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# **Taxonomic and Faceted Classification for Intelligent Tagging and Discovery in Net-Centric Command and Control**

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# Objectives

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**Motivation – Importance of discovery and tagging**

**Problem statement – NCE services classification**

**Two-pronged approach – taxonomic and faceted classification**

**Prototype of services discovery and tagging tool**

**Next steps**

# Motivation

## Importance of discovery and tagging in the NCE



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### Assertions:

- 1) Success of NCOW depends upon ability to readily discover useful information and services in the NCE
- 2) Effective discovery depends on good semantic tagging
- 3) Good semantic tagging must be sound and intuitive
- 4) But, “sound” and “intuitive” are in the eye of the beholder

### Problems:

- 1) How to resolve or finesse the conflicting perspectives?
- 2) How to provide tools that support NCE user without overwhelming?

# Problem Statement

## NCE services classification



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### Why use a structured classification approach?

- ❑ Some claim taxonomies and ontologies are (almost) irrelevant
  - Why not just Google everything?
- ❑ 3 responses
  - Structured knowledge facilitates domain understanding
  - Structure facilitates automated search and associated tools
  - Service catalog has inherent structure that can be leveraged

### What structured classification approach for net-centricity?

- ❑ Requirements
  - Accommodate very large collection of services
  - Encompass many federated COIs
  - Provide traceability and justification for services
- ❑ Conclusion: one monolithic approach will not work
  - Lack of agreement
  - Diversity of communities and requirements

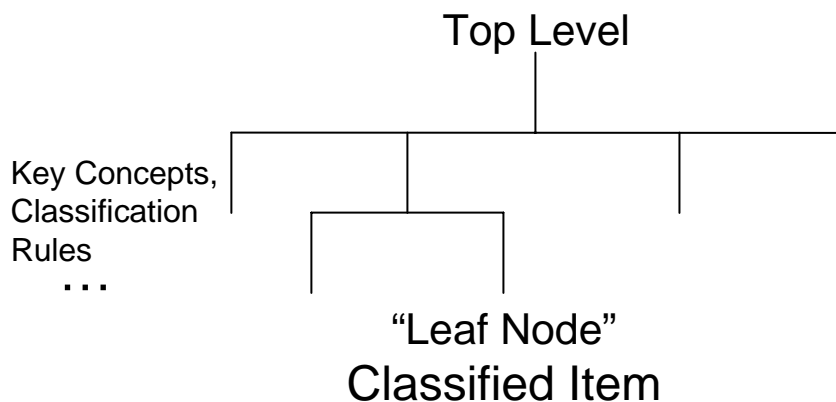
# Two-Pronged Classification Approach



## INFORMATION TECHNOLOGY (Taxonomic and Faceted)

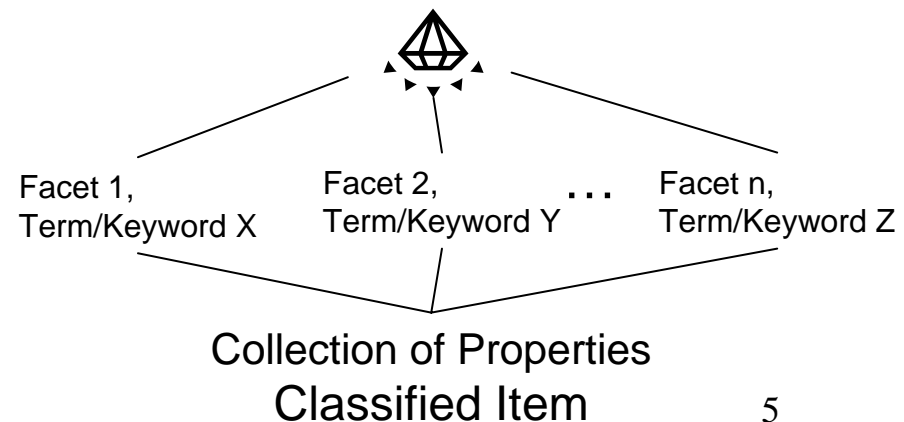
### Taxonomic classification

- ❑ “Traditional” approach
- ❑ Based on *concept hierarchy* with *rules* aggregating unique distinguishing features of item
- ❑ *Applies more to the “essence” of the item*
- ❑ Can place item at 0–1 nodes in a particular taxonomy
- ❑ There can be multiple taxonomies



### Faceted classification

- ❑ More recent approach
- ❑ Based on “facets”: categories isolating useful perspectives on an item
- ❑ *Applies more to specific properties of the item*
- ❑ Assigns 0–n *defined values* per facet to an item; can also add synonyms
- ❑ There can be multiple facet schemes



*Apply both approaches, as follows:*

## **Taxonomic classification**

- ❑ Use to position services within communities of interest
- ❑ Use as basis for browsing and comparing services
- ❑ Incorporate “standard” DoD taxonomies based on user and COI demand
- ❑ Can be used to enable automated reasoning through hierarchical structure

## **Faceted classification**

- ❑ Use facets to support a structured tagging approach
- ❑ Use to improve searches and refinements to searches
- ❑ Synthesize a proposed high-level faceted classification system for NCE Services
  - Based on fundamental categories
  - Incorporate other DoD knowledge and terminology

# Taxonomic Classification

## "Standard" DoD Taxonomy List



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**DoD Core Taxonomy\***

**CSFL (Common System Function List)\***

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**Army Battlespace Command Knowledge System  
(BCKS) Reference Taxonomy**

**Geospatial Services Taxonomy**

**USAF Core Information Taxonomy**

**NCTC Architecture Reference Model Services  
Taxonomy**

\*Used in the prototype

# Taxonomic Classification

## DoD Core Taxonomy



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### Background and status

- ❑ “Baseline taxonomy for NCES discovery capability [services or information]”
- ❑ Developed by MITRE et al.
- ❑ Submitted to DoD Metadata Registry 1/11/2005

### Description and structure

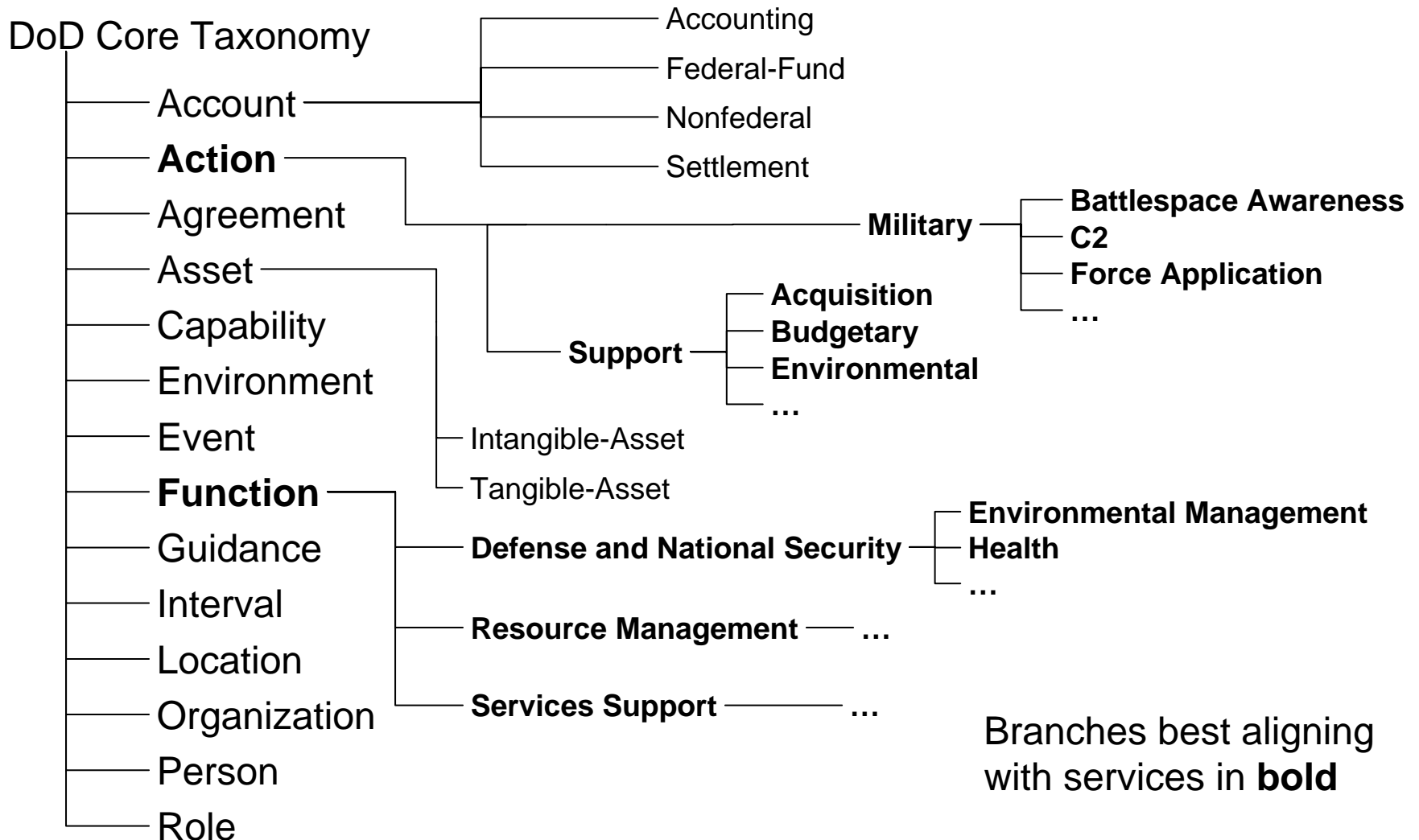
- ❑ Class/subclass hierarchy (214 classes)
- ❑ Each class is a concept of interest to DoD
- ❑ Each class has a (textual) description
- ❑ Each description has a source (e.g., GAO/AFMD2.1.1, InvestorWords.com, Merriam-Webster)



# DoD Core Taxonomy: Structure



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# Taxonomic Classification

## CSFL (Common System Function List)



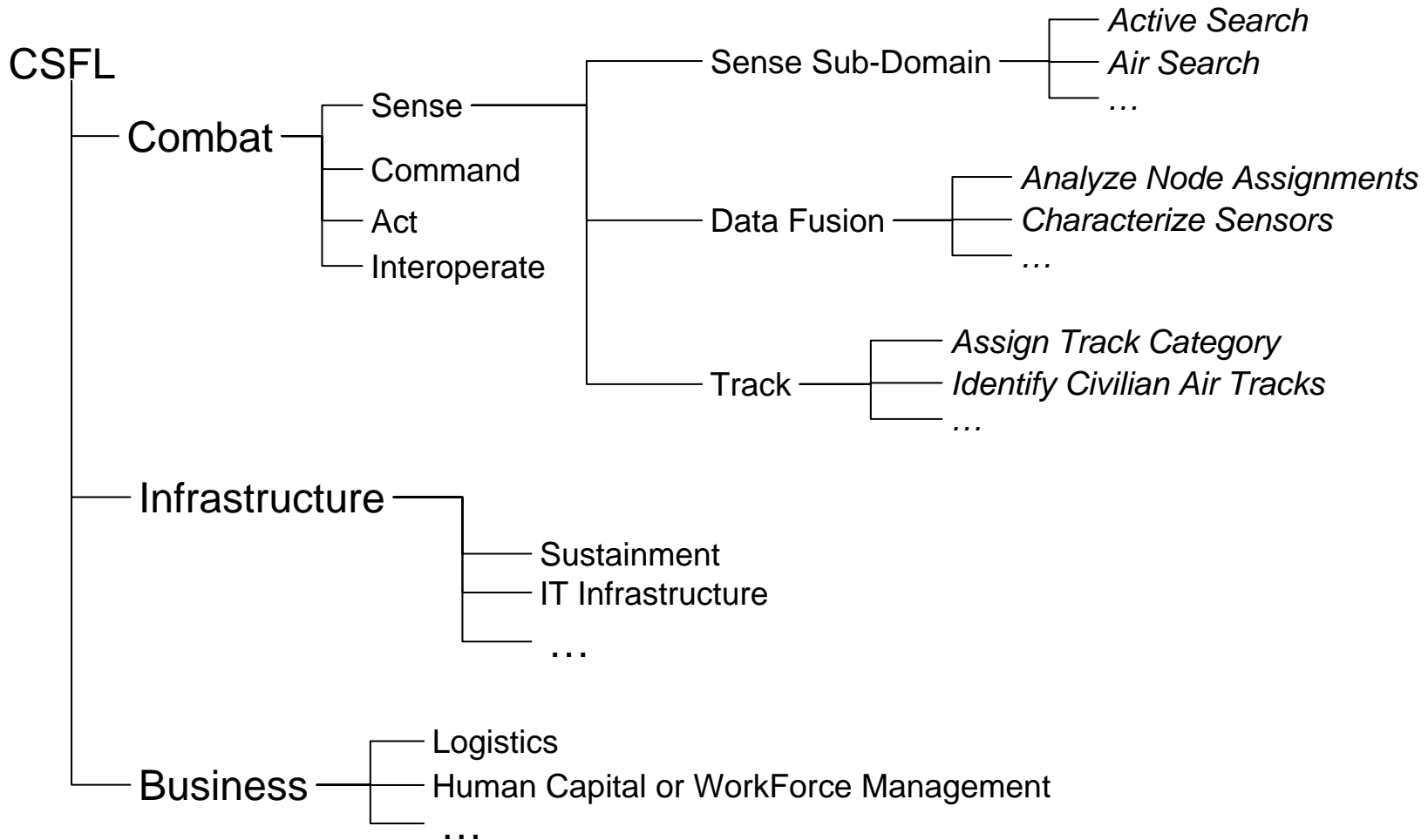
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- Background and Status
  - “System functions and associated definitions” supporting all aspects of Combat, Infrastructure, and Business activities
  - Developed by the Department of the Navy
  - Can be basis for service components in DoD EA SRM
  - A well-written, large collection of system functions
- Description and structure
  - Each function has a name, a description, and a domain (and sub-domains)
  - Leaf nodes can be cast as potential invocable services

# CSFL Taxonomy: Structure



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# Faceted Classification: “7 W’s” Framework



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## **Who** uses the service

- ❑ Notion of the service’s client or invoker
- ❑ Could also include service developer or “distributor”

## **What** the service activity is

- ❑ Verb denoting the activity

## **On What**

- ❑ Notion that the service must act on an input or object; tied to the service domain

## **To Whom**

- ❑ Covers case where object is a person

## **When** the service occurs or has an effect

- ❑ Typically a temporal performance measure

## **Where** the service applies or has an effect

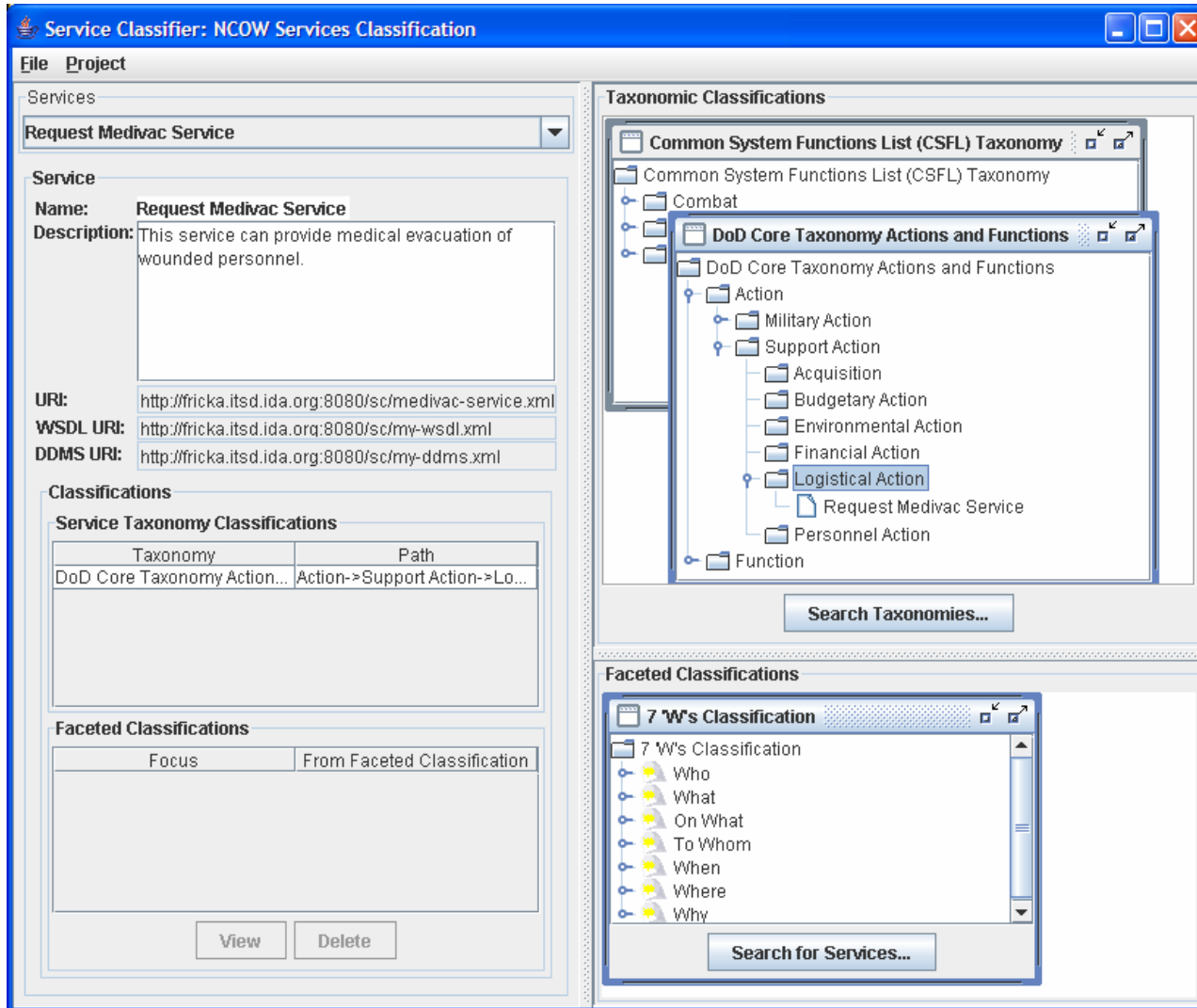
- ❑ Could be geographic (e.g., CONUS) or conceptual (e.g., relative to a battlespace)

## **Why** the service is used

- ❑ Reference to authorities, responsibilities, regulations, guidance

# Taxonomic Classification of a Service

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The screenshot displays the 'Service Classifier: NCOW Services Classification' application window. The interface is divided into several sections:

- Services:** A dropdown menu shows 'Request Medivac Service' selected.
- Service Details:**
  - Name:** Request Medivac Service
  - Description:** This service can provide medical evacuation of wounded personnel.
  - URI:** <http://fricka.ittd.ida.org:8080/sc/medivac-service.xml>
  - WSDL URI:** <http://fricka.ittd.ida.org:8080/sc/my-wsdl.xml>
  - DDMS URI:** <http://fricka.ittd.ida.org:8080/sc/my-ddms.xml>
- Classifications:**
  - Service Taxonomy Classifications:** A table with two columns: 'Taxonomy' and 'Path'. One entry is visible: 'DoD Core Taxonomy Action...' with path 'Action->Support Action->Lo...'
  - Faceted Classifications:** A table with two columns: 'Focus' and 'From Faceted Classification'. It is currently empty.
- Taxonomic Classifications:** A tree view showing a hierarchy of taxonomies. The selected path is: 'Common System Functions List (CSFL) Taxonomy' > 'DoD Core Taxonomy Actions and Functions' > 'Action' > 'Support Action' > 'Logistical Action' > 'Request Medivac Service'.
- Faceted Classifications:** A tree view showing the '7 W's Classification' with categories: Who, What, On What, To Whom, When, Where, Why.

Buttons for 'Search Taxonomies...' and 'Search for Services...' are located at the bottom of their respective sections. 'View' and 'Delete' buttons are at the bottom of the 'Faceted Classifications' table.

# Faceted Classification of a Service



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**Service Classifier: NCOW Services Classification**

**File Project**

Services  
Request Medivac Service

**Service**  
**Name:** Request Medivac Service  
**Description:** This service can provide medical evacuation of wounded personnel.

**URI:** http://fricka.itsd.ida.org:8080/sc/medivac-service.xml  
**WSDL URI:** http://fricka.itsd.ida.org:8080/sc/my-wsdl.xml  
**DDMS URI:** http://fricka.itsd.ida.org:8080/sc/my-ddms.xml

**Classifications**

**Service Taxonomy Classifications**

Taxonomy	Path
DoD Core Taxonomy Action...	Action->Support Action->Lo...

**Faceted Classifications**

Focus	From Faceted Classification
Military forces organization	7 W's Classification
Protection	7 W's Classification

View Delete

**Taxonomic Classifications**

Common System Functions List (CSFL) Taxonomy

Search Taxonomies...

**Faceted Classifications**

7 W's Classification

- 7 W's Classification
  - Who
    - DoD Core Taxonomy for Organization
    - Governmental organization
    - Defense organization
      - Military forces organization (T)
      - Civilian forces organization
    - Nongovernmental organization
  - What
  - On What
  - To Whom
  - When
  - Where
  - Why
    - Requirement
    - Objective
    - Capability
      - Business Capability
      - Military Capability
        - Battlespace awareness
        - Battlespace communications
        - Focused logistics
        - Force application
        - Protection (T)
      - Intelligence Capability
      - Enterprise Information Environment Capability

Search for Services...

# Service Discovery through Taxonomies



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The screenshot displays the 'Service Classifier: NCOW Services Classification' application. The main window shows a service named 'Request Medivac Service' with a description: 'This service can provide medical evacuation of wounded personnel.' The URI is 'http://fricka.ittd.ida.org:8080/sc/medivac-service.xml' and the WSDL URI is 'http://fricka.ittd.ida.org:8080/sc/my-wsdl.xml'. A 'ServiceTaxonomy Search' dialog box is open in the foreground, showing search results for the term 'logistics'. The search results table is as follows:

Type	Name	Taxonomy
📁	Calculate Logistics Scenarios	Common System ...
📁	Engineering Logistics	Common System ...
📁	Logistics	Common System ...
📁	Logistics Invoice Verification	Common System ...
📁	Logistics Management	Common System ...
📁	Maintenance Logistics	Common System ...
📁	Mobility, Transportation and Movem...	Common System ...
📁	Process Unit Readiness and Logi...	Common System ...
📁	Supply Logistics	Common System ...

The dialog box also includes a 'Search By' section with radio buttons for 'Names Only' (selected) and 'Names and Descriptions', a search input field containing 'logistics', and a 'Search' button. Other buttons include 'Add Services' and 'Close'. The background application shows a tree view of 'Taxonomic Classifications' with folders for 'Common System Functions List (CSFL) Taxond', 'Combat', 'Business', and 'DoD Core Taxonomy Actions and Functions'.

# Service Discovery by Faceted Classification



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The screenshot displays the 'Service Classifier: NCOV Services Classification' application. A 'Faceted Classification Search' dialog box is open, showing search terms and discovered services.

**Faceted Classification Search**

**Search Terms**

**Facets**

- Who
- What
- On What
- To Whom
- When
- Where
- Why

**Available Terms**

- Global
- In-transit
- OCONUS
- Operational
- POD
- POE
- Regional
- Strategic
- Tactical
- Theater

**Selected Terms**

- Intelligence organization
- Theater

Ignore Case

**Start Search**

**Discovered Services**

Name	Taxonomy
Analyze CONUS and Theater Material Handling Equipment Availability	Common System Functions List ...
Analyze Theater Assets Entry/Exit Visibility	Common System Functions List ...
Analyze Theater Commercial Supply Availability	Common System Functions List ...
Analyze Theater Engineering Infrastructure Capability and Limitation	Common System Functions List ...
Analyze Theater Engineering Supportability	Common System Functions List ...
Analyze Theater Engineering Units Visibility	Common System Functions List ...
Analyze Theater Facility Requirements	Common System Functions List ...
Analyze Theater Host Nation/Commercial Engineering Asset Availability	Common System Functions List ...
Analyze Theater Host Nation/Commercial Medical Capabilities	Common System Functions List ...
Analyze Theater Host Nation/Commercial Repair Facilities Availability	Common System Functions List ...

**Close**

**View** **Delete**

**Search for Services...**



# Summary

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**Discovery and tagging in the NCE are critical**

**Combining taxonomic and faceted classification is a promising approach for improving discovery and tagging**

- ❑ Supports multiple constituencies
- ❑ Is intuitive
- ❑ Is standards-based
- ❑ Improves search

**Prototype functionality demonstrated**

# Next Steps

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**Integrate with intelligent software agent**

**Learning algorithm for suggesting appropriate tags**

**Facilitate evolution of taxonomies and tags for NCE  
Services**