

*International Technology Alliance
in
Network & Information Sciences*

Anytime Cognition

*An information agent
for emergency response*

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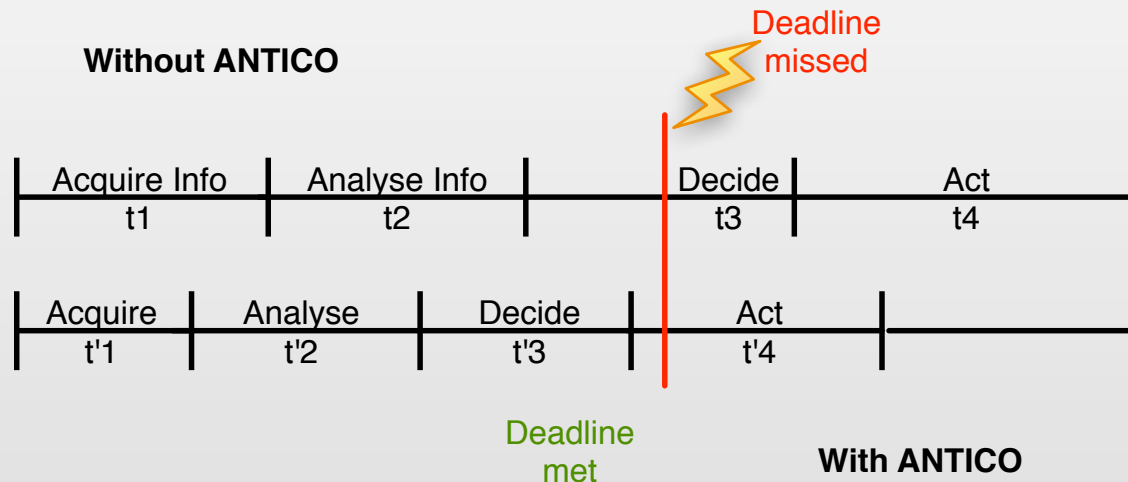


Motivation

- Planning is challenging:
 - Under time-pressure
 - Relying on uncertain information
- Humans under significant cognitive workload
 - Result in missed deadlines

- Anytime Cognition concept:

- Generic information assistant architecture
- Maintains a manageable cognitive workload



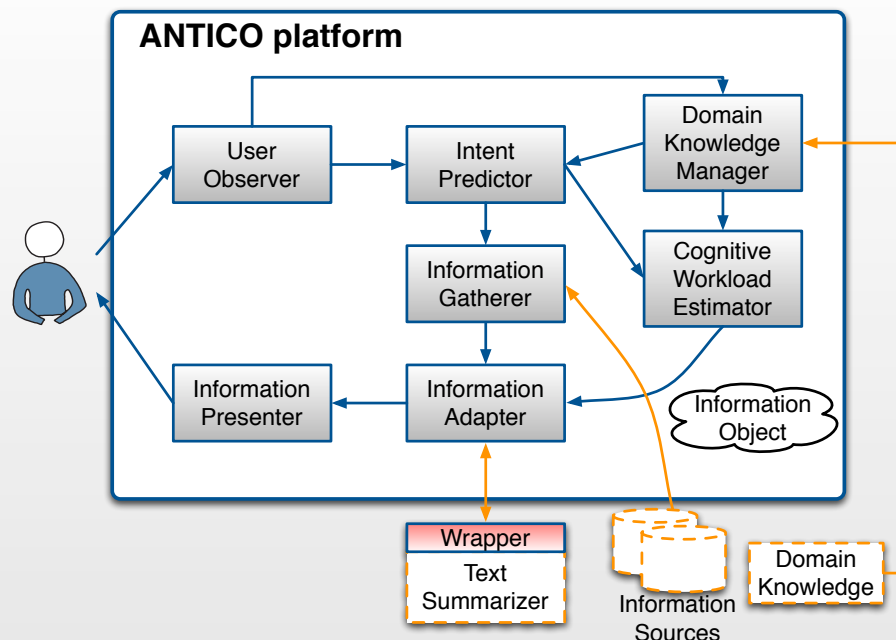


Scenario Description

- Based on the National Planning Scenarios developed by the DHS
- ANTICO focuses on six areas:
 - Emergency Assessment/Diagnosis
 - Emergency Management/Response
 - Incident/Hazard Mitigation
 - Public Protection
 - Evacuation/Shelter
 - Victim Care
- Attack Scenario
 - Based on the nerve agent scenario
 - Deployment of multiple Sarin Gas Canisters into a public building in DC
- Initial phases of the response are critical
 - Conflicting diagnosis info
 - Potential for additional casualties from first responders



ANTICO Architecture



- Generic assistance architecture
 - Integrates multiple AI components
 - Modularized to allow different techniques to be used
- Main objectives
 - User activity recognition
 - Unobtrusive assistance



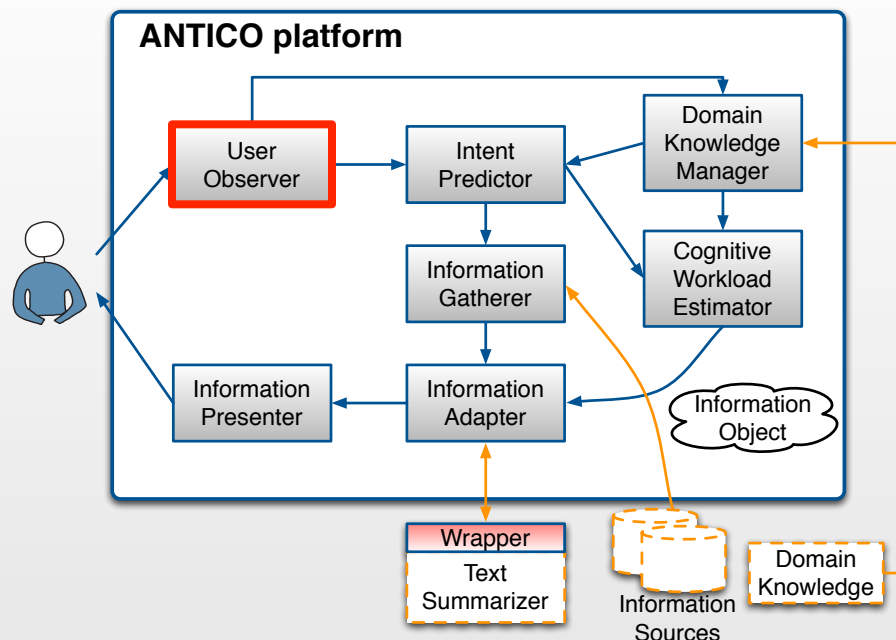
ANTICO Domain Description Language (ADDL)

- Designed to be generic and applicable to various problem domains
- XML-based
 - Human-readable
 - Network friendly
- Domain description includes:
 - User Workflows
 - Information Sources

```
<?xml version="1.0" encoding="UTF-8"?>
<anticoDomain>
  <stateVariables>
    <variable name="zip-code"><domain type=numeric min=15201
max=15295/></variable>
    <variable name="hazmat-dispatch"><domain type=boolean/></
variable>
    ...
  </stateVariables>
  <activities>
    <activity name="callHazMat">
      <observations>
        <observation name="dialedXYZ" prob=".5" />
        <observation name="lookedContacts" prob=".5" />
      </observations>
      <infoObject>
        <query value="select phone from Contacts where
name='HAZMAT' and zip=$(zip-code)$" />
        <constraints>
          <deadline value="17:00 02-06-2011 GMT" />
        </constraints>
        <retrieval status="queried" source=Contacts" timestamp=""
data="" />
        <presentation><zoom-coords="" /></presentation>
      </infoObject>
      <effects>
        <variable name="hazmat-dispatch" value="true" prob="0.9" />
      </effects>
    </activity>
    ...
  </activities>
</anticoDomain>
```



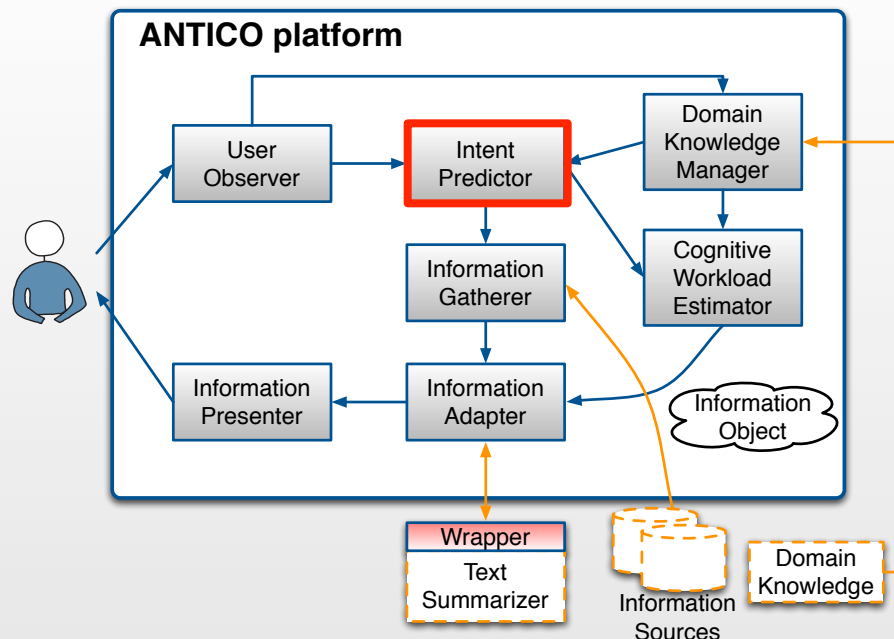
User Observer



- Obtains and interprets
 - User activities
 - Messages from the field
- Multiple observer objects specialized in specific observation types, e.g.
 - UI activities
 - Input devices
 - External messages



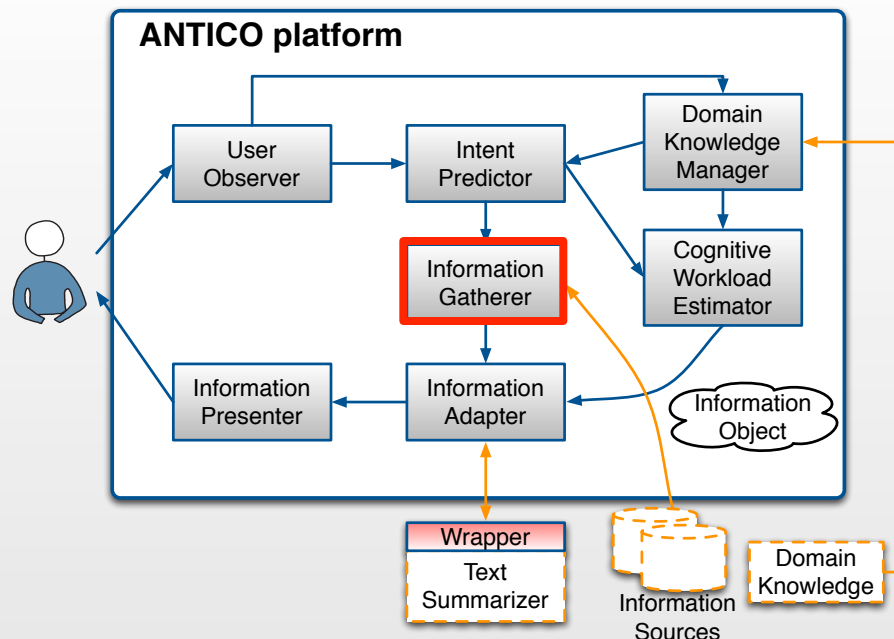
Intent Predictor



- Uses a domain description in ADDL
- Analyzes observations from User Observer
 - Generates a set of information requirements
 - Employs HMM-based intention recognition



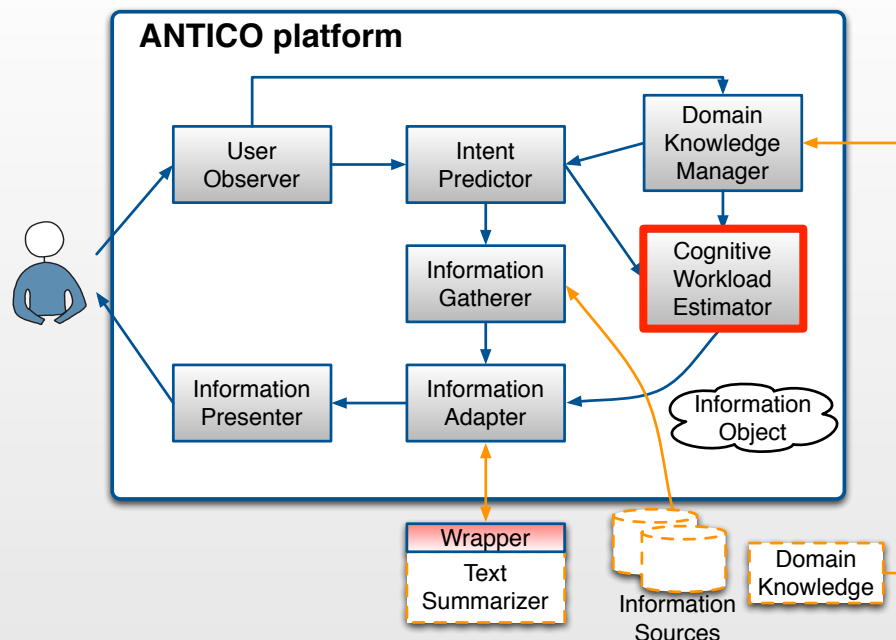
Information Gatherer



- Using the information requirements from intent predictor, determines:
 - Which information to be gathered
 - When to gather information
 - How to cope with resource restrictions



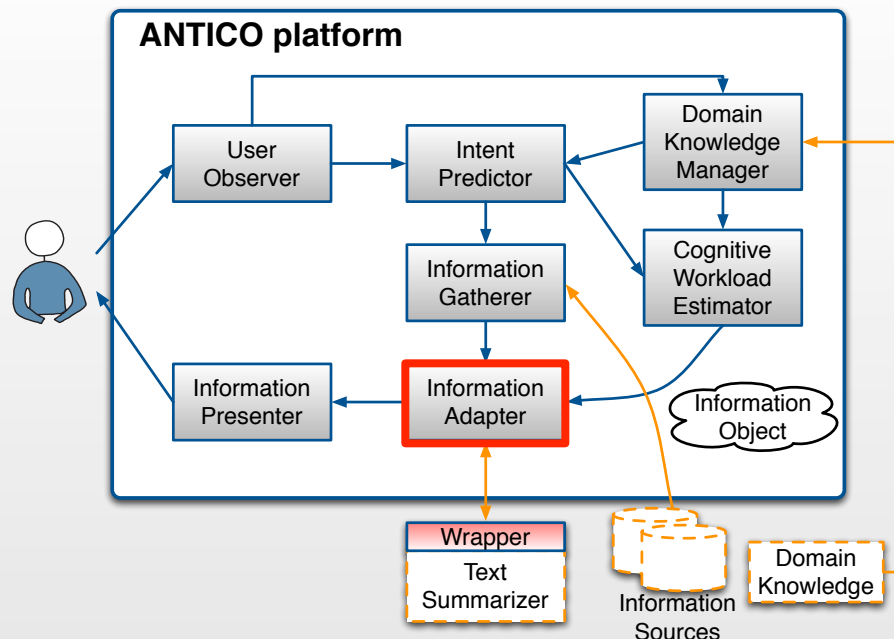
Cognitive Workload Estimator



- Calculates cognitive workload
 - Based on the number of tasks executed by user
 - Queuing model for user workload
- Estimates the maximum amount of information to be presented



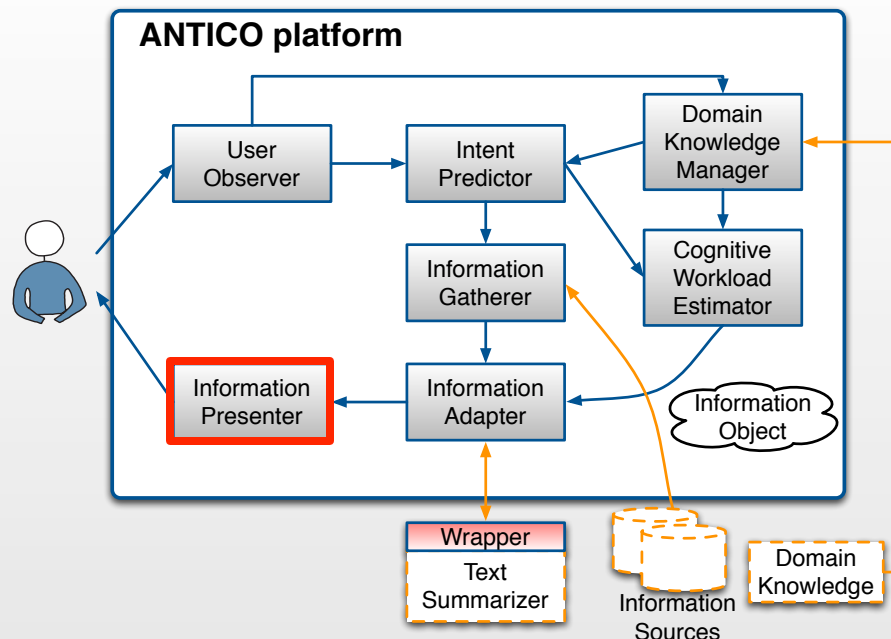
Information Adapter



- Adapts information before presentation to appropriate level of detail
- Level of detail of presented information depends on:
 - Cognitive workload
 - Time available for user



Information Presenter



- Presents information to the user
- Uses current belief state to determine optimal time for presentation
- Monitors when and whether information has been used to improve future presentation



Application Description

AnticoDemo

http://127.0.0.1:8888/AnticoDemo.html?gwcodevr=127.0.0.1:9997

Sarin Gas Attack **Get Hazmat Info**

Timer 00:00:04

Event Msgs
the station
People experiencing breathing difficulty.

Event Messages Panel

Map

Hazmat
Police
Hospital
DHS
Capitol Police
Media
Helicopter
DC Metro

Relevant Org. Contact Info

Washington DC Police
Notification Sent to Hazmat

Reminders

Reminders Panel

Contact
Hazmat
Short Info
Medium Info
Long Info
DONE

Diagnostics
Diagnostics Information
the victim has difficulty breathing and experiences nausea and drooling. As the victim continues to

Affected Areas
Vulnerable Population Information

Weather
Weather Updates



Contributions

- Mitigation of user cognitive workload
- Adaptive presentation of time and context-sensitive information
- Proactive management of information requirements
- Generic XML-based domain description language
- Integration of several AI techniques:
 - Probabilistic plan recognition
 - Constraint optimization
 - Domain independent



Current Work

Current Work by CMU

- Integration of ANTICO with CPOF Sandbox
- Aimed at:
 - Testing of agent assistance for CPOF users
 - Refinements to information assistance in a realistic environment
 - Great potential for technology transition

CPOF Sandbox

- Developed by CERDEC
- Replicates UI functionality of CPOF in a “Sandbox” environment
 - Uses simulated data plus human interaction
 - No access to sensitive data
 - Aimed at usability studies in a controlled environment



Integration with CPOF Sandbox

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The screenshot displays the CPOF Sandbox interface. On the left, there are panels for 'General Frames' (Map, Tree Viewer, Stickie) and 'Tool Frames' (Item Palette, Package Palette, Tool Bar, Trash Can). Below these is an 'Effort List' with a 'Scratch Effort' checkbox. The main area is a map of Washington D.C. with several units marked: 'EOD Unit' (blue square), 'CBRN Unit' (blue square), 'J O Wilson Elementary School' (blue square), and 'Two Rivers Public Charter School' (blue square). An 'IED Explosion' is marked with a red star. The map includes labels for streets, parks, and landmarks like the White House and the National Mall.

Evac Plan Data

Schools

1. J O Wilson Elementary School, 660 K Street Northeast, Washington D.C., DC 20002-3530. Ph: (202) 698-4733

2. Two Rivers Public Charter School, 1227 4th Street NE, Washington D.C., DC 20002. Ph: (202) 546-4477

The screenshot displays the ANTICO AGENT ACTIVITY interface. It features a 'USER WORKFLOW' section with 'CBRN Recon' and 'Evac Plan' tasks. A 'USER TASKS' section lists various tasks: 'Situational Assessment', 'Dispatch Units', 'Dispatch EOD Units', 'Identify Personnel', 'Issue WARNO', and 'Initiate movement'. A 'SCHOOLS list' on the right shows the same two schools as the previous window. The interface includes navigation buttons for 'PREVIOUS', 'CURRENT', and 'NEXT'.

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