

# **Intelligent Semantic Query (ISQ) NOTAMS**

## **Semantic Web Applications for National Security**

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**AFRL/IF**



# The Mobility Problem



*Diplomatic Clearances*



AIRCRAFT

CARGO

FUEL

PERSONNEL

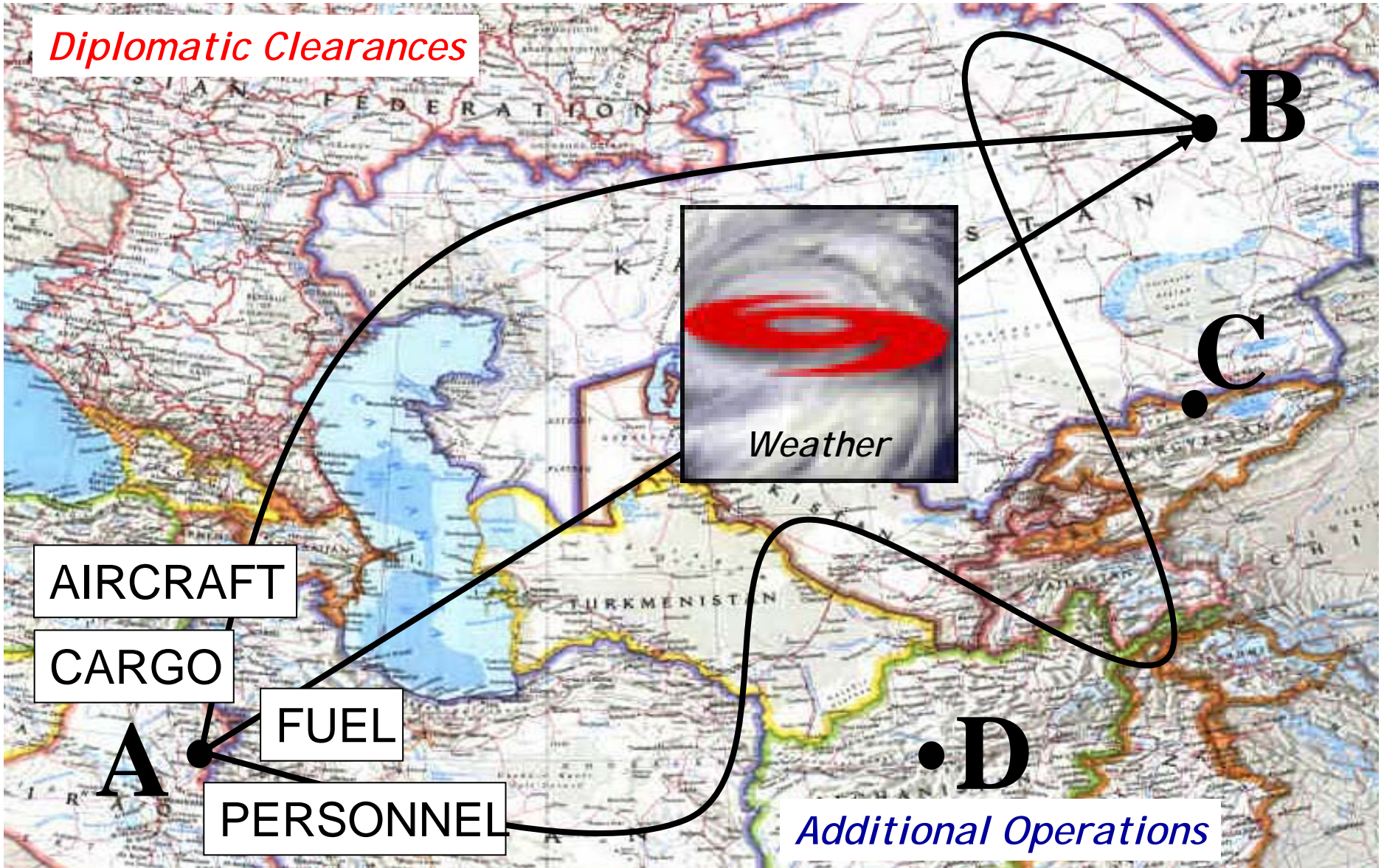
**A**

**B**

**C**

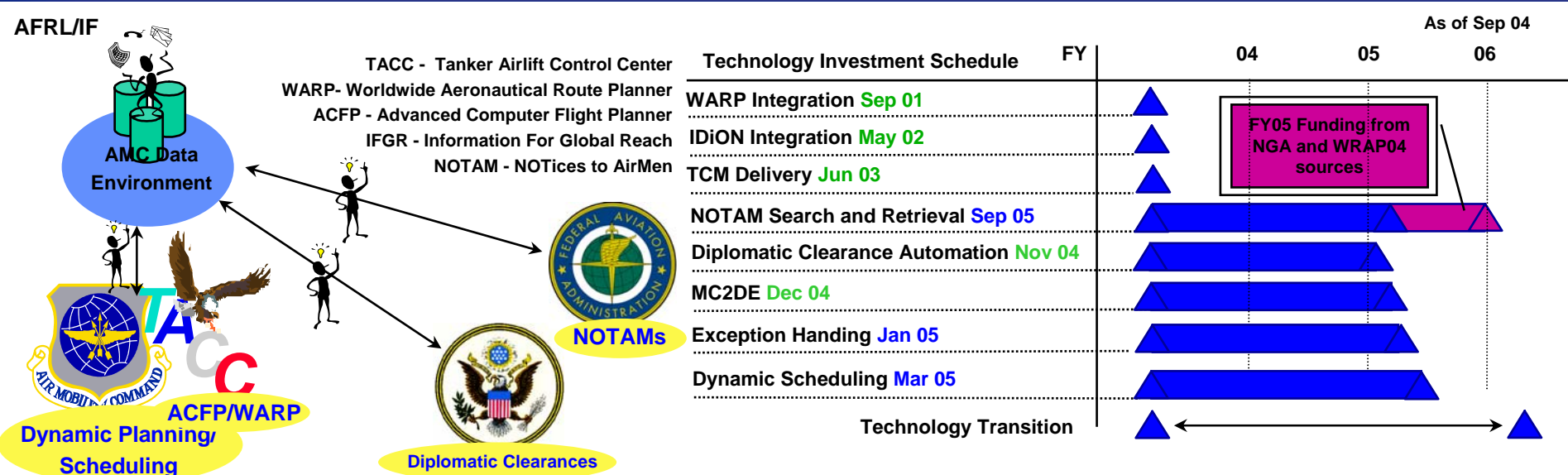
**D**

*Additional Operations*





# Integrated Flight Management ATD



Description	Benefits to the Warfighter
<ul style="list-style-type: none"> <li>Develop intelligent search, retrieval, and storage of mission planning data to optimize current, and future C2 capabilities</li> <li>Improve AMC's flight planning system</li> </ul>	<ul style="list-style-type: none"> <li>WARP, integrated with IFGR and dispatcher products, led to 14% fewer flying hours and 7% (\$202.9M) less fuel in mobility scenario†</li> <li>Reduce unneeded information presented to flyers, planners, and flight managers</li> <li>Highlight constraining events automatically to operators</li> <li>Increase overall productivity within TACC</li> <li>Allow the operator to run numerous courses of action quickly and then to pick the best</li> </ul>
Technology	
<ul style="list-style-type: none"> <li>Comprehensive, efficient algorithm for flight planning</li> <li>Data search and integration methods with automated feedback into planning and scheduling system</li> <li>Intelligent software agent technology for mobility asset planning</li> <li>Constraint-based planning/scheduling</li> </ul>	

†Defense Science Board (DSB) Fuel Study - May 2000



# NOTAM Deficiencies



**NOTAMS -- NOTICES TO AIRMEN** – are time-critical, safety-critical announcements of temporary changes to runways, instruments, lighting, fuel, and other airport facilities, navigation aids, restrictions on airspace, and traffic regulations, etc.

NOTAMs are issued by over 6,000 airports and facilities world-wide. Cryptic, highly abbreviated language, misspellings are common, and standards are more likely honored in the exception.

**FACT:** *NOTAMs are required reading for pilots and planners before flight.*

*but*

**FACT:** *There are over 25,000 active NOTAMs at any given time, updated at a rate of several thousand per day –*

**Question:**

*How do you make sure aircrews and planners get the right information in a timely fashion?*

Capability: **OWL-NOTAMS System**, a set of data acquisition, parsing and interpretation tools to translate critical content of **NOTAMs** into **OWL** annotations to make possible semantic retrieval and dissemination of NOTAMs.





# ISQ NOTAMS 2 System

## ISQ - Intelligent Semantic Query

Start with Free-Form Text

```

2003-04-07 04:23 GMT
A0108/03 NOTAMN A) KZJX B) 03040716
0304080215 E) STATIONARY ALTITUDE
RESERVATION WI AN AREA DESCRIBED
SZW182042 TO SZW161049 TO SZW1600
SZW196053 TO POINT OF BEGINNING,
AVOIDANCE ADVISED. 5,000 FT AMSL U
BUT NOT INCLUDING FL180 F) SEE TEXT
SEE TEXT
    
```

```

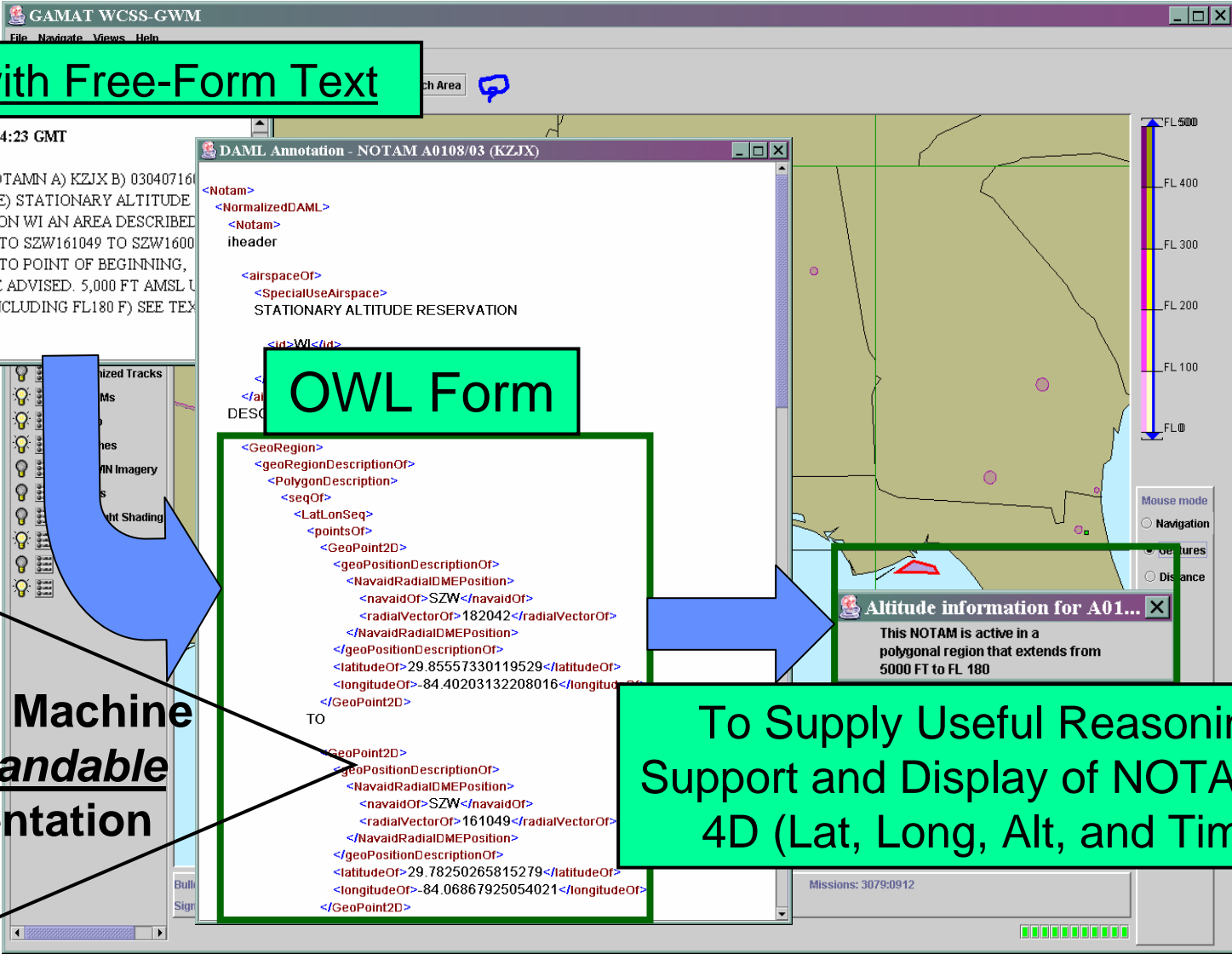
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  <NormalizedDAML>
  <Notam>
    iheader
      <airspaceOf>
        <SpecialUseAirspace>
          STATIONARY ALTITUDE RESERVATION
        </SpecialUseAirspace>
      </airspaceOf>
    <id>WL</id>
    <lat>
      <DESCR
        <GeoRegion>
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            <PolygonDescription>
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                          <navaidOf>SZW</navaidOf>
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                </seqOf>
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          <longitudeOf>-84.40203132208016</longitudeOf>
        </GeoPoint2D>
      </pointsOf>
    </LatLonSeq>
  </seqOf>
  </GeoRegion>
  </DESCR
    </id>
  </Notam>
</NormalizedDAML>
</Notam>
    
```

OWL Form

Use this Machine  
*Understandable*  
Representation

Altitude information for A01...  
This NOTAM is active in a polygonal region that extends from 5000 FT to FL 180

To Supply Useful Reasoning,  
Support and Display of NOTAMs in  
4D (Lat, Long, Alt, and Time)





# System Features

## ISQ NOTAMS - Intelligent Semantic Query



- The ISQ NOTAMS system:

- Reliably obtains NOTAMS from an official source, the AMC NOTAM cache.



- Annotates NOTAMS with machine *understandable* OWL annotations.



- Provides a mechanism for *human review* of these annotations.



- Provides a simple, reliable interface for systems, written in a variety of computer languages and residing on multiple platforms, to obtain such annotated NOTAMS.



The ISQ NOTAM system started operation in August 2002, and has produced continually improving OWL annotations of over 3 Million NOTAM records retrieved since that time.



# The ISQ NOTAM Project

Intelligent Semantic Query (ISQ) of NOTAMs for Integrated Flight Management – An AFRL IFM/ATD Component



## Definition:

**NOTAMS - NOTICES to AirMen** are time-critical, safety-critical, worldwide announcements that impact global flight conditions. They cover much of the aerospace flight environment including:

- ✦ Condition and Availability of Airport Facilities (e.g. Runways, Instrumentation, Fuel, etc)
- ✦ Flight / Navigational Aids
- ✦ Restrictions on Airspace (Weather, political, commercial, etc)
- ✦ Air Traffic Regulations and Flight-Related Concerns.

## Scope:

NOTAMs are issued by over 6,000 airport facilities world-wide and there are over 25,000 active NOTAMs at any given time - being updated at a rate of several thousand per day.

## Problem:

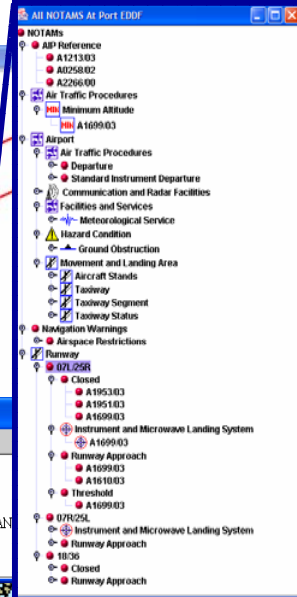
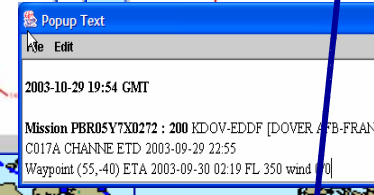
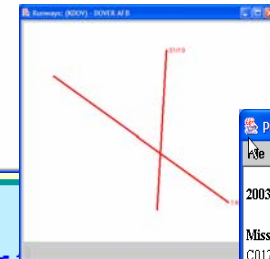
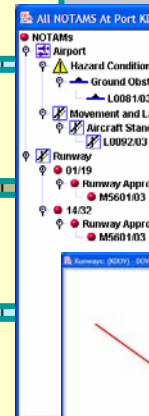
NOTAM text uses a highly abbreviated flight domain language, misspellings are common, sentences are fragmented and punctuation is applied haphazardly which must be manually read, reviewed and distributed.

## Solution:

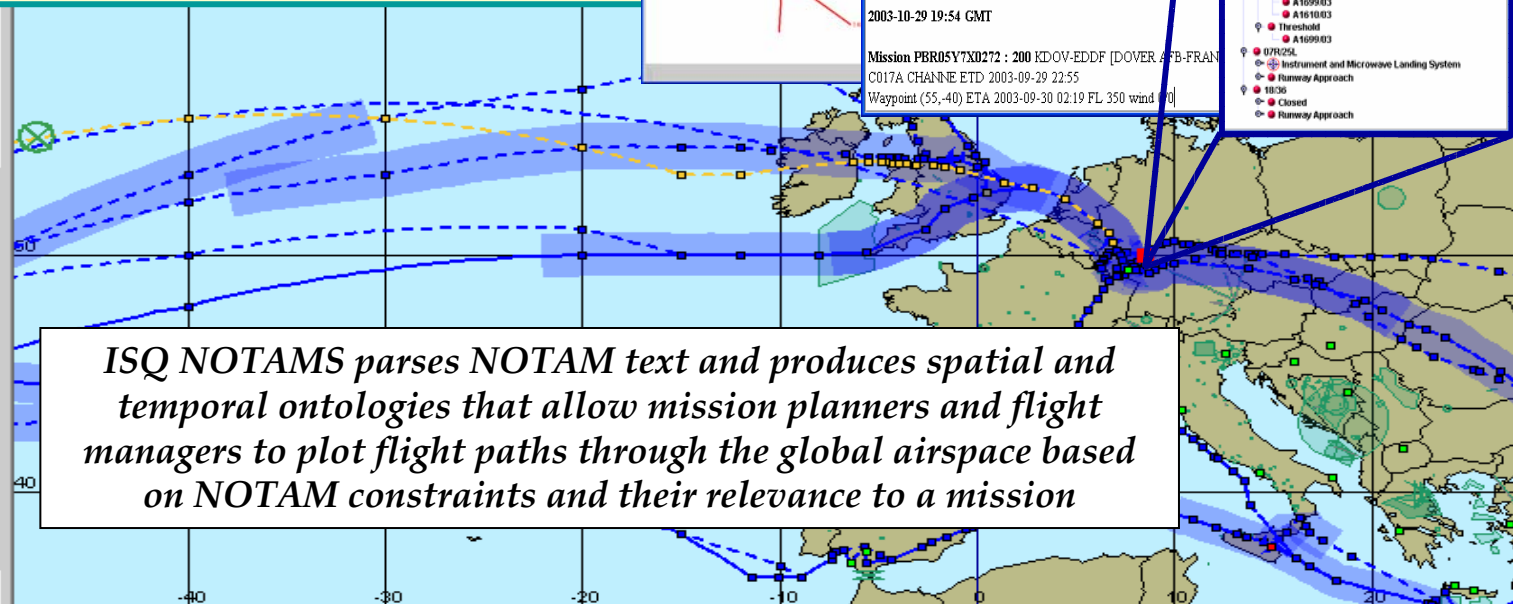
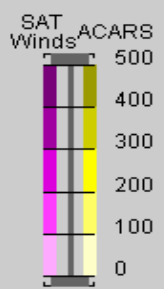
Under the AFRL IFM/ATD, BBN has developed parsing and interpretation tools to translate the critical content of NOTAMs into OWL Web Ontology annotations to enable a semantic retrieval and dissemination of NOTAMs.

ISQ NOTAMS parses NOTAM text and produces machine-understandable annotations capturing critical facts, including:

- Individual airport runways that are affected by NOTAMS
- Runway conditions that are being reported
- Aerodrome equipment and services that are not operating normally
- Procedures that are being modified
- Regional NOTAMS in 4 dimensions:
  - Latitude
  - Longitude
  - Altitude
  - Time



- 🔦 NOTAMS
- 🔦 Graticule
- 🔦 Political Boundaries



*ISQ NOTAMS parses NOTAM text and produces spatial and temporal ontologies that allow mission planners and flight managers to plot flight paths through the global airspace based on NOTAM constraints and their relevance to a mission*