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12-14 June 2007, at US Naval Academy, Annapolis, MD

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(Please use the same title listed on MORSS Form 712 A/B. If the title was changed please list the revised title below.) Revised title:

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Demonstration, _____, Tutorial, _____ or Focus Session # _____

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Report Documentation Page

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Semantic Web Technologies for Storing and Accessing Immediately Needed Training Data

*Dr. William (Bill) Gerber
Gabriel Aviles
Karen Fraser
Wayne Randolph*

June 12-14, 2007



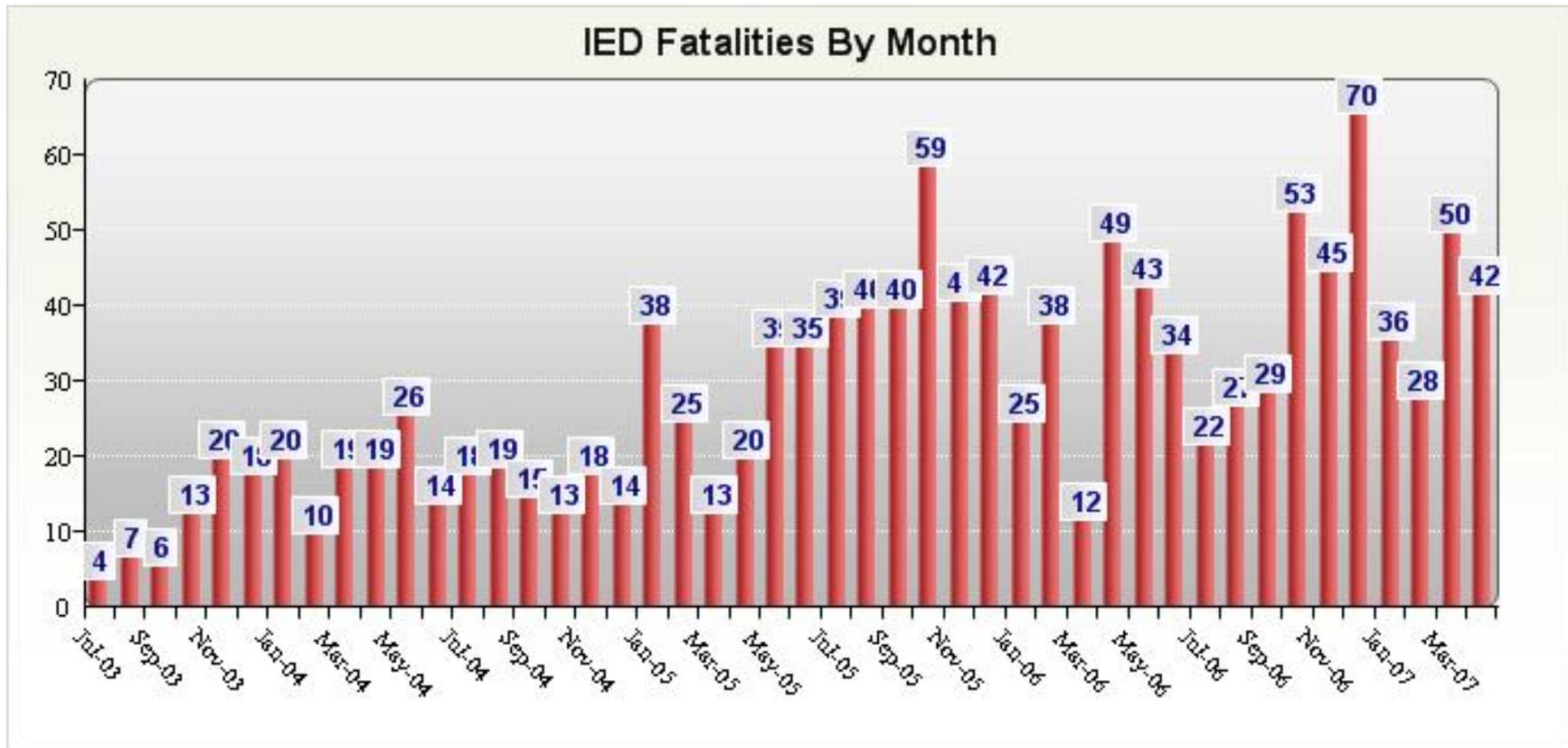
- **Joint Explosive Ordnance Disposal (JEOD) Decision Support System (DSS)**
 - Challenges
 - Overview
- **DARPA - Semantic Web Research**
 - Dynamic Job Aid System (DJAS)
 - Technology Behind the Scenes
- **JEOD Knowledge Transfer Operational Demonstration (KTOD) Advanced Concept Technology Demonstration (ACTD)**
 - Technology Overview
 - Content Authoring Tool (CAT)
 - Reference Assistant Tool (RAT)
- **Summary**
- **Questions**



- **Save Warfighter Lives**
 - EOD warfighters exposed to increasingly sophisticated terrorist improvised explosive devices (IEDs)
 - Inadequate Information Dissemination
- **Enable near real-time dissemination of critical content to mobile users**
 - Deploy network to enable mobile users access to semantic web
 - Near real-time Tactics, Techniques & Procedures (TTP) generation and dissemination
- **Reduce Cost for Procedural Instructional Content**
 - Provide a system to author and publish contextualized content to multiple form factors –
“author once publish many”

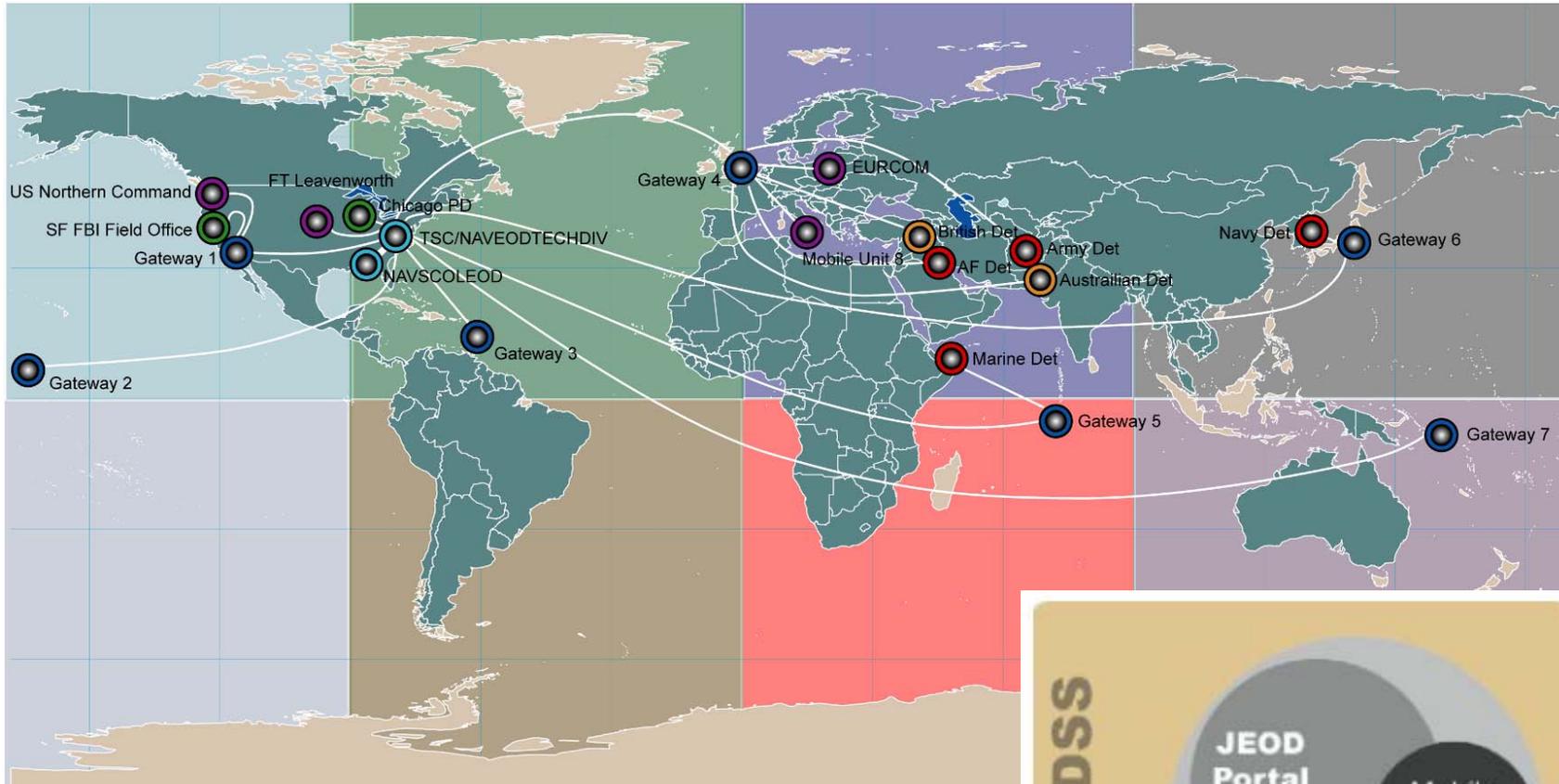


Context: IED US Fatalities By Month

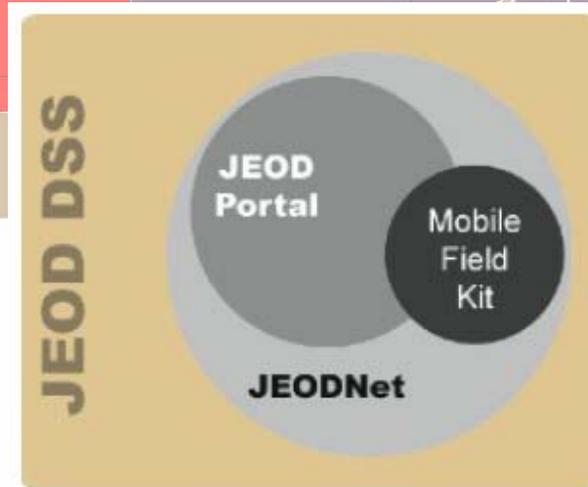


Source: <http://icasualties.org/oif/IED.aspx>

Context: JEOD Decision Support System (DSS) - Globally Deployable



-  JEOD Core Site
-  JEODNET Gateway
-  EOD Detachment
-  Operational Commander
-  Coalition Partner Detachment
-  Civilian or Non-DoD Government Entity



- **Joint Explosive Ordnance Disposal (JEOD) Advanced Concept Technology Demonstration (ACTD) is placing new tools in the hands of EOD techs facing IED threats.**
- **JEOD techs will use the Decision Support System (DSS) to access “just-in-time” Job Aids.**
- **Job Aids help them learn/recall how to perform their mission.**
- **DRC developed tools which leverage Semantic Web technology to:**
 - Reduce development costs of authoring Job Aids by dynamically composing Job Aids from procedural knowledge bases on the fly.
 - Enable “just-in-time” training with tailored instructions based on current conditions (e.g., user roles, weather, location, mission phase, etc.).

JEOD DSS Overview

Network-Centric JEOD Training, Support, and Operations enabled by the JEOD Decision Support System

Empowering the operational JEOD community's response Teams to counter threats..

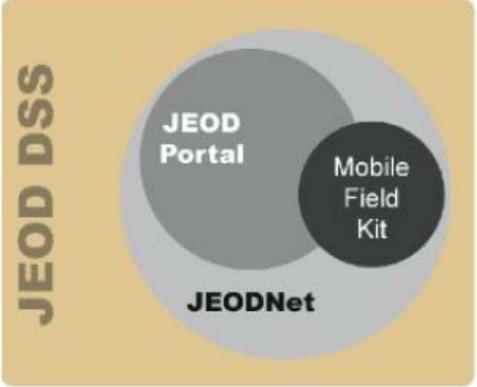
EOD Response Teams



Threats



UXO IEDs CBRNE



...with advanced automated tools and connectivity...

JEOD Decision Support System

JEOD Portal



JEODNET Infrastructure



Mobile Field Kit

Clients with GPS



Secure Wireless Communications



Server



...to the training and support communities



DoDAF OV-1



Semantic Web Research and Dynamic Job Aid System (DJAS) Demonstration



Funded by DARPA



- **Member of DARPA Agent Markup Language (DAML) research team**
 - Focus on military applications of semantic web technology
- **Leveraged our Training & Performance Support Business Solution**
 - Training/Task Analysis
 - High Performance Team Training
 - Interactive Multimedia Instruction
 - Automated Training Management
- **Developed Dynamic Job Aid System (DJAS)**
 - Instantiated the system with Joint Explosive Ordnance Disposal (JEOD) related content:
 - Tactics, Techniques, and Procedures (TTPs)

- **Proof-of-principle demonstration for filtering and formatting JEOD TTPs using Semantic Web markup**
- **Goals**
 - Domain agility
 - Separation of content from format
 - Context-based filtering (dynamic)
 - Standard representations support sharing and inferencing
- **Demonstration**
 - Auto-author procedural-based instructional information
 - Content contextualized in real-time
 - Content used for just-in-time warfighter training while in the field

Dynamic Job Aid System (DJAS) Demonstration



Dynamic Job Aid System (DJAS) Demonstration

Filtering and Formatting Selection

Select Conditions:

Domain:

User Role:
 Team Leader
 Master EOD Tech
 Primary Responder (P1)
 Secondary Responder (P2)

[View Source TTP](#)
[View RDF Condition List](#)
[View Filtered TTP](#)

Format Filtered Content:

[View Checkbox Format](#)
[View Hyperlink Format](#)
[View Expanded Format](#)
 [View Index Format](#)

ArrLoc-SuspPkg

- ArrLoc-SuspPkg
- ArrLoc-Hostage
- ArrLoc-Vehicle
- ArrLoc-SuspPkg
- ArrLoc-WMD
- RecID-SuspPkg-Manual
- RecID-Vehicle-Manual
- RecID-Vehicle-Remote
- RecID-WMD-Remote
- RecID-WMD-Manual
- Neut-Manual-GenDisrup
- Neut-Manual-SrgDisrup
- Neut-Manual-RemRemove
- Neut-Remote-GenDisrup
- Neut-Remote-SrgDisrup
- Neut-Remote-RemRemove
- Neut-Manual-Hostage

Dynamic Job Aid System

Arr/Loc:SuspPkg

- [Develop Multiple EOD Courses of Action](#)
- [Develop Multiple EOD Courses of Action](#)
- [Perform Risk Assessment for Each COA](#)
- [Perform Risk Assessment for Each COA](#)
- [Consider Wait Time \(Arrival\)](#)
- [Consider Wait Time \(Arrival\)](#)
- [Tool Selection \(Arrival\)](#)
- [Tool Selection \(Arrival\)](#)
- [Select Appropriate PPE](#)
- [Select Appropriate PPE](#)
- [Plan Easy Remote Approach](#)
- [Plan Easy Remote Approach](#)
- [Plan Safe Manual Approach](#)
- [Plan Safe Manual Approach](#)
- [Perform Team Brief](#)
- [Brief OSC \(Arrival\)](#)

Dynamic Job Aid System

Arr/Loc:SuspPkg

Indexed View

A B C D E F G H I J K L M N O P Q
 R S T U V W X Y Z

Dynamic Job Aid System

Arr/Loc:SuspPkg

Index - B

[Brief OSC \(Arrival\)](#)

[Brief entry team](#)

[Be alert for entrapment](#)

- **The Semantic Web is the new evolution of the World Wide Web supported by ontologies.**
- **Ontologies formally specify concepts and their relationships to other concepts.**
 - When classes, subclasses, and relationships among entities expressed in an ontology are defined, they provide a very powerful medium for assisting in the interpretation of the data by software agents.
 - Ontologies can be encoded using the Web Ontology Language (OWL) which received W3C Recommendation Status in 10 February 2004.
 - OWL is built on XML/RDF, adding structure to web content that is required to support automated reasoning.
- **A set of related ontologies form the foundation of the semantic web.**



Semantic Web Standards Layers

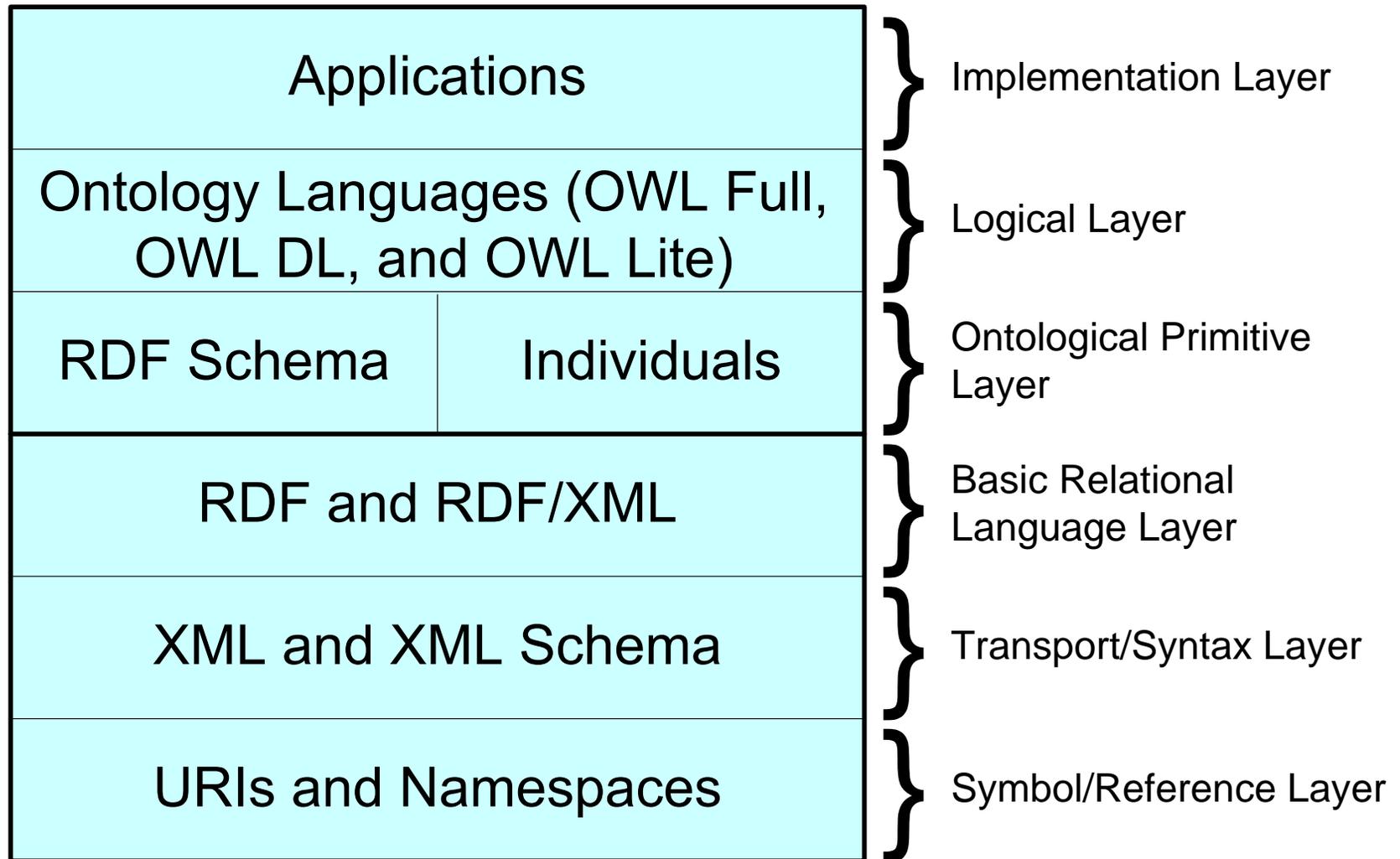
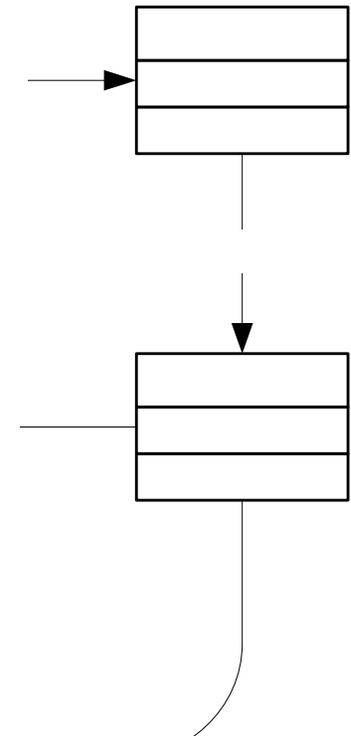
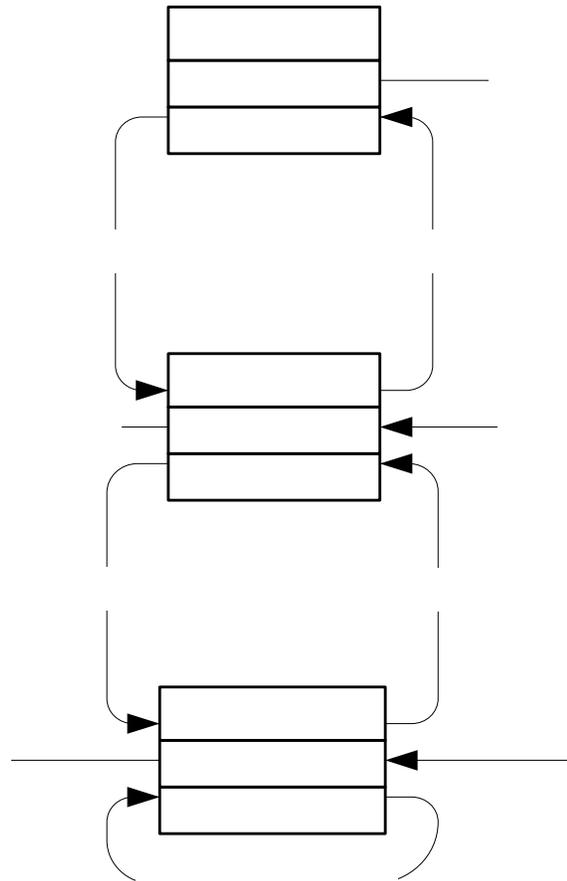
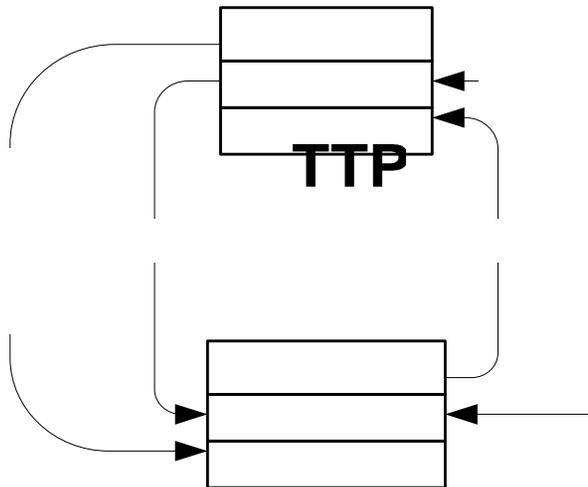
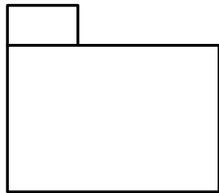
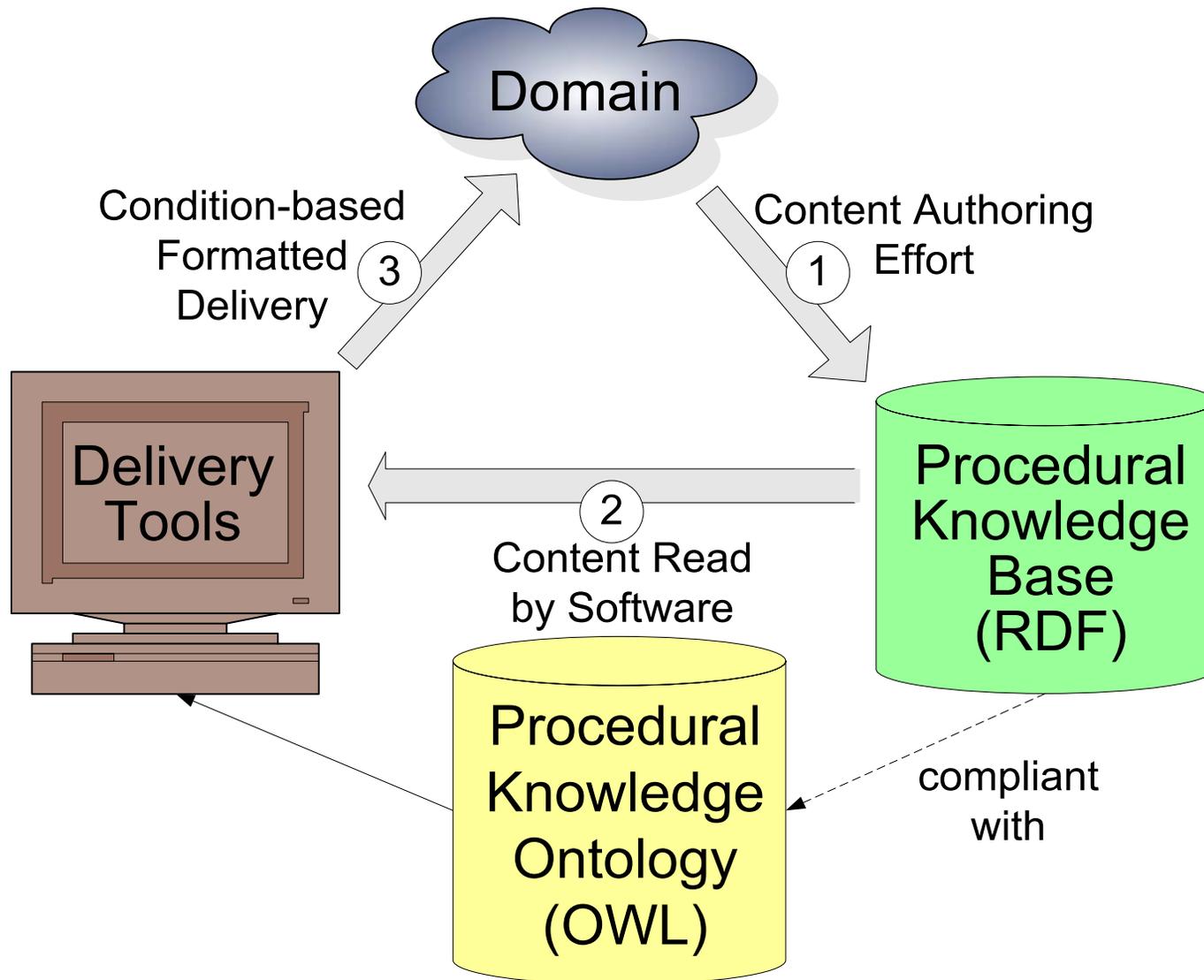


Figure © Lee W. Lacy - 2005

Tactics Techniques Procedures (TTP) Ontology Design



Dynamic Job Aid System (DJAS) Concept Diagram



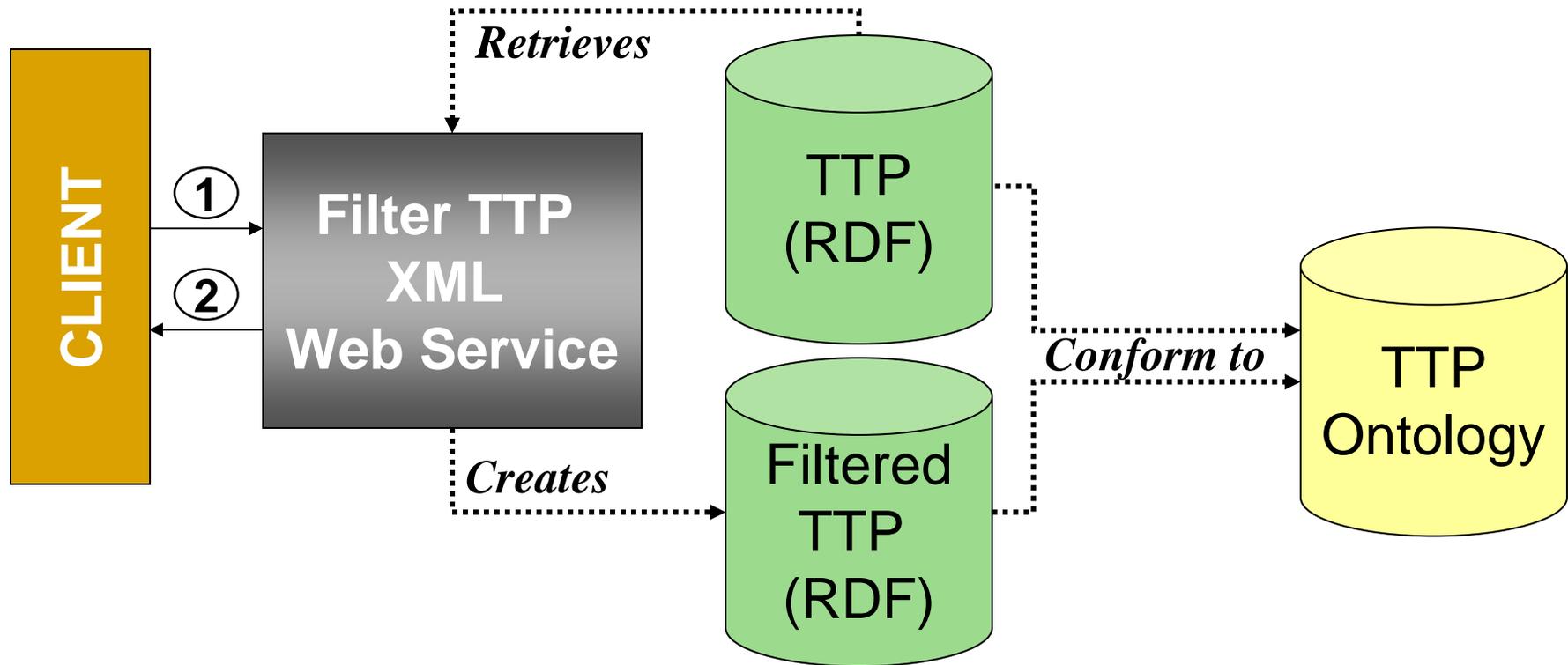
**Filter TTP
XML
Web Service**

- **Filter Web Service**
 - Based on current conditions

**Format TTP
XML
Web Service**

- **Format Web Service**
 - Based on form factor (e.g., handheld, tablet PC) and desired presentation method

DJAS Filter Web Service Component Interaction Diagram

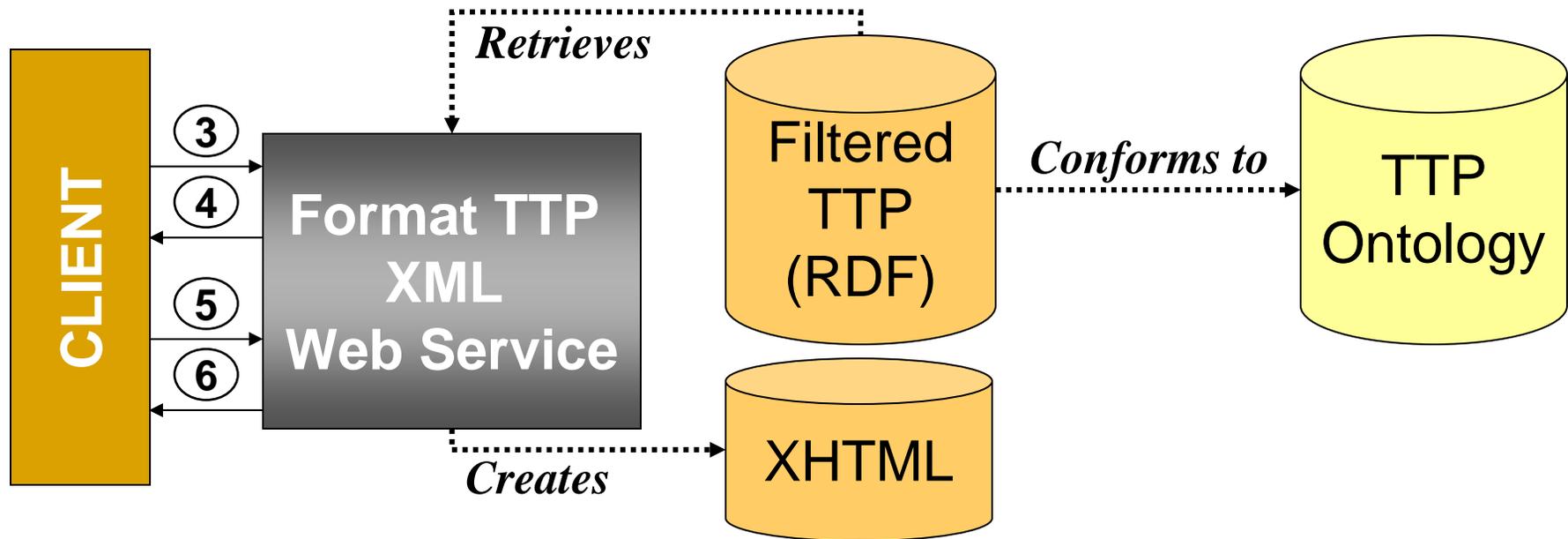


LEGEND

- ① Client Filter Request with:
- Defined RDF TTP URL
 - Defined ConditionNodeSet

- ② Filter Web Service Response with:
- URL for Filtered RDF TTP

DJAS Format Web Service Component Interaction Diagram



LEGEND

- | | |
|---|--|
| <p>3 Client Format Request with:</p> <ul style="list-style-type: none"> • Defined RDF TTP URL • Defined FormatType | <p>5 Client Format Request with:</p> <ul style="list-style-type: none"> • Defined RDF TTP URL • Defined Index |
| <p>4 Format Web Service Response with:</p> <ul style="list-style-type: none"> • URL for XHTML Formatted TTP | <p>6 Format Web Service Response with:</p> <ul style="list-style-type: none"> • URL for XHTML Hyperlinked Indexes |



JEOD KTOD ACTD Decision Support System (DSS)

Funded by JEOD KTOD ACTD



Evolution of DJAS to JEOD KTOD ACTD Decision Support System

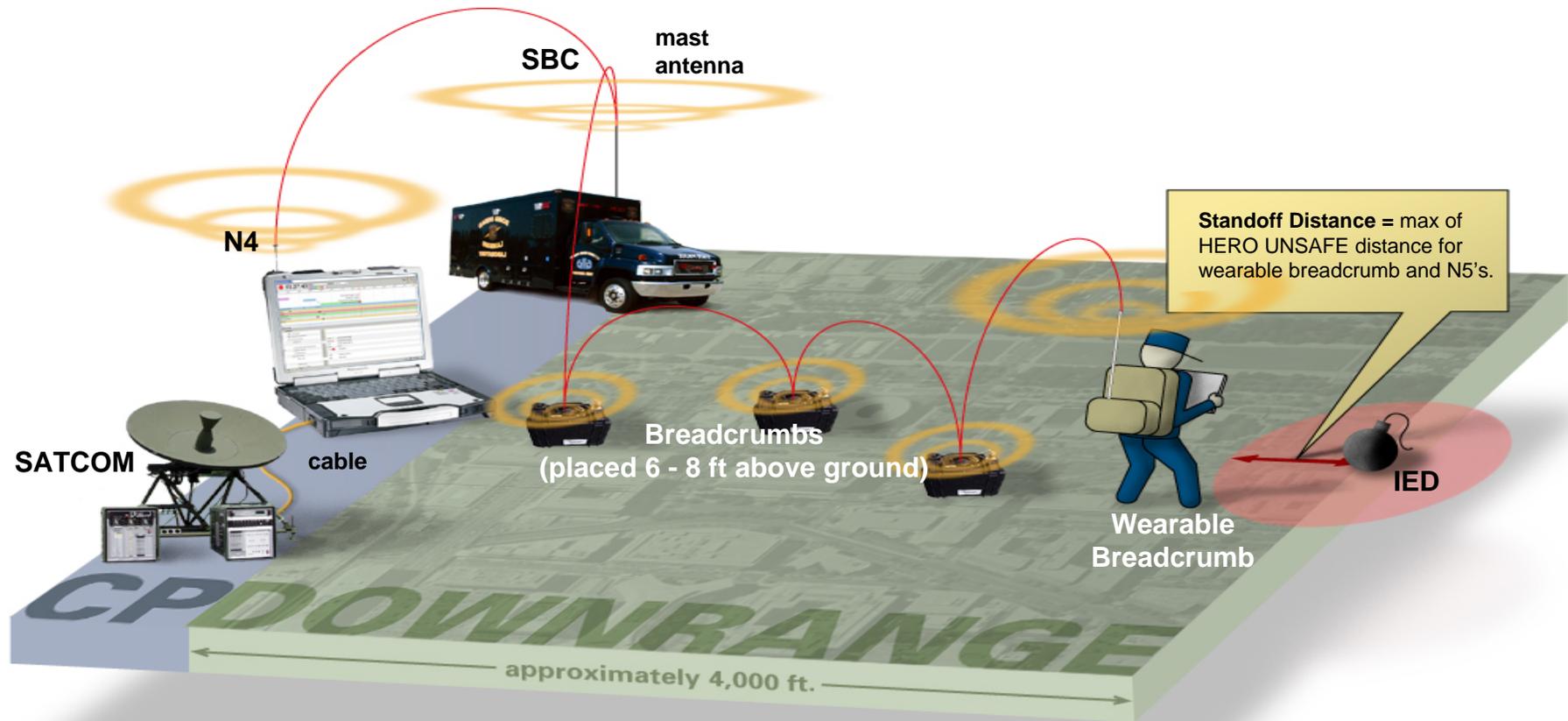
- **JEOD Advanced Concept Technology Demonstration (ACTD) recognized the potential of DJAS**
- **JEOD funded DRC to evolve DJAS into a Reference Assistant Tool (RAT) and to also develop a Content Authoring Tool (CAT)**
- **RAT is part of the Mobile Field Kit (MFK) of the JEOD Decision Support System (DSS) while CAT supports the content authoring in the Portal**
- **Initial DJAS TTP Ontology evolved to a suite of ontologies:**
 - Mission Ontology
 - Content Ontology
 - Condition Ontology

Military Learning Objective

- Provide contextualized Just-In-Time (JIT) training of procedural content to warfighters while in the field.

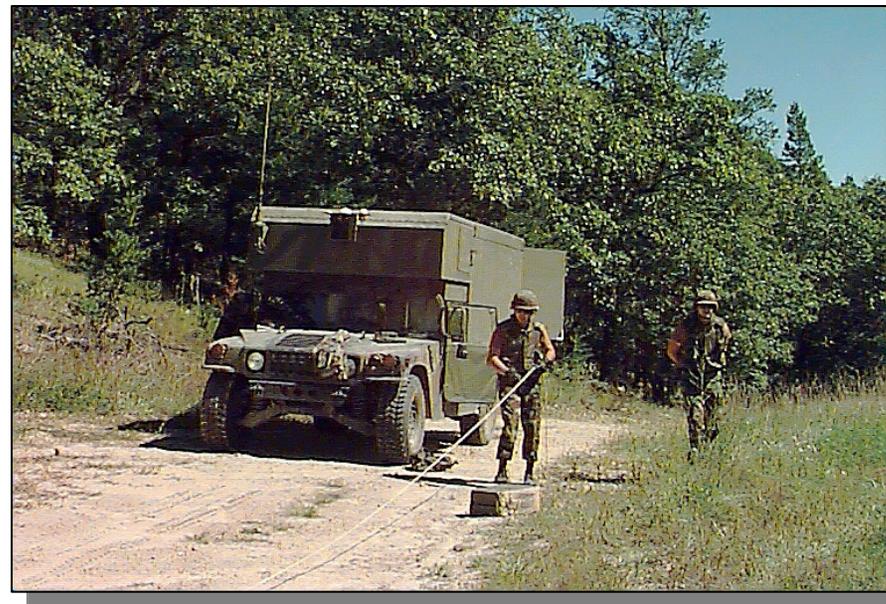


Mobile Field Kit (MFK) Technology



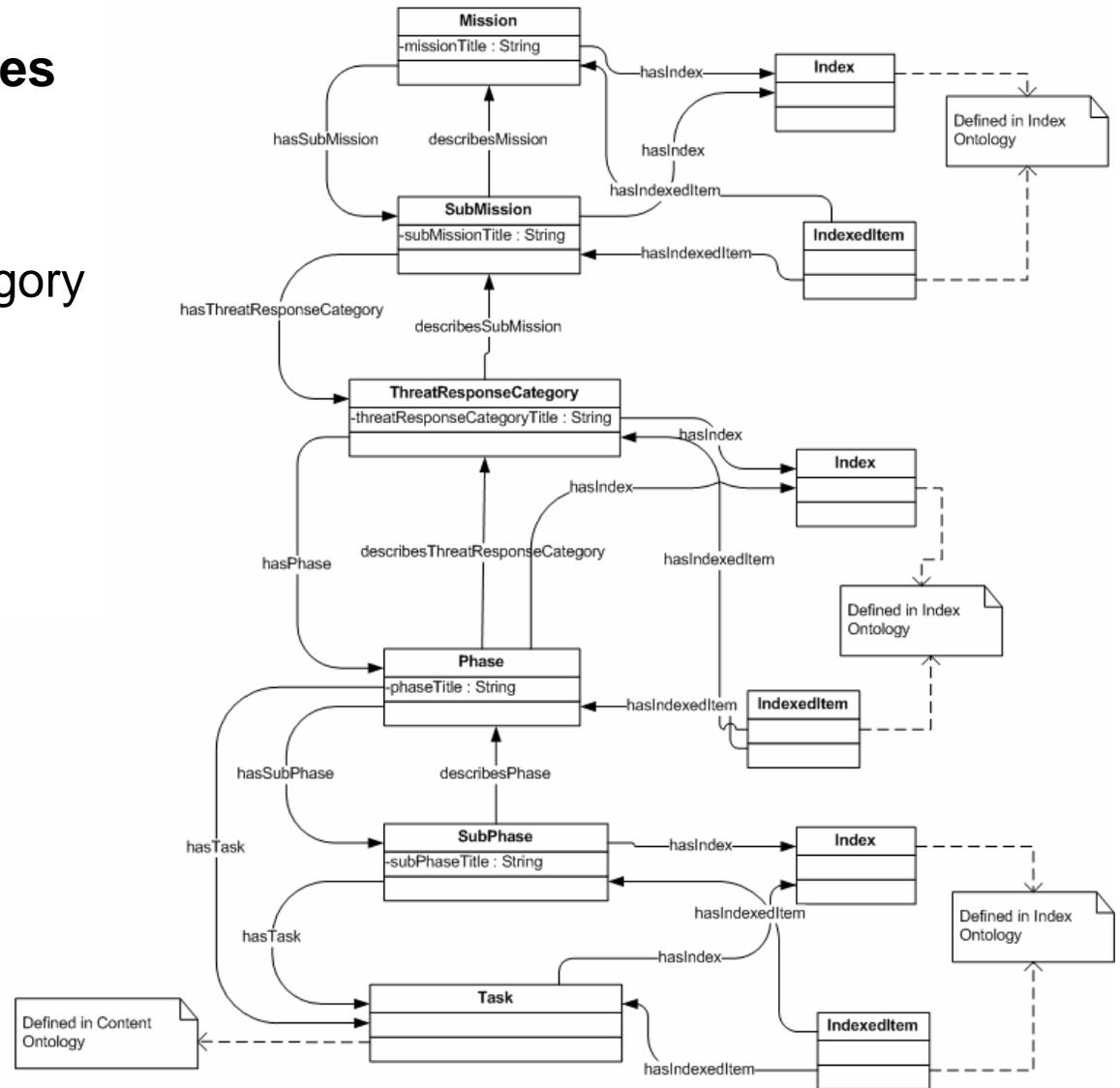
- **Identified “just in time” instructional content needed by EOD Techs**
- **Created ontology suite representing instructional (job aid) material**
- **Developed a capture tool as part of the JEOD Portal that allows distributed authors to create hyperlinked content by populating a database that generated RDF/XML files compliant with ontology suite**
- **Created instructional component of the JEOD DSS allowing learners to retrieve context-sensitive (conditions based) training on-the-fly in multiple formats**

- **Content identified for use in the field by warfighters are Tactics, Techniques, & Procedures (TTPs) for Improvised Explosive Devices (IEDs)**
- **The TTPs may only be applicable to certain Universal Joint Task List (UJTL) conditions (ex: weather, terrain, light)**



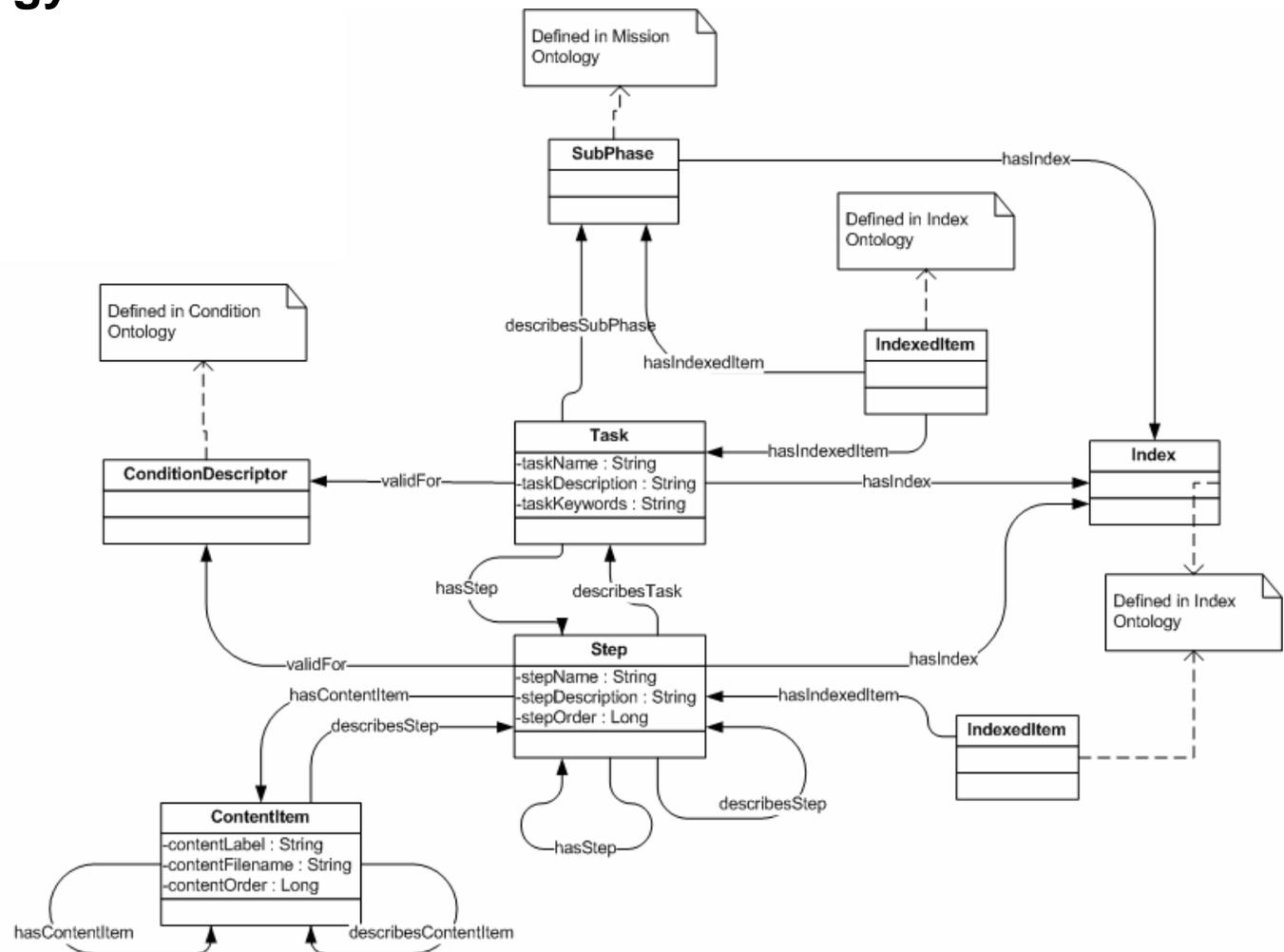
- **Developed a set of ontologies to capture the JEOD IED domain**
- **Ontologies developed describe Mission, Content, and Conditions**
- **Ontology design documentation used UML-like notation**
- **Ontology design was used to evolve the design of the database used in the authoring of content**

- **Mission Ontology Classes**
 - Mission
 - Sub-Mission
 - Threat Response Category
 - Phase
 - Sub-Phase
 - Task



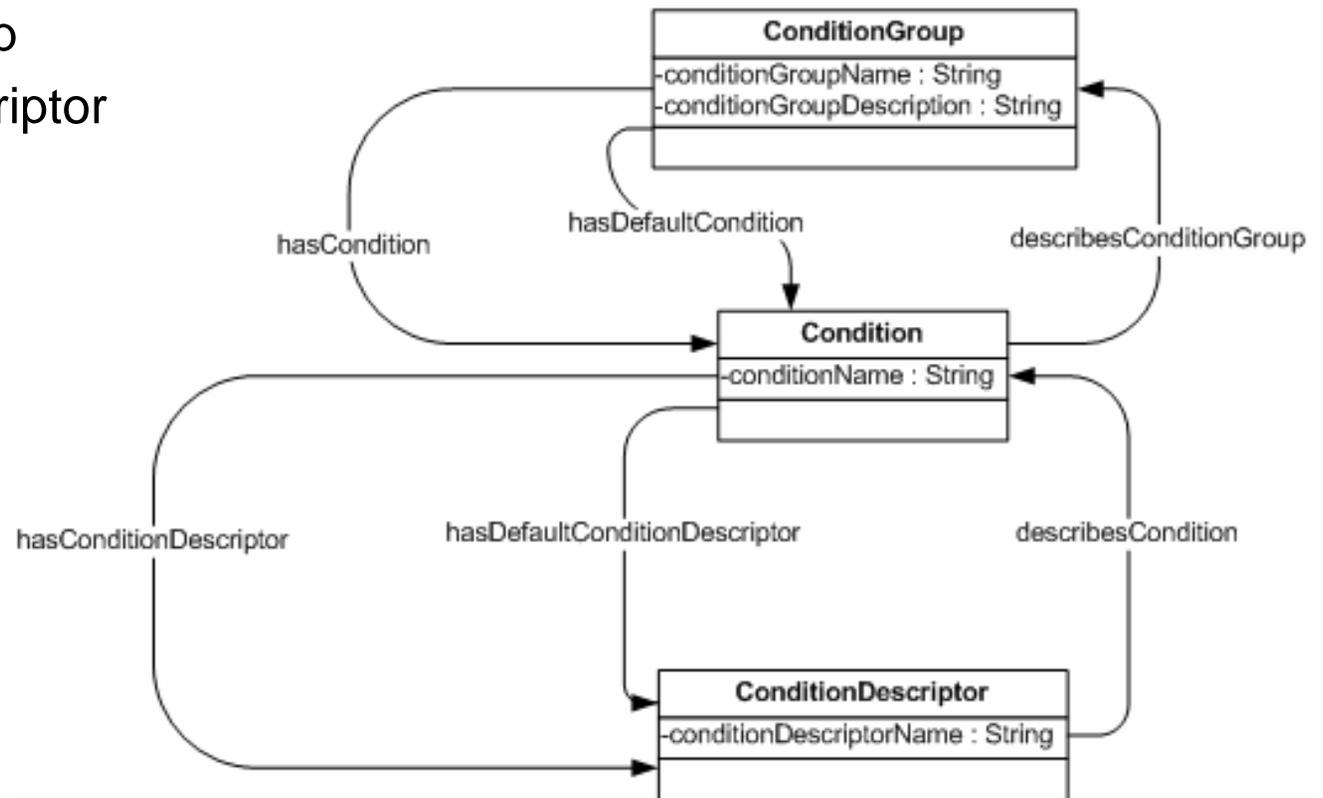
- **Content Ontology Classes**

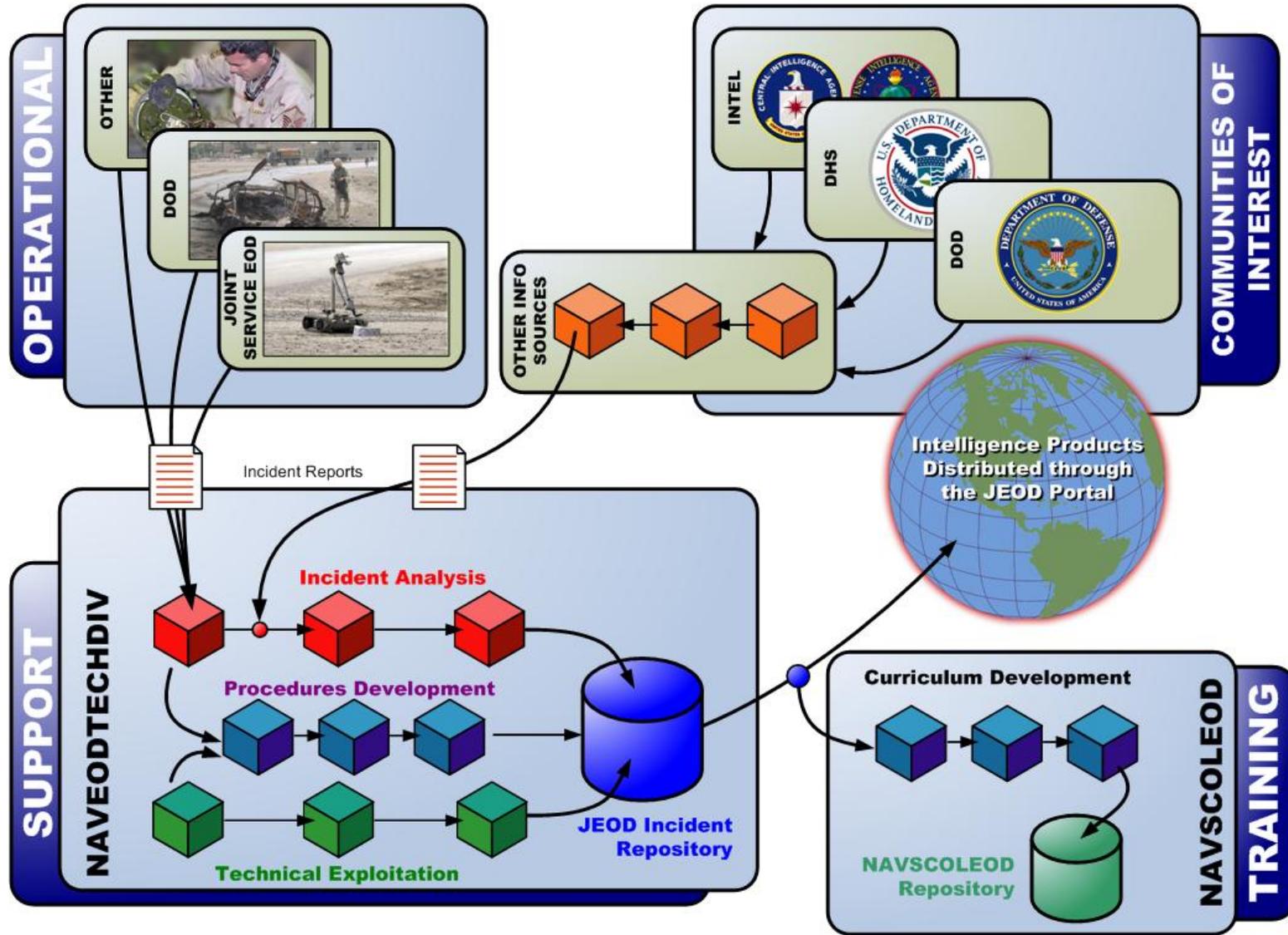
- Task
- Step
- Content Item



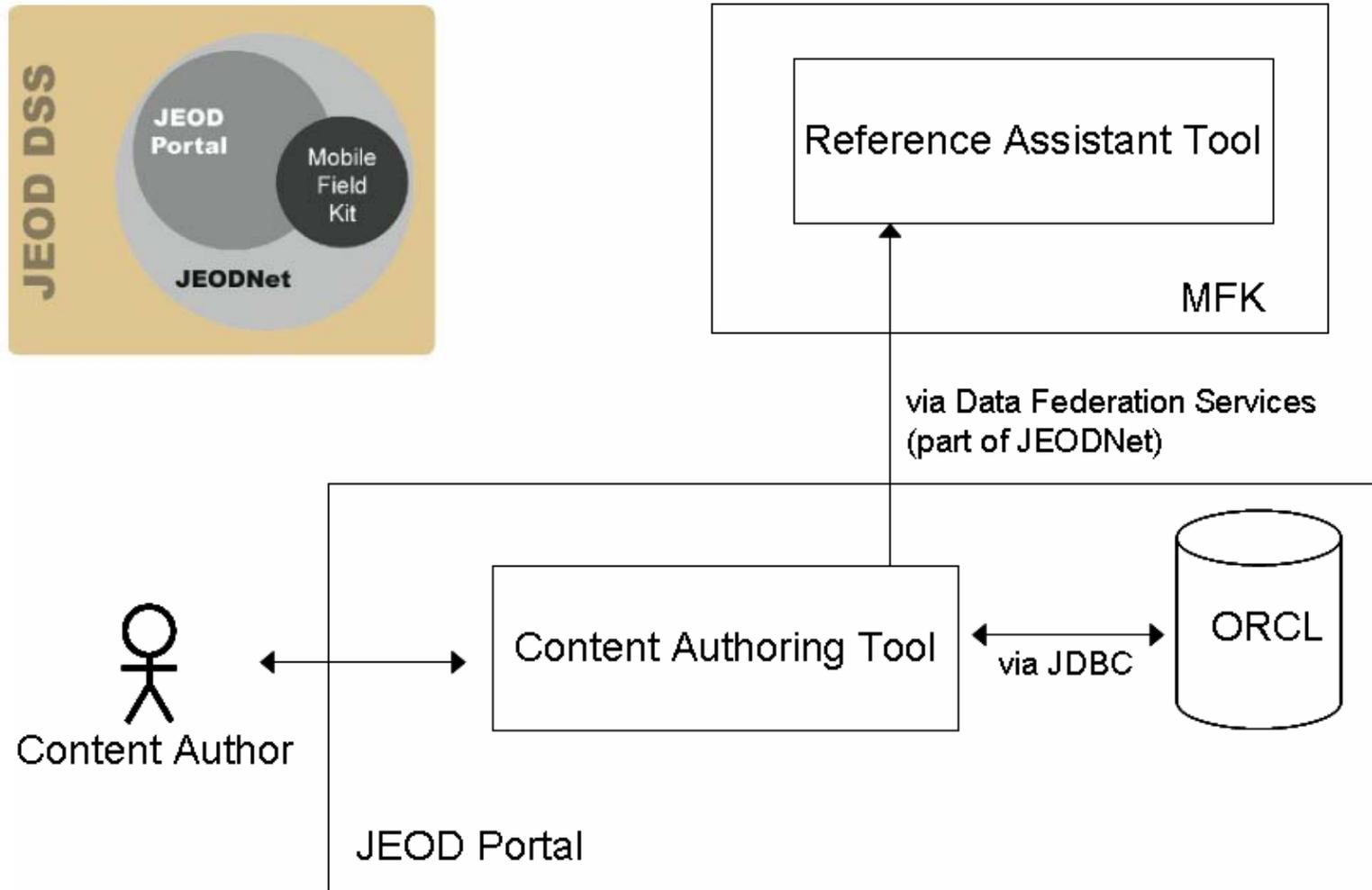
- **Condition Ontology Classes**

- Condition
- Condition Group
- Condition Descriptor





High Level Overview TTP based Tools





Content Authoring Tool (CAT) J2EE Portlet

Funded by JEOD KTOD ACTD



Content Authoring Tool

- **Developed a Content Authoring Tool portlet on the JEOD Portal that allowed distributed authors to create TTP content**
- **Authored TTP content populated an Oracle database that generated RDF/XML files compliant with the JEOD ontology suite**
- **Content Authoring Tool (CAT) allowed authors to assign conditions to the developed content**

Content Authoring Tool Add Steps – Sub Steps

The screenshot displays the 'Add Step' interface within the Content Authoring Tool (CAT). The interface includes a navigation bar with tabs for Home, IFIS, ThinkMap, AEODPS-IG, GIS, Lexicon, and CAT. A disclaimer banner reads 'DISCLAIMER: JEODNet Portal DEVELOPMENT VERSION'. A user greeting 'Welcome, Karen Fraser!' is visible in the top right. The main content area is titled 'Add Step' and contains a 'Step Name' input field (callout 1). Below this are tabs for 'Sub-Steps', 'Content', 'Conditions', and 'References'. A 'Sub-Step Name' input field (callout 2) is accompanied by 'Add' (callout 3) and 'Clear' (callout 4) buttons. A list of sub-steps is shown with 'Up' (callout 5) and 'Down' navigation buttons on the left, and 'Delete' (callout 6) and 'Delete All' (callout 7) buttons on the right. At the bottom, 'Save' (callout 8) and 'Cancel' (callout 9) buttons are present.

Content Authoring Tool

Add Step - Conditions

The screenshot shows the 'Add Step' interface in the Content Authoring Tool. At the top, there is a navigation bar with 'Home', 'IFIS', 'ThinkMap', 'AEODPS-NG', 'GIS', 'Lexicon', and 'CAT'. Below this is a red banner with 'DISCLAIMER: JEODNet Portal DEVELOPMENT VERSION' and a user greeting 'Welcome, Karen Fraser!'. The main content area has a 'Content Authoring Tool' header and a 'Step Name' input field. A yellow bracket labeled '1' encompasses the 'Step Name' field and the 'Conditions' tab. The 'Conditions' tab is active, showing three dropdown menus for 'Condition Group', 'Condition', and 'Condition Descriptor', each with a yellow callout '2', '3', and '4' respectively. Below these are 'Add' and 'Clear' buttons, with callouts '5' and '6'. At the bottom of the form is a table with columns for 'Condition Group', 'Condition', and 'Condition Descriptor'. To the right of the table are 'Delete' and 'Delete All' buttons, with callouts '7' and '8'. At the very bottom are 'Save' and 'Cancel' buttons.

Content Authoring Tool

Add Task - Steps

The screenshot displays the 'Add Task' interface within the Content Authoring Tool. At the top, the JEODNET logo and a disclaimer 'DISCLAIMER: JEODNet Portal DEVELOPMENT VERSION' are visible. A navigation bar includes links for Home, IFIS, ThinkMap, AEODPS-NG, GIS, Lexicon, and CAT. A user greeting 'Welcome, Karen Fraser!' is shown on the right. The main content area features a breadcrumb trail: 'Step Information Task Information Organize Tasks List Maintenance Utilities Home'. The title 'Add Task' is centered. Below the title, there are two input fields: 'Task Name:' and 'Task Keywords:'. A yellow bracket labeled '1' encompasses the 'Task Name' field and the 'Steps' tab. The 'Steps' tab is selected, showing a 'Step Name' input field with a dropdown arrow. Below this field are 'Add' and 'Clear' buttons, with yellow callouts '4' and '5' pointing to them. A list of 'Step Name' entries is shown in a white box. To the left of this list are 'Up' and 'Down' buttons, with a yellow callout '6' pointing to them. To the right are 'Delete' and 'Delete All' buttons, with yellow callouts '7' and '8' pointing to them. At the bottom of the interface are 'Save' and 'Cancel' buttons, with yellow callouts '9' and '10' pointing to them. A yellow arrow labeled '2' points to the 'Task Keywords' field. A yellow arrow labeled '3' points to the 'Step Name' dropdown field.

Content Authoring Tool

Add Task - Conditions

The screenshot shows the 'Add Task' interface in the Content Authoring Tool. At the top, there is a navigation bar with 'Home', 'IFIS', 'ThinkMap', 'AEODPS-NG', 'GIS', 'Lexicon', and 'CAT'. Below this is a 'Content Authoring Tool' header with a breadcrumb trail: 'Step Information > Task Information > Organize Tasks > List Maintenance > Utilities > Home'. The main title is 'Add Task'. There are two input fields: 'Task Name:' and 'Task Keywords:'. Below these are three tabs: 'Steps', 'Conditions', and 'References'. The 'Conditions' tab is active. It contains three dropdown menus: 'Condition Group', 'Condition', and 'Condition Descriptor'. Below these are 'Add' and 'Clear' buttons. At the bottom of the 'Conditions' section is a table with columns for 'Condition Group', 'Condition', and 'Condition Descriptor'. To the right of the table are 'Delete' and 'Delete All' buttons. At the very bottom are 'Save' and 'Cancel' buttons. Eight yellow callout boxes with numbers 1 through 8 point to specific elements: 1 points to the 'Conditions' tab; 2, 3, and 4 point to the 'Condition Group', 'Condition', and 'Condition Descriptor' dropdowns respectively; 5 and 6 point to the 'Add' and 'Clear' buttons; 7 points to the 'Delete' button; and 8 points to the 'Delete All' button.



Reference Assistant Tool (RAT) on JEOD DSS Mobile Field Kit

Funded by JEOD KTOD ACTD



- **Enables the warfighter to search the knowledge base for instructional content**
- **The search results are filtered based on system conditions**
- **The RAT allows the user to retrieve context-sensitive (condition based) training formatted on-the-fly based on the users' form factor**
- **The user is allowed to override system conditions which triggers a real-time re-authoring of the training materials**

- **Resides on Mobile Field Kit (MFK)**
 - part of the JEOD Decision Support System (DSS)
 - installed on Tablet PC platform
- **Searches knowledge base for instructional content requested by warfighter (mobile user)**
 - speech to text capability
 - natural language processing capability
- **Filters search results based on current conditions**
 - MFK can receive condition updates from sensors
- **Retrieves context-sensitive training formatted for user's form factor on-the-fly**
- **Triggers immediate re-authoring of the training materials based on user's decision to override current conditions**

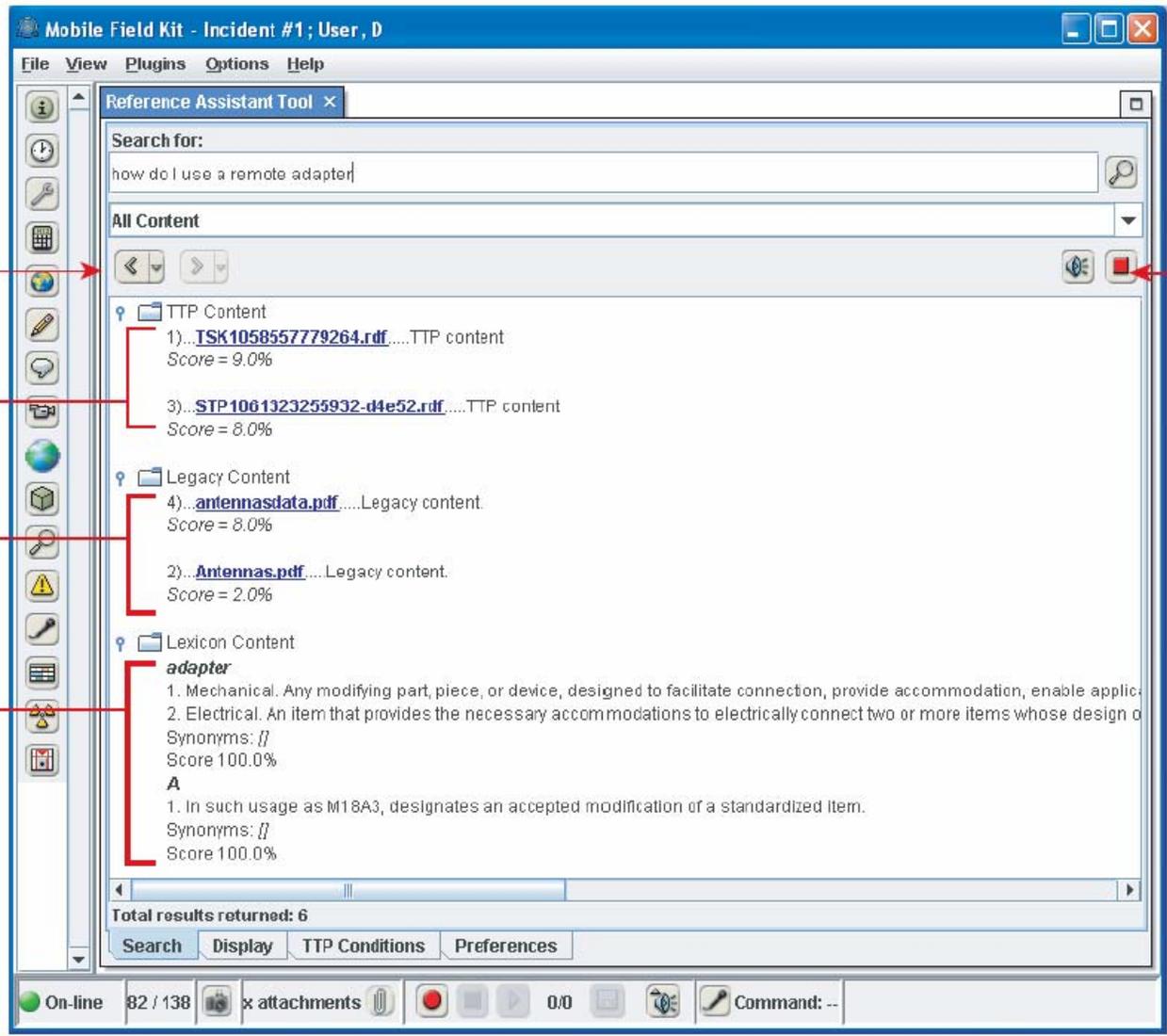
Reference Assistant Tool (RAT) Demonstration

1 search history
User is able to move back and forth through search history.

2 TTP content
Tactics, Techniques, and Procedures are available for searching.

3 legacy content
More supported formats for searching: XML, HTML, XHTML, RDF, PDF, DOC, XLS, PPT, TXT, RTF.

4 lexicon terms
Terms and definitions from the default EOD lexicon available for searching.



5 read results
Results can be read aloud.

Reference Assistant Tool (RAT) Demonstration

1 navigation

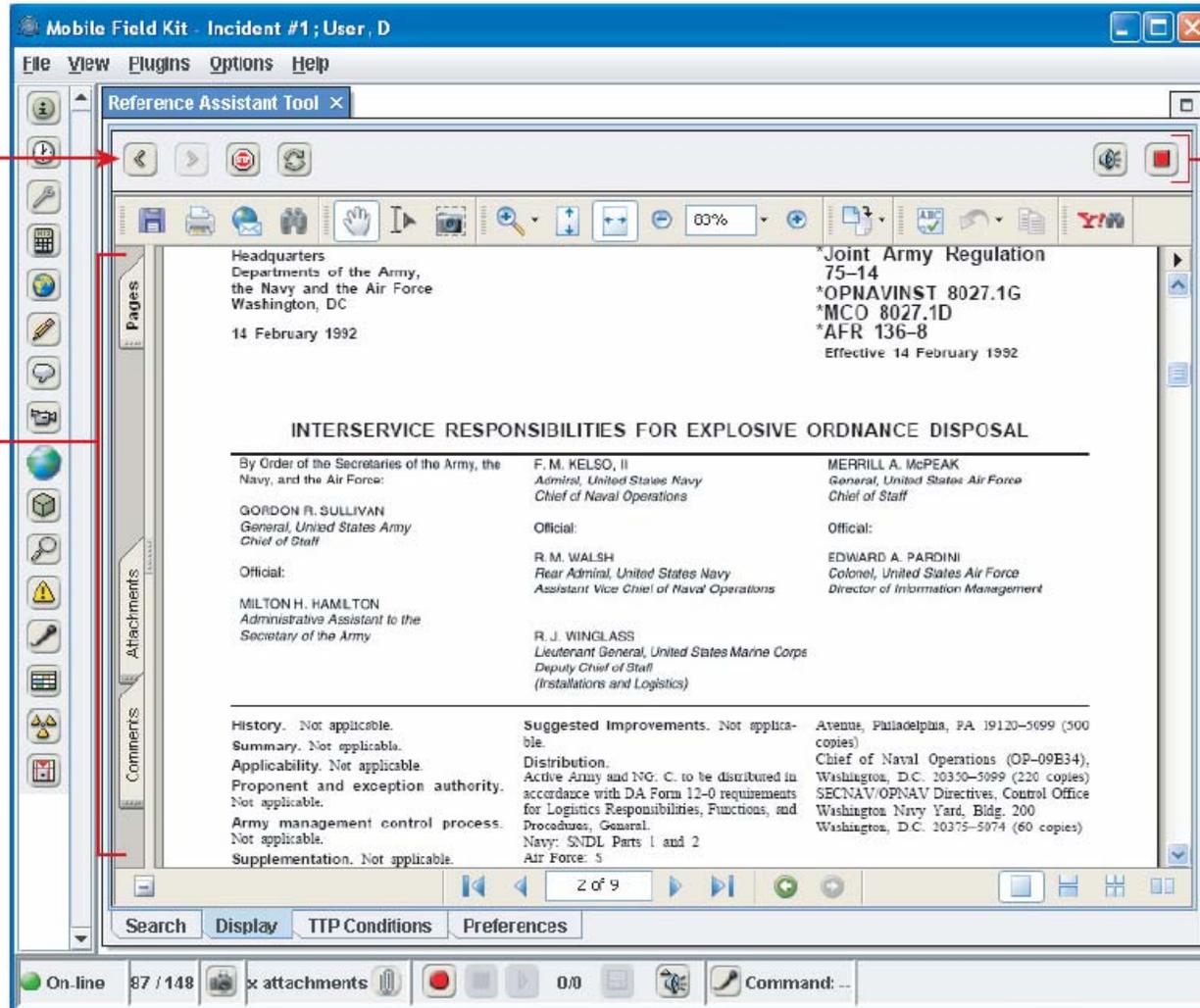
User can navigate through content similar to web browsers.

2 browser

Standard browser (IE or Firefox) is embedded. This allows for more types of content to be displayed and abides by a common look and feel for the end user.

3 read

Content can be read aloud. Multiple formats supported (HTML, XML, XHTML, RDF, PDF, RTF, PPT, TXT, and XLS).



Mobile Field Kit - Incident #1; User, D

File View Plugins Options Help

Reference Assistant Tool x

Navigation icons: Home, Back, Forward, Stop, Refresh, Print, Copy, Paste, Find, etc.

Pages: Headquarters, Departments of the Army, the Navy and the Air Force, Washington, DC. 14 February 1992.

*Joint Army Regulation 75-14
*OPNAVINST 8027.1G
*MCO 8027.1D
*AFR 136-8
Effective 14 February 1992

INTERSERVICE RESPONSIBILITIES FOR EXPLOSIVE ORDNANCE DISPOSAL

By Order of the Secretaries of the Army, the Navy, and the Air Force:	F. M. HELSO, II <i>Admiral, United States Navy Chief of Naval Operations</i>	MERRILL A. McPEAK <i>General, United States Air Force Chief of Staff</i>
GORDON R. SULLIVAN <i>General, United States Army Chief of Staff</i>	Official:	Official:
Official:	R. M. WALSH <i>Rear Admiral, United States Navy Assistant Vice Chief of Naval Operations</i>	EDWARD A. PARDINI <i>Colonel, United States Air Force Director of Information Management</i>
MILTON H. HAMILTON <i>Administrative Assistant to the Secretary of the Army</i>	R. J. WINGLASS <i>Lieutenant General, United States Marine Corps Deputy Chief of Staff (Installations and Logistics)</i>	

History. Not applicable.
Summary. Not applicable.
Applicability. Not applicable.
Proponent and exception authority. Not applicable.
Army management control process. Not applicable.
Supplementation. Not applicable.

Suggested Improvements. Not applicable.
Distribution. Active Army and ING. C. to be distributed in accordance with DA Form 12-0 requirements for Logistics Responsibilities, Functions, and Procedures. General.
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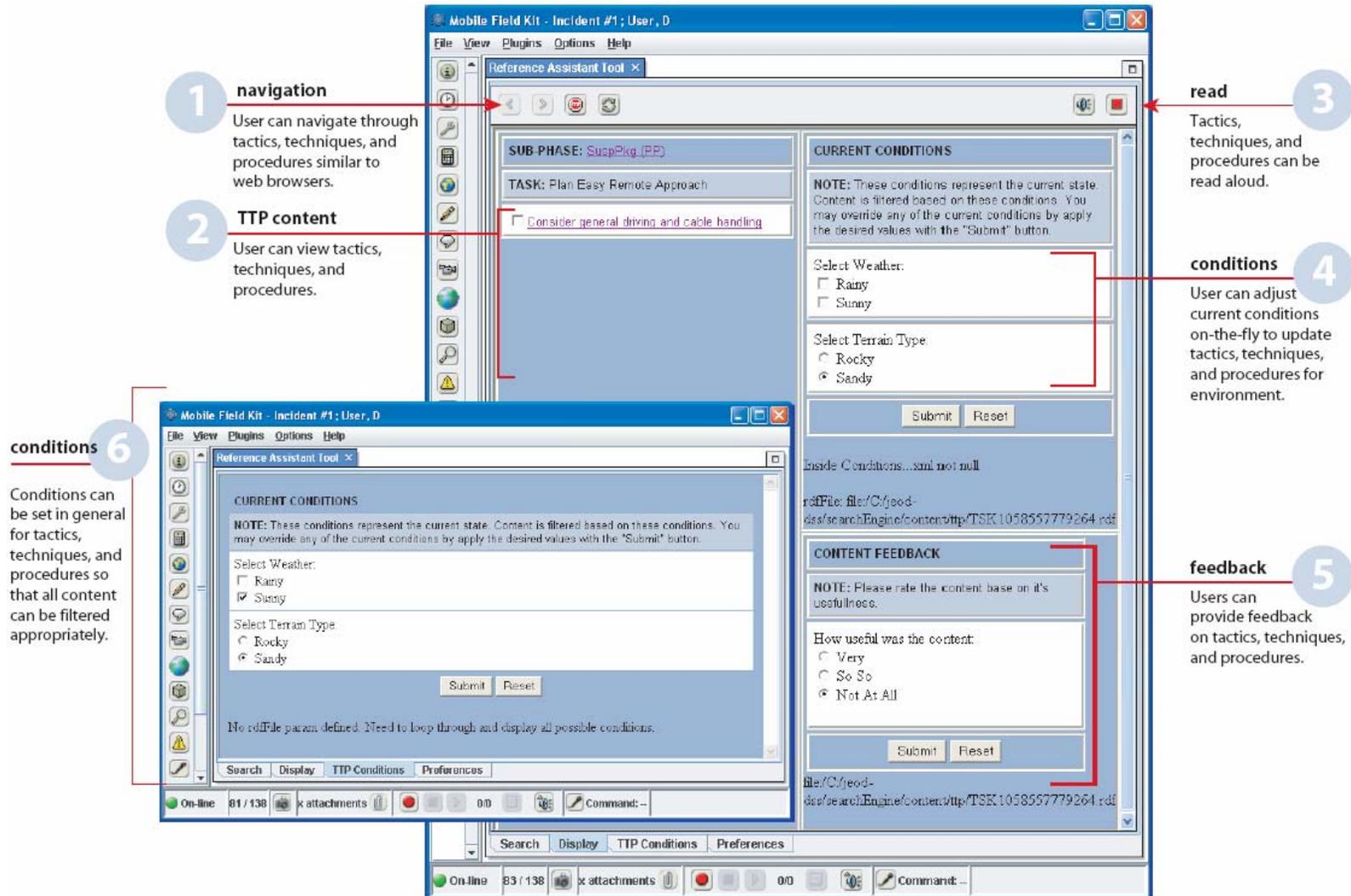
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2 of 9

Search Display TTP Conditions Preferences

On-line 87 / 148 x attachments 0/0 Command: ...

Reference Assistant Tool (RAT) Demonstration



1 navigation
User can navigate through tactics, techniques, and procedures similar to web browsers.

2 TTP content
User can view tactics, techniques, and procedures.

3 read
Tactics, techniques, and procedures can be read aloud.

4 conditions
User can adjust current conditions on-the-fly to update tactics, techniques, and procedures for environment.

5 feedback
Users can provide feedback on tactics, techniques, and procedures.

6 conditions
Conditions can be set in general for tactics, techniques, and procedures so that all content can be filtered appropriately.

The screenshot shows the RAT interface with the following components:

- Navigation:** A toolbar at the top of the RAT window with icons for back, forward, and search.
- TTP Content:** A central pane displaying "SUB-PHASE: SuspPkg (PP)" and "TASK: Plan Easy Remote Approach". A checkbox labeled "Consider general driving and cable handling" is visible.
- Current Conditions:** A section on the right with a "NOTE" and two selection areas: "Select Weather" (with "Rainy" and "Sunny" options) and "Select Terrain Type" (with "Rocky" and "Sandy" options). "Submit" and "Reset" buttons are present.
- Content Feedback:** A section at the bottom right with a "NOTE" and a "How useful was the content:" section with radio buttons for "Very", "So So", and "Not At All". "Submit" and "Reset" buttons are present.
- General Conditions:** A separate window (callout 6) showing "CURRENT CONDITIONS" with the same "Select Weather" and "Select Terrain Type" options. "Sunny" is selected for weather and "Sandy" for terrain type.

- **Challenge**
 - Save Warfighter Lives
 - Reduce Cost for Procedural Instructional Content
- **Context**
 - IEDs constantly evolving
 - JEOD ACTD – globally deployable DSS
- **Military Learning Objective**
 - Provide contextualized JIT training to warfighters in the field
- **Semantic Web Background**
 - Next Evolution of the Web (OWL)
 - Standards Layers allow automation based on content
- **Military Learning Solution**
 - DJAS as a prototype
 - JEOD DSS design/development