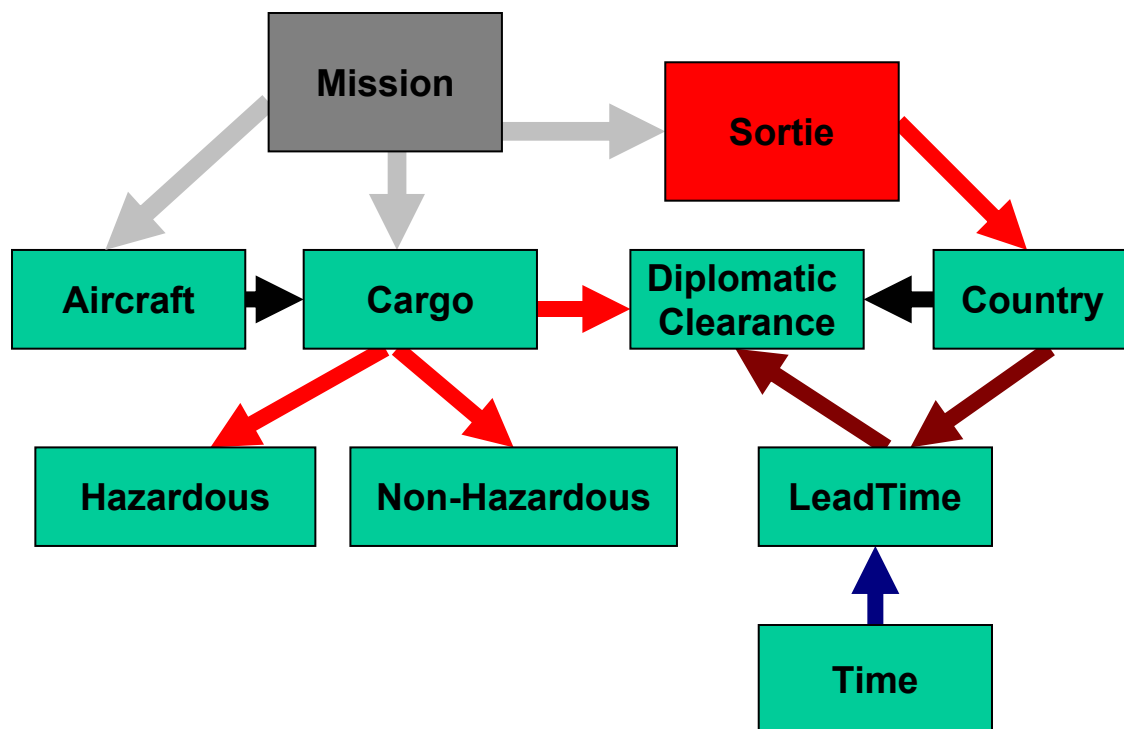
The Semantic Web

- The Semantic Web is an extension of the existing web, in which information has well-defined meaning through the use of markup tags that are associated with ontologies.
- The Ontology Web Language (OWL) is built on XML, adding structure to web content that is required to support automated reasoning.
- An ontology formally specifies a concept and its relationship to other concepts. When classes, subclasses, and relationships among entities expressed in the ontology are defined, they provide a very powerful medium for assisting in the interpretation of the data by software agents.
- A set of related ontologies forms a semantic web.



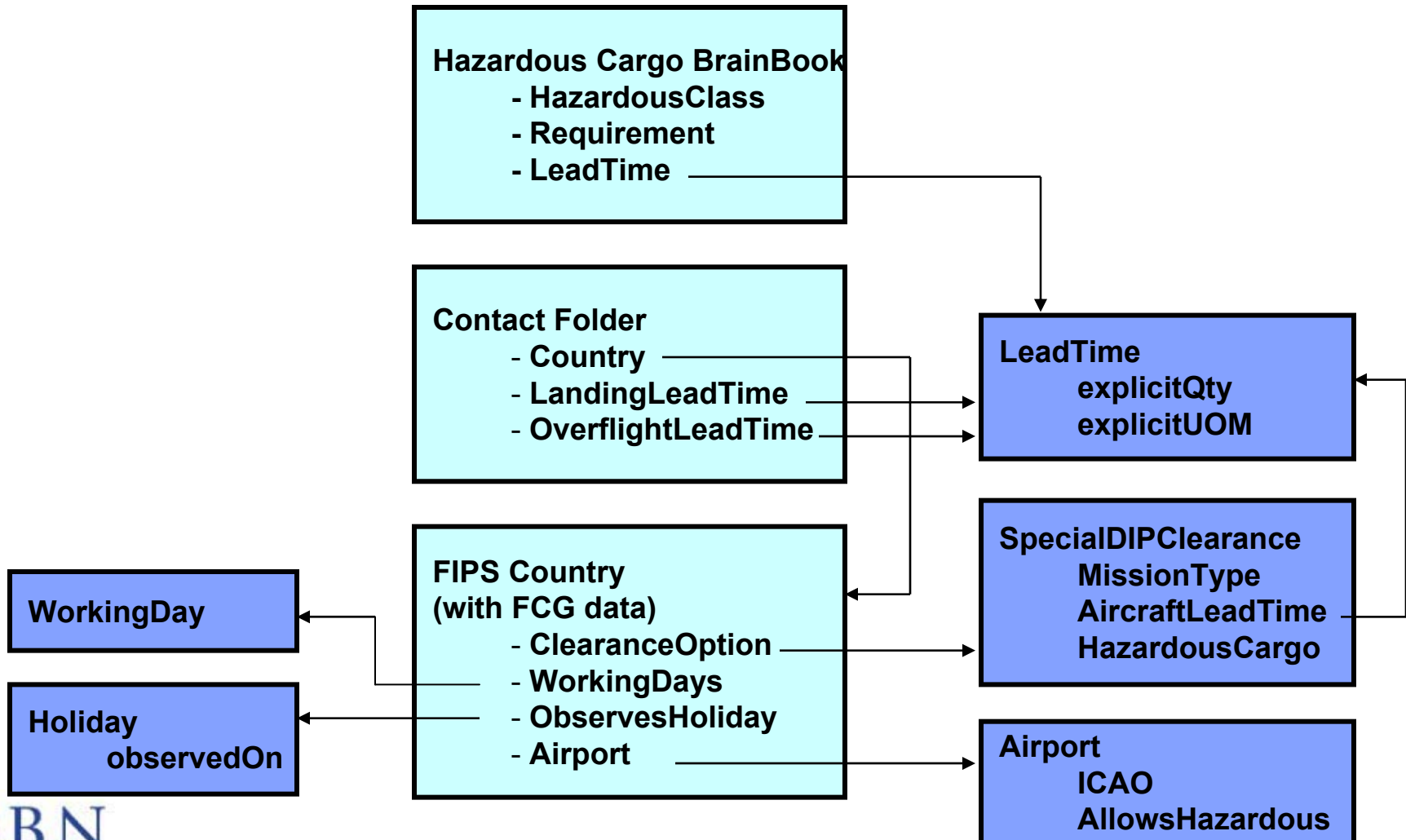
Use of Ontologies

- ACT data sources are semantically annotated (encoded) data, so they can be interpreted by software agents.
- ACT is a tool that leverages the concept of the “Semantic Web”, utilizing a group of ontologies that describe the problem.



Foundation ontologies were provided to the BBN tool developers to analyze from the perspective of an information consumer, which resulted in incremental revisions to the ontologies.

Using Ontologies to Support Automated Reasoning



ACT Highlights



ACT provides a framework for:

- ✓ Processing diplomatic clearance mission requests.
- ✓ *Monitoring key events* in the process.
- ✓ Making changes to existing plans as needed.

ACT provides the following capabilities

- ✓ *Data-form consistency* and update.
- ✓ *Alerts* to the user about environment changes, e.g., new missions, data changes.
- ✓ *Graphical methods* to display mission and/or diplomatic clearance problems.
- ✓ Automatically generates and maintains *explanations* of how calculations are performed.

Challenges to Automated Systems that Use Ontologies



- **Data Source Preference**

In ACT we developed a preference parameter that lets the user choose which data source to use for computation. Users need to specify data sources for specific instances of data, not just for the entire data set.

- **Ontology Validation**

While tools exist to develop XML schemas and ontologies, there is little guarantee that the resulting ontologies are valid for a given problem-solving domain. For example, while there is generally higher integrity for representations of more concrete concepts (e.g., airports, holidays), representation of rule-like information tends to be biased by the way that the information will be used by a particular tool.



Recommendations

- *XML Tools* must be developed to allow consumers to *annotate data sources*, to the granularity that their applications require, without corrupting the original source.
- User-friendly methods need to be developed to allow users to *identify preferred data sources* at a granularity that is as fine as a single term associated with a data provider, e.g., “temperature” from the source “weather.com”.
- *Ontology development must be managed* in order to maintain consistency across ontologies.
- *User-friendly methods* need to be developed to *adapt existing software agents* to changing ontologies and/or data sources.