DEFENCE R&D DÉFENSE

The Multi-Intelligence Tools Suite (MITS)

Supporting Research and Development in Information and Knowledge Exploitation

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Outline

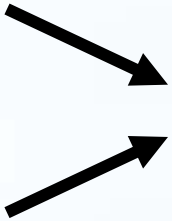
- Multi-Intelligence Tools Suite (MITS) definition
- Key characteristics of the MITS
- The MITS as a knowledge-based system
- Ingesting data into the MITS
- Overview of the MITS main components
- MITS exploitation example
- MITS implementation and evolution

Multi-Intelligence Tools Suite (MITS)

A federation of innovative, composable and interoperable intelligence related tools, which are integrated and interleaved into an overall, continuous process flow relevant to the intelligence community

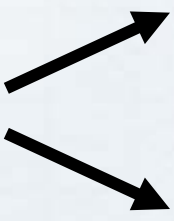
Input

- Domain Specific Knowledge
  - Domain concepts
  - Inference Rules
  - Etc.
- Documents, Lists, Track Data, Etc.



MITS

- Document Management
- Text Document Processing
- Semantic Analysis
- Automated Annotation
- Fact Extraction
- Trend Analysis
- Manual Fact Insertion
- Automated Reasoning
- Subject List Processing
- User Notification
- Etc.



Output

- Facts
- Targetted information

Key Characteristics of the MITS

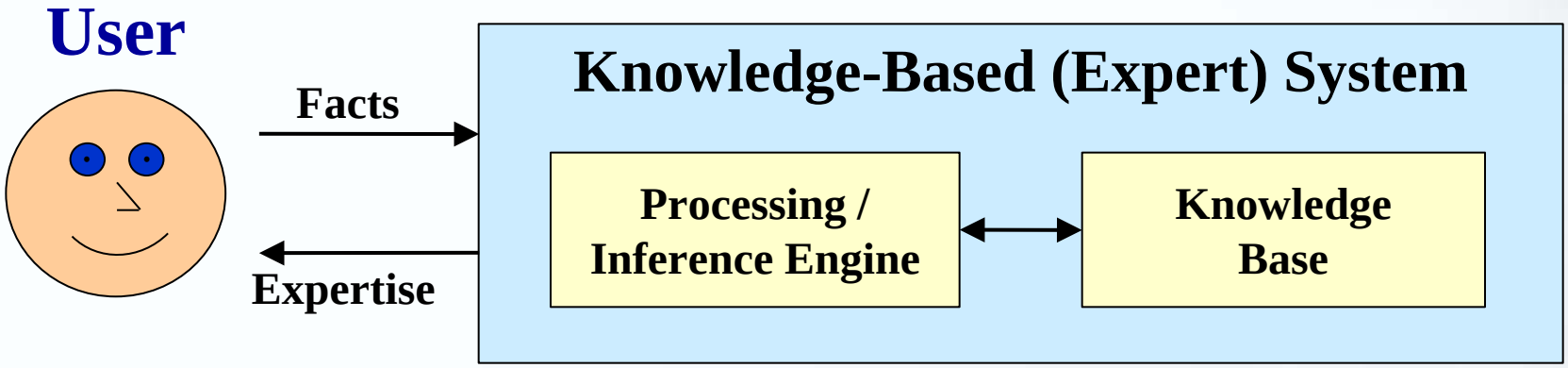
Multi-Intelligence Tools Suite (MITS)

Key Characteristics

- Multi-Int Analysis
  - I&I Section primary focus
  - HUMINT, SIGINT, IMINT, OSINT, Etc.
  - Intelligence products (no "raw" data)
- Tool Suite: One-Stop Shop for the Tools
  - Easy access to all available tools
- Tool Synergy
  - Mutually advantageous conjunction and compatibility
- Ease of Exploitation
  - Facilitates the transfer of data, information and knowledge
  - Seamless pipelining of the individual tools
- Uniformity of Exploitation
  - Organization of knowledge
  - Standardized HCI / GUI
- An R&D Integration Environment
  - Unconstrained environment
    - No imposed technologies
  - Reusability and incremental development
    - Spiral development approach
    - Not having to start from scratch every time
  - Integrated validation
    - Already validated components provide realistic stimulation
    - Overall components interactions
- Knowledge-Based Systems Technologies
  - Generic technology ("easy" to adapt to a new domain)
  - Domain dependent analysis (MDA, IED, terrorism, etc.)
  - Cross-domain analysis

The MITS as a Knowledge-Based System

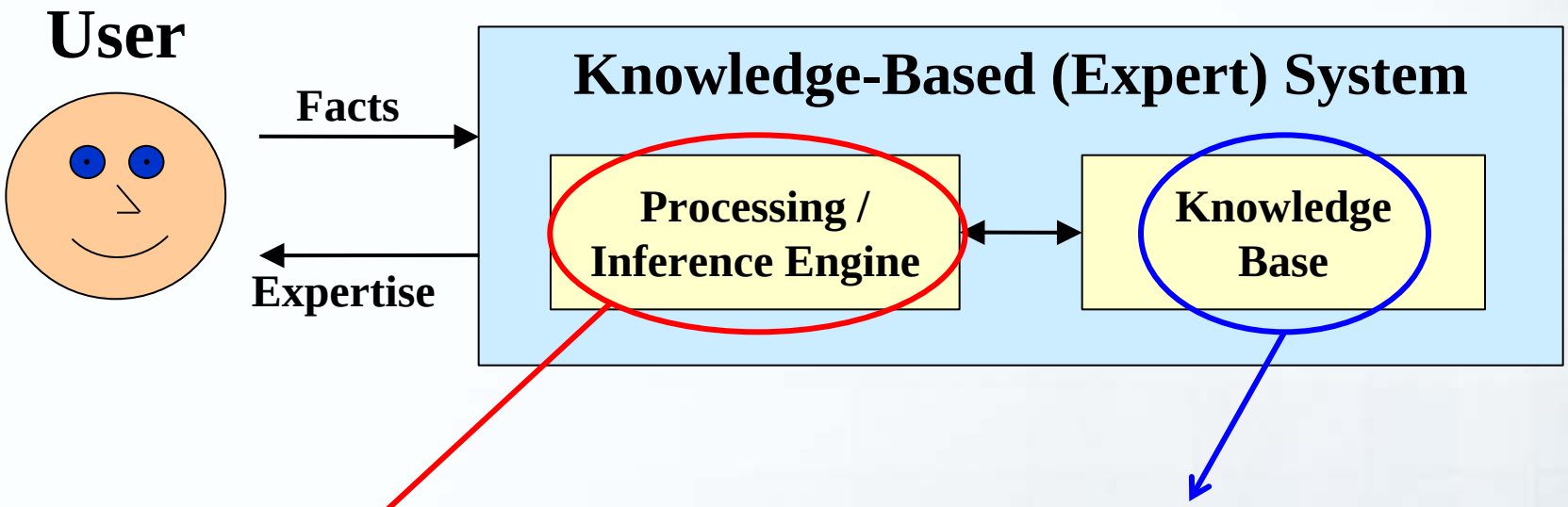
Knowledge-Based System Technologies (1/2)



« Processing is separated from the problem-solving knowledge »

- Represent knowledge in a more natural fashion
- Focus is on capturing and organizing problem-solving knowledge
- Allow changes to be made to the knowledge base without side effects on program code
- Allows the same control and interface software to be used in a variety of systems, in different domains
- Allows to experiment with alternative control software for the same knowledge base

Knowledge-Based System Technologies (2/2)



- Generic
- Developed “only once”
- Developed by “others”:
  - Comercially available
  - Open source

- Specific to a domain
  - « Knowledge Cartridge »
- Requires knowledge acquisition from domain experts
  - Very difficult
- Requires knowledge representation
  - « Knowledge Engineering »

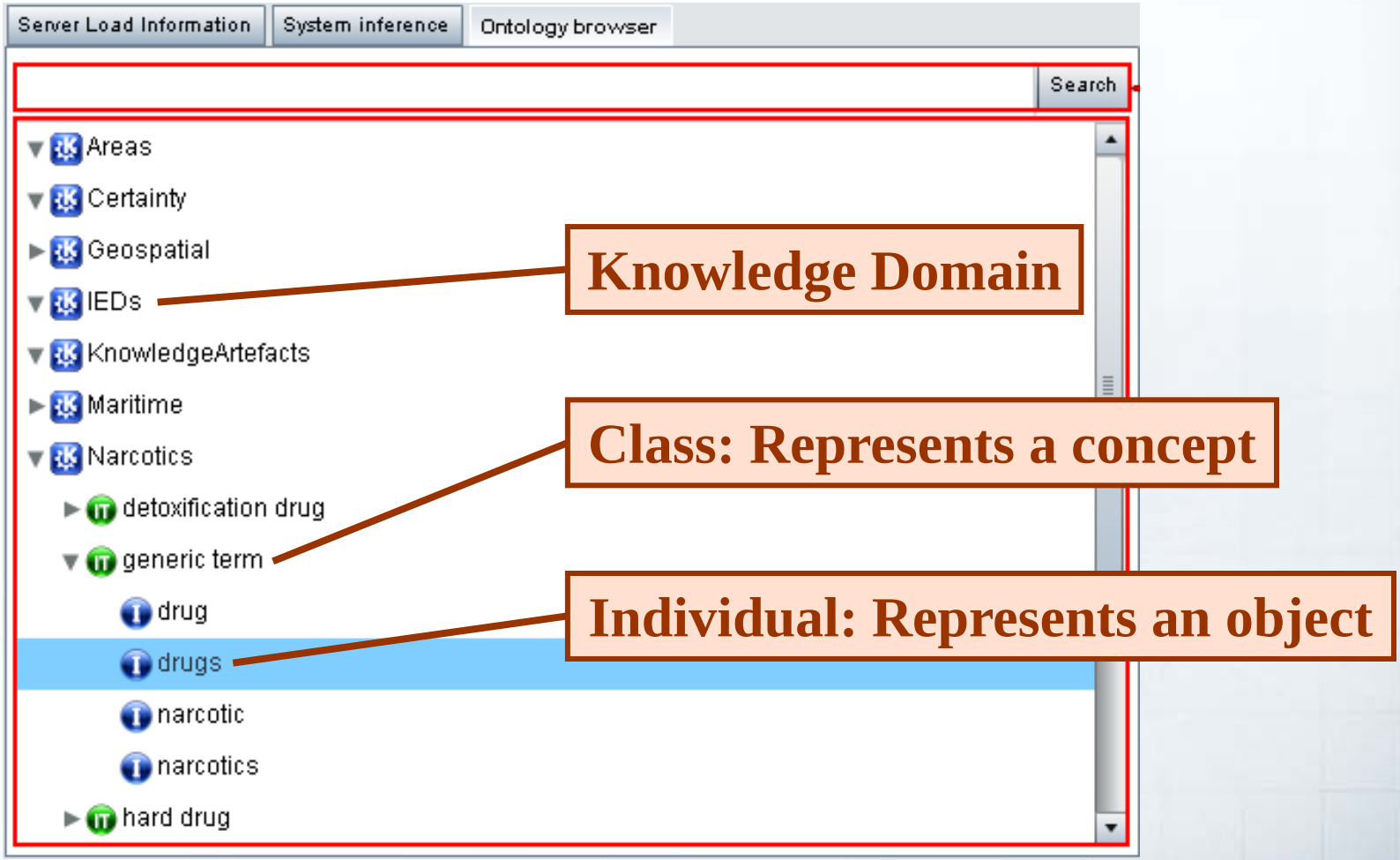
Multi-Intelligence Tools Suite (MITS)

A Knowledge-Based System

- **Knowledge Representation Building Blocks**
  - Ontologies
  - Facts
    - Atom definitions
  - Built-in definitions
  - Inference rules
  - Text-based templates (for fact extraction)
- **Domain Knowledge (A Priori / Reference / « Static »)**
  - Domain environment knowledge
    - Ontologies and taxonomies
  - Domain expert knowledge (know-how)
    - Inference rules
    - Text-based templates
  - Utilities
    - Local grammars (pattern matching rules)
    - Sources characterization
    - Fact generators
- **Situation Knowledge Base (Dynamic Situation Model)**
  - Situational facts
  - Situational ontologies
- **Knowledge Engineering Module**

Domain Knowledge « Cartridge »

Domain Environment Knowledge (MITS)
(Ontologies / Taxonomies)

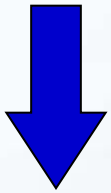


Situational Facts and Atom Definitions

A fact is a pragmatic « truth », a statement that can, at least in theory, be checked and confirmed.

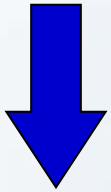
« Ship X is in proximity of infrastructure Y »

Fact in Natural Language



In Proximity (Ship X, Infrastructure Y)

Fact in Formal Language

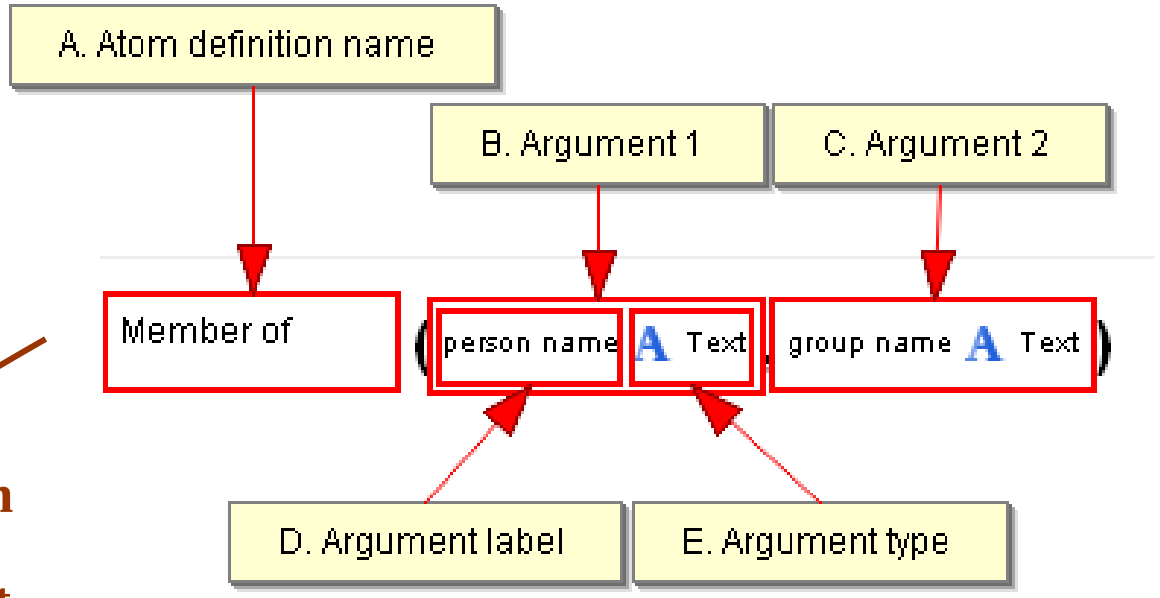


In Proximity (Ship Name, Infrastructure Name)

Atom Definition (Fact Structure Template)

Situational Facts: Atom Definitions
(Fact Formal Structure Template)

- Represents a template (the formal structure) on which facts in the system will be based
- It is defined by a **name** and **a list of arguments** with a precise **type** and **order**.



Atom Definition Could be Used to Create a Fact

Member of (Bin Laden,Al-Qaeda)

Built-In Definitions

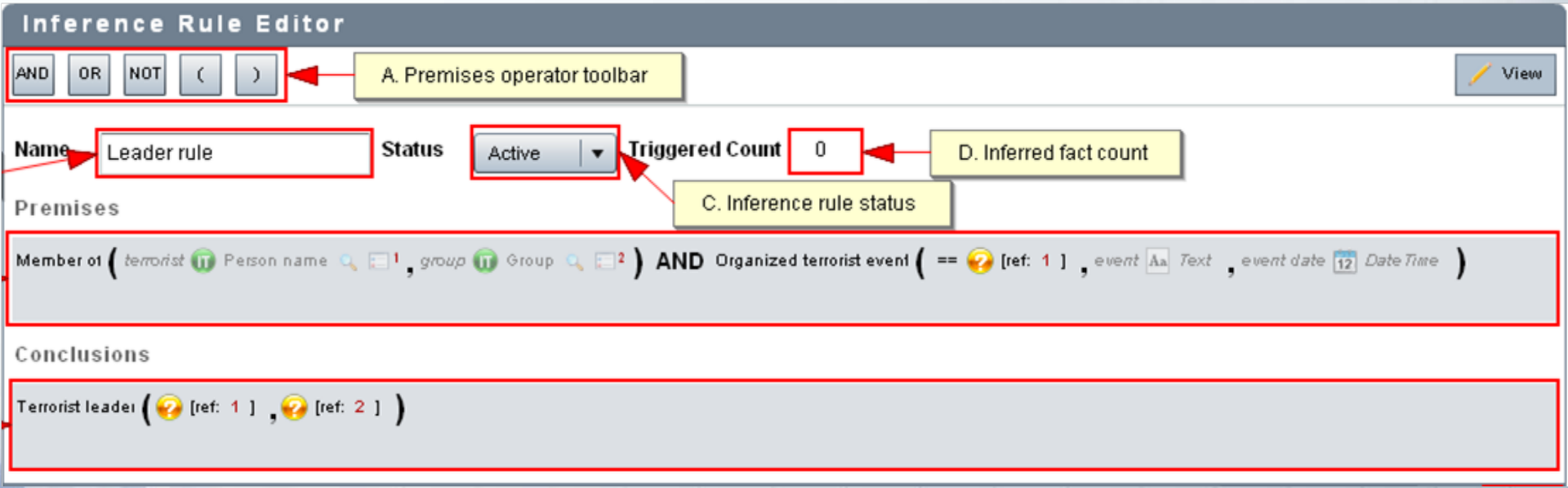
- Can be used in inference rule premises
- Defines functions that can be invoked to perform custom validations during the inference process
  - Evaluate their arguments using functions pre-embedded in the system
  - Returns « True » or « False »
- The MITS is pre-initialized with a predefined set of built-in definitions
  - They cannot be edited, deleted or neither a new built-in definition can be added
- The current set:
  - after
  - before
  - collect
  - inArea
  - includeDate
  - includeDateRange
  - overlap

Validates if a geometry (e.g., a point) is contained within a reference area

Validates if the ranges of two dates overlap

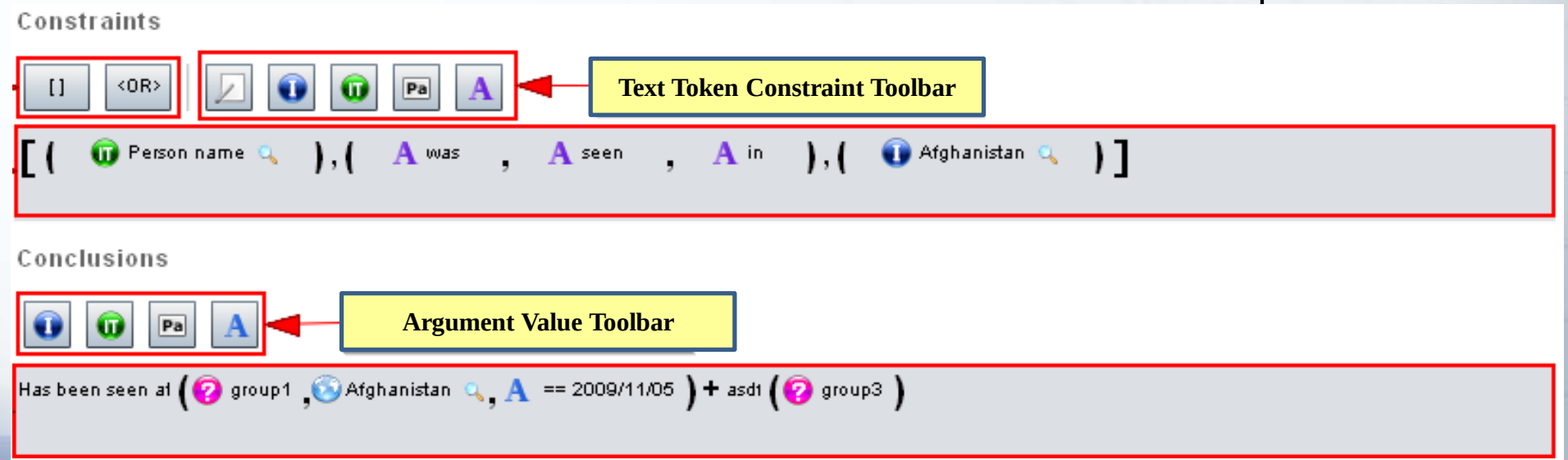
Inference Rules

- Used by the rule-based inference functionality to infer new facts
- Defines which pattern of facts will generate new facts
- **Inference rule premises** (the « IF » part)
  - Define the facts required to be validated as « *True* » in order to trigger the rule
  - Composed of atom definitions, built-in definitions and operators
- **Inference rule conclusions** (the « THEN » part)
  - Define the facts that will be created when the rule premises are satisfied (i.e., when facts matching the premises are found in the system)
  - Composed of atom definitions and operators

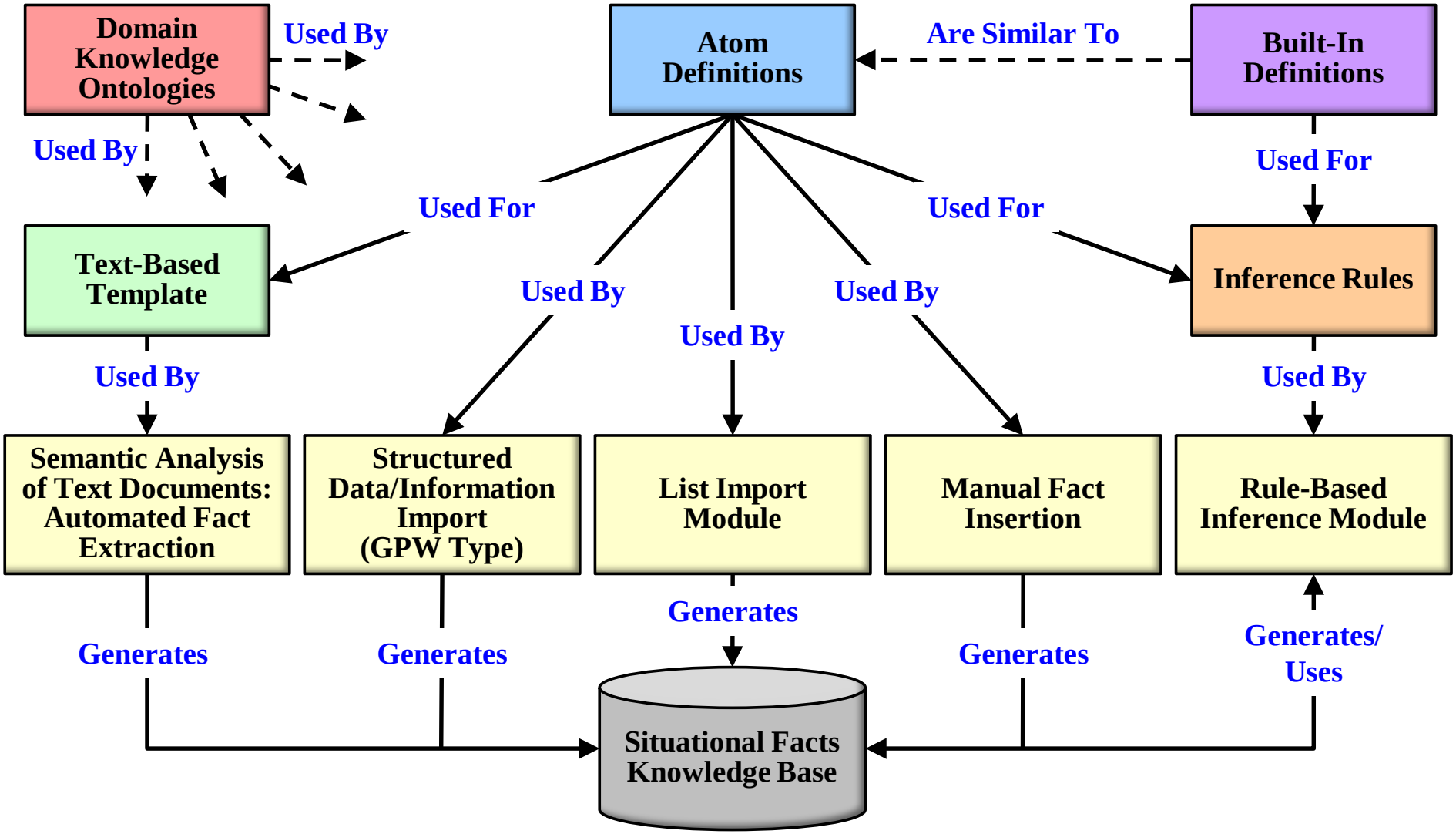


Text-Based Templates

- To find precise series of words in unstructured text documents (Word, PDF, etc.) and to extract specific facts from them
- Text-based « processing rule » defining
  - **Constraint:** A text-based pattern to search for in text documents
    - Find precise series of words in a document
    - The user can define:
      - The order of words he/she is looking for
      - If the template has to match with an instance, instance type, or instance type pattern (of a knowledge domain ontology)
      - A word's lexical category
  - **Conclusion:** The facts that will be created when this text-based pattern is found

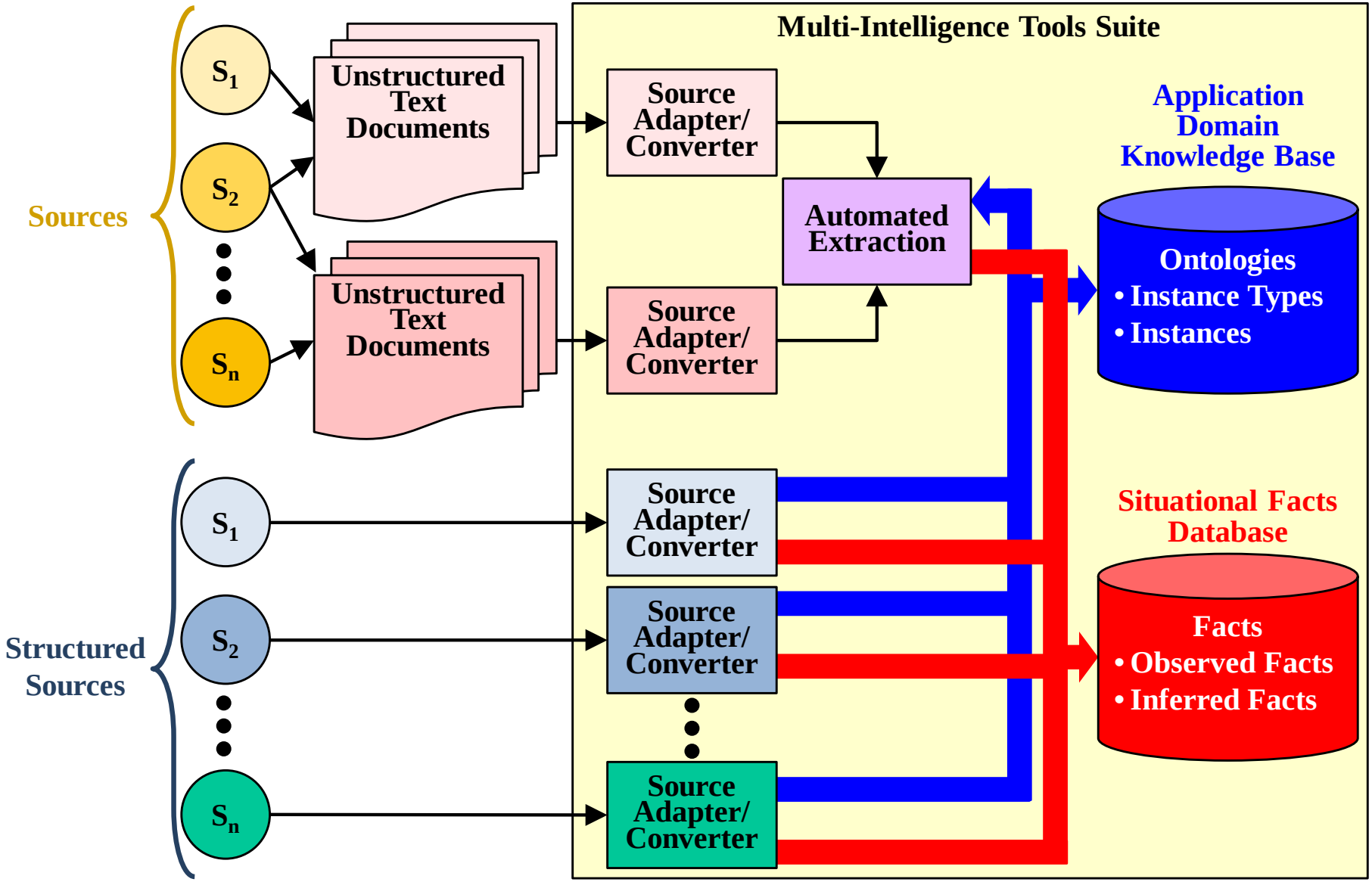


Knowledge Representation Building Blocks and Situational Facts Generation



Ingesting Data into the MITS

Ingesting Data into the MITS



Overview of the MITS Main Components

Multi-Intelligence Tools Suite (MITS)

Features in a Nutshell

- Natural language processing capabilities to support automated semantic analysis of unstructured documents
- Automated place name disambiguation and geo-referencing of any piece of information
- Semantic and geospatial search for information in sources
- Automated entity extraction
- Automated collation of all entities of interest pertaining to the knowledge domain(s) of interest:
  - Person names, date and time elements, locations, organizations, components, effects, triggering mechanisms, types, etc.
- Automated/manual fact extraction capabilities from observations contained in sources (published intelligence products in general)
- Automated reasoning capabilities over facts
- List-based processing
- Support to trend and pattern analysis
- Automated and personalized alerting/notification capabilities

Multi-Intelligence Tools Suite (MITS)

Modules

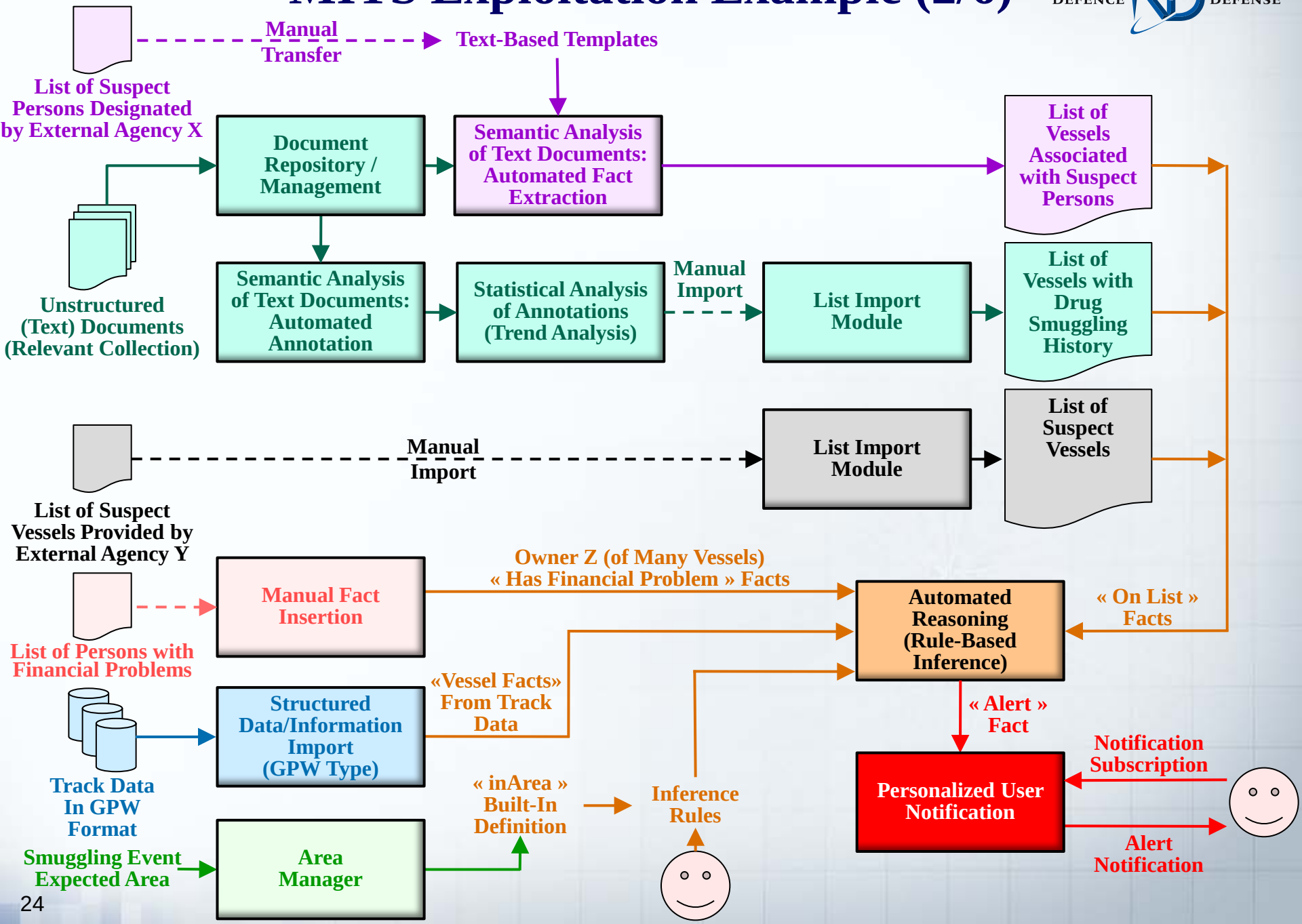
- Structured Data/Information Import
  - Track Modeling
  - Data/Information Preview
  - Data/Information to Fact Conversion
- Unstructured Text Documents Processing
  - Document Repository / Management
  - Document Viewer
  - Semantic Analysis
    - Automated Annotation
    - Automated Fact Extraction
    - Geo-Referencing
  - Statistical Analysis of Annotations
    - Trend Analysis
- Manual Fact Insertion
- Automated Reasoning / Inference
  - Rule-Based, Case-based, Description Logic, Kinematics & Geospatial Analysis
- Subject Lists Processing
  - List-Based Situation Monitoring
  - Situation-Based List Filling
- Administration
  - Server Load, Inference, Ontologies
- Situational Fact Management
  - Situational Fact Knowledge Base
    - Fact Viewer (Tabular Format)
      - ✔ Fact Filtering
    - Fact Export (KML Output)
- Personalized User Notification
  - Notification Subscription
    - Fact Notification
    - Document Notification
  - Notification Management
- Knowledge Engineering
  - Atom Definitions
  - Built-In Functions
  - Text-Based Templates
  - Inference Rules
  - Domain Knowledge Base
    - Ontology Browser
- GIS
  - Area Manager
- Online Help
- User Login

MITS
Exploitation Example

MITS Exploitation Example (1/6)

- Initial Trigger
  - A rather vague input from a source
    - There's going to be a drug related event involving a ship
    - Expected to happen in some (rather large) area at sea
    - In a given time window
    - Involving a person listed on a list of suspects
- Analysis Problem:
  - Find a vessel that:
    1. Has a historical record of drug smuggling
    2. Is associated with a suspect person designated by Agency X on a list
    3. Is on a list of suspect vessels provided by external Agency Y
    4. Is own by a person who currently has serious financial problems
    5. Is within the area where the drug smuggling event is expected to happen in the given time window

MITS Exploitation Example (2/6)



MITS Exploitation Example (3/6)

Derived With MITS

List of Vessels Associated with Suspect Persons

KING GRATTON
BRUTUS
ZIPPO POTOMAK
STRATOCASTER
TATIANA
MORDICUS
TRINITY
ESCAMBA

Derived With MITS

List of Vessels with Drug Smuggling History

MORDICUS
STRATOCASTER
ZIPPO POTOMAK
KING GRATTON
SEADION
AET LIBERTY
PRETTY SCENE
DELTA PRIDE
THOMAS
JANE

Externally Provided

List of Suspect Vessels

OLIVER JACOB
HORACE
SEA DION
A.C.O. RELENTLESS
DELTA PRIDE
MORDICUS
ALEX B
TRINITY
ANNA MICHAEL
LACANAU
BRUTUS
APPOLO
FREEMONT
CLAXTON
MERCURY GLORY
DUSTIN CENAC
STRATOCASTER
CANDY FACTORY
JO KIRI
OKEANIS
STUDII
SEA KING
LONE STAR
PEONY
WICHITA
VALENCIA CARRIER
TERRY BORDELON
GLENROSS
OCEAN WILD
STINGRAY
PALO DURO
ENERGY PRIDE
NORDVENUS
YANKEE
SPANKY
MISS CYNTHIA
THOR
MOBILE3
HOS BYRD
KING GRATTON

Derived With MITS

Vessels in Smuggling Event Expected Area

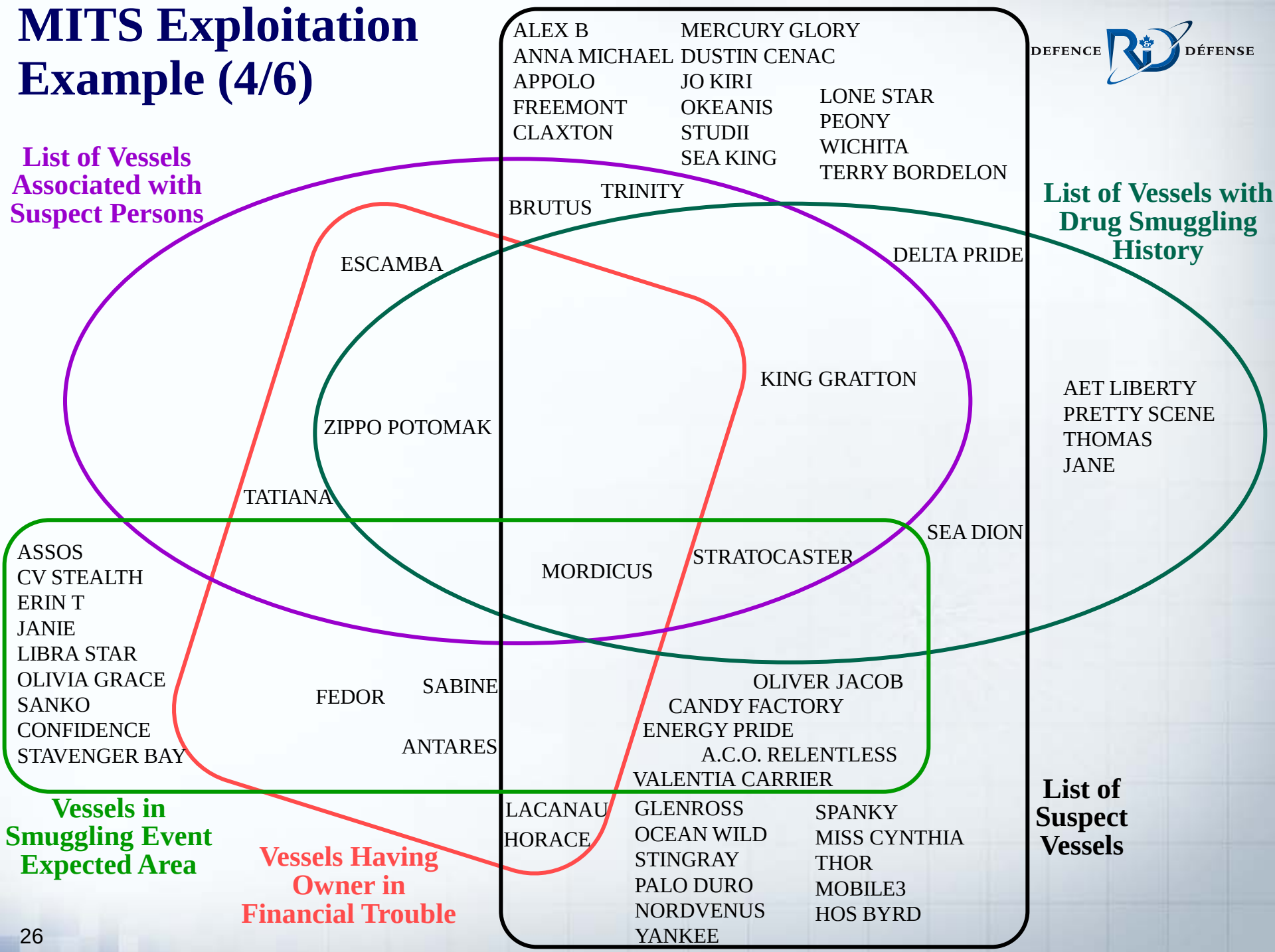
A.C.O. RELENTLESS
ANTARES
ASSOS
CANDY FACTORY
CV STEALTH
ENERGY PRIDE
ERIN T
FEDOR
JANIE
LIBRA STAR
MORDICUS
OLIVER JACOB
OLIVIA GRACE
SABINE
SANKO
CONFIDENCE
STAVENGER BAY
STRATOCASTER
VALENTIA CARRIER

Derived With MITS

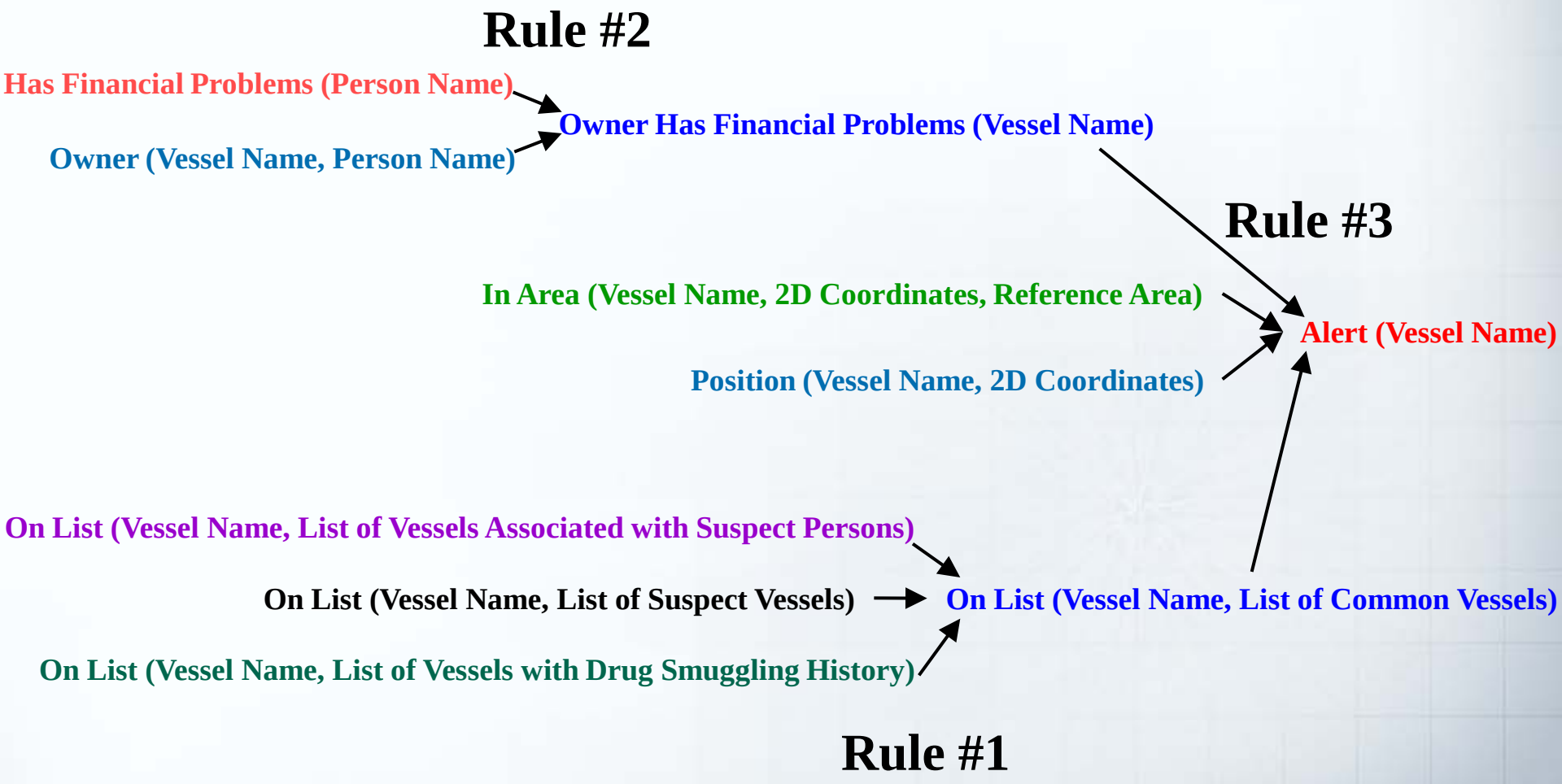
Vessels Having Owner in Financial Trouble

SABINE
FEDOR
MORDICUS
ANTARES
TATIANA
ESCAMBA
ZIPPO POTOMAK
HORACE
LACANAU

MITS Exploitation Example (4/6)

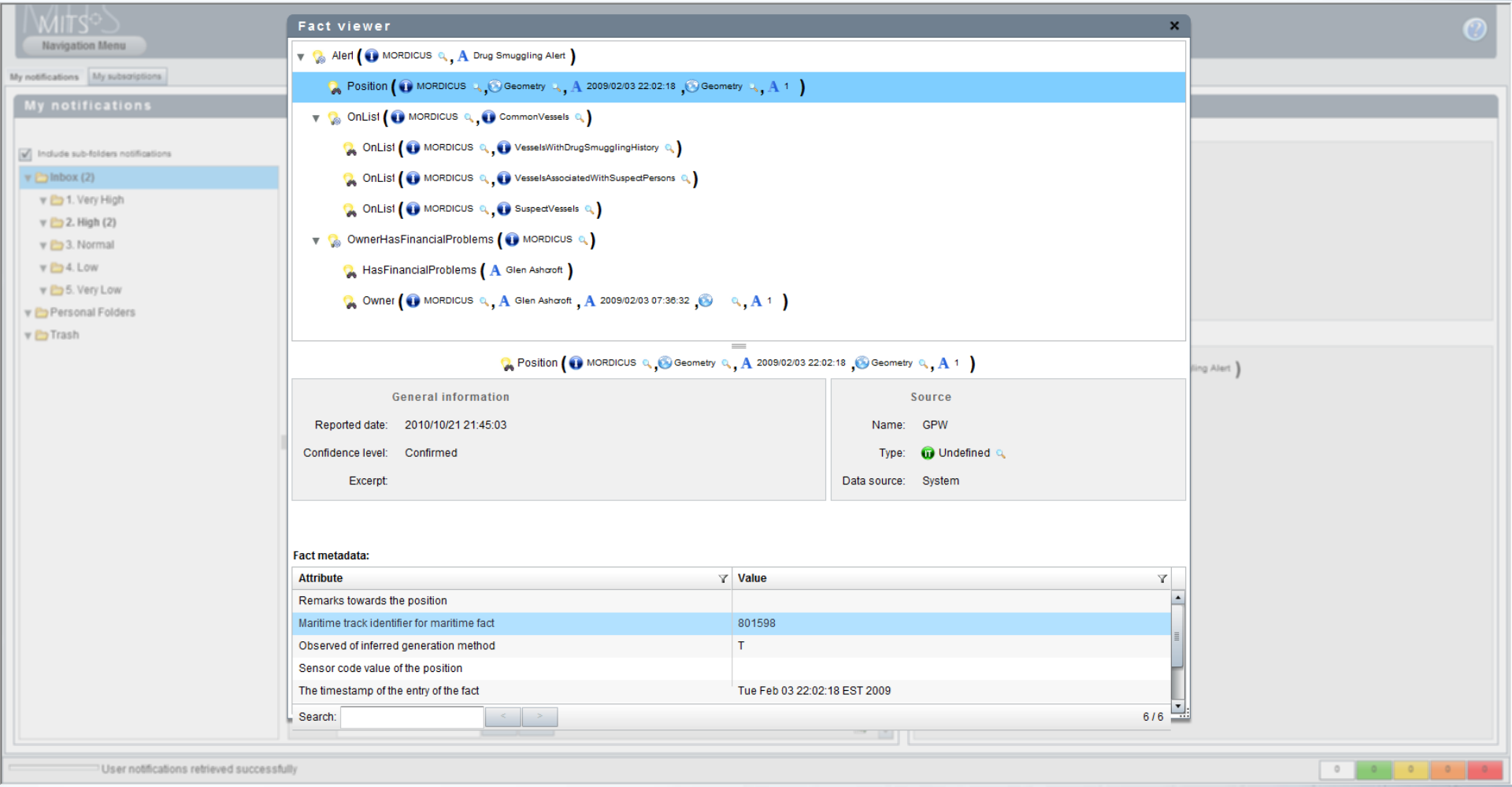


MITS Exploitation Example (5/6)



MITS Exploitation Example (6/6)

Notification – Justification

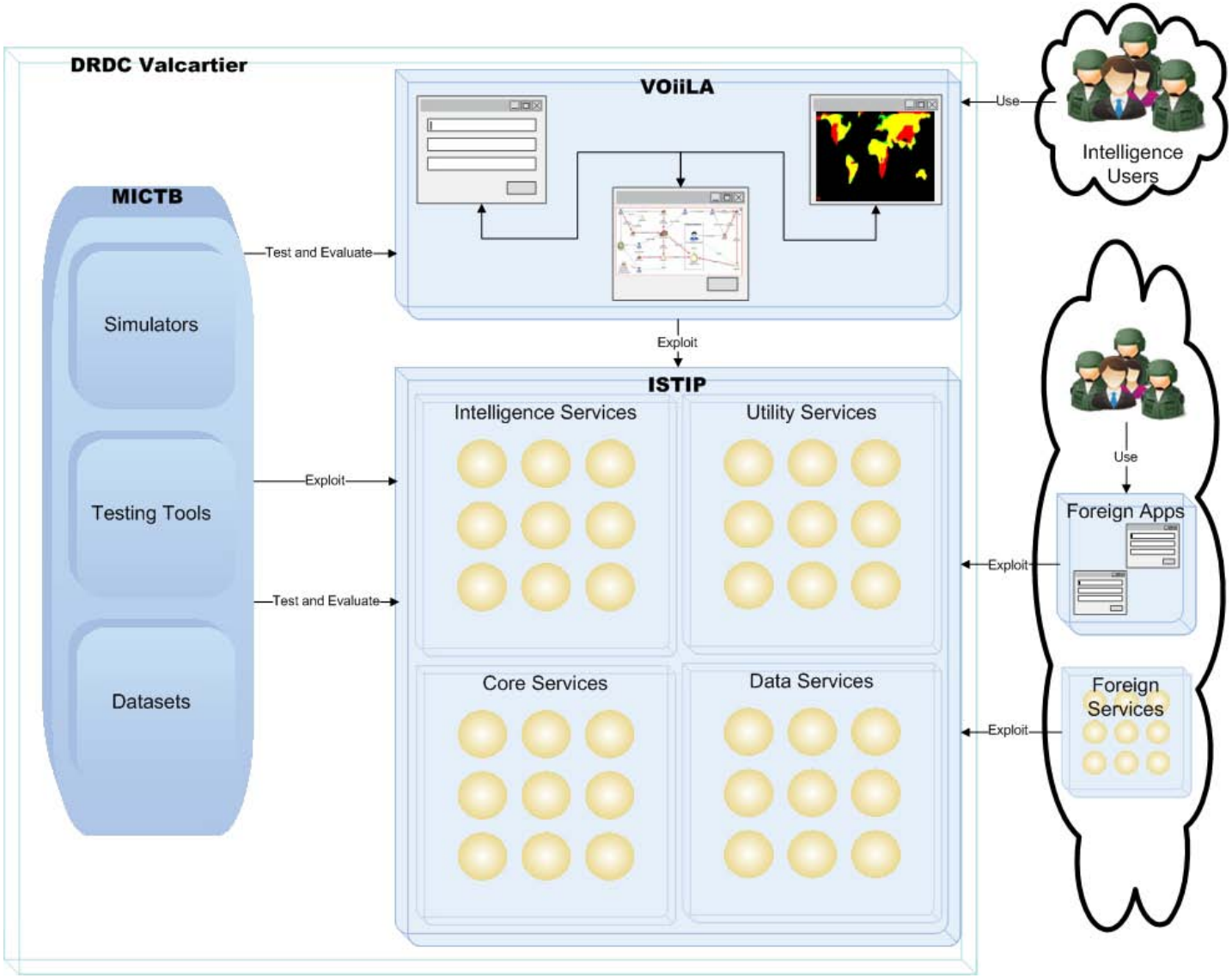


MITS
Implementation and Evolution

MITS Implementation and Evolution (1/2)

Intelligence Science and Technology Integration Platform (ISTIP)

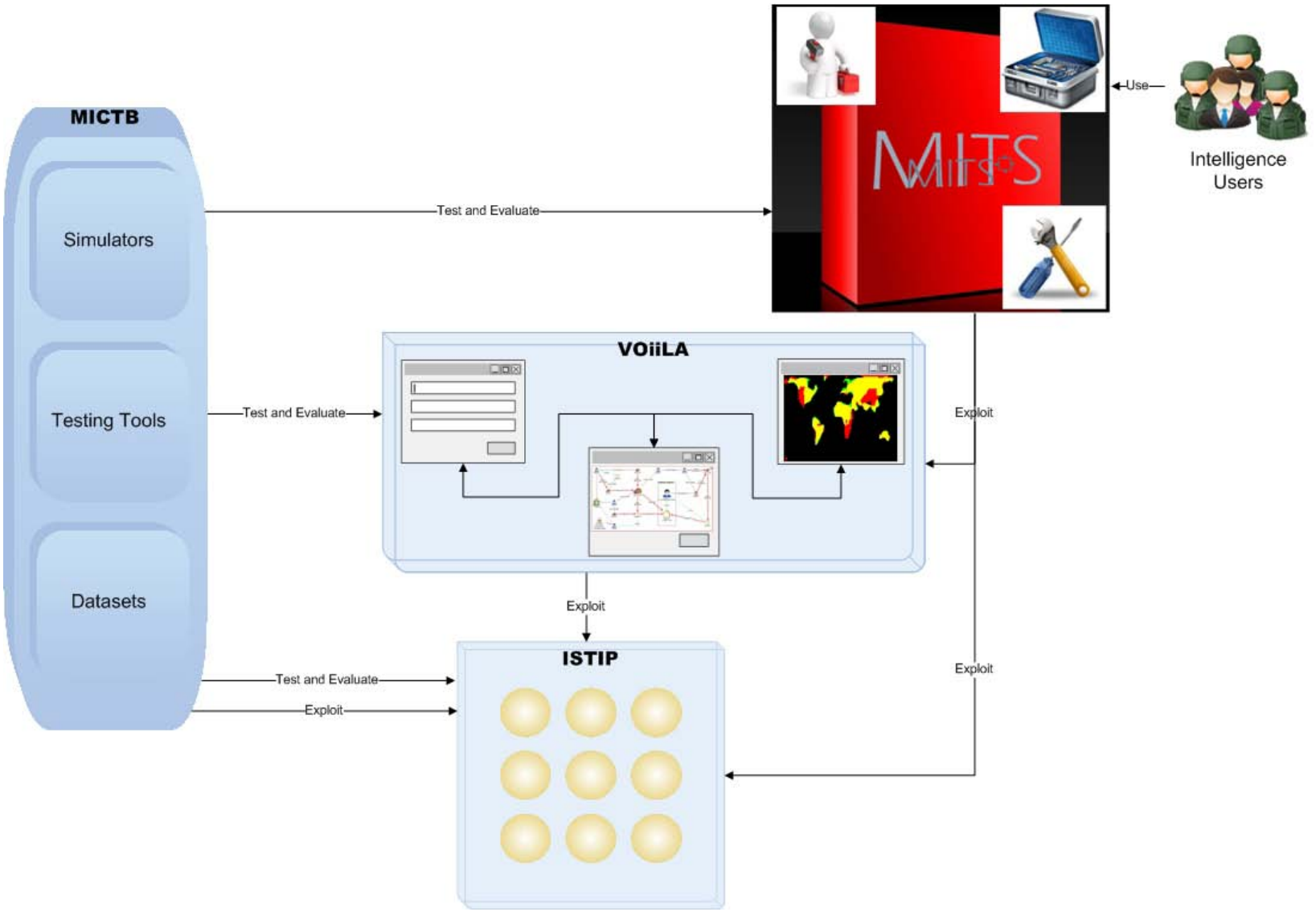
Visionary Overarching Interaction Interface Layer for the Analyst (VOiiLA)



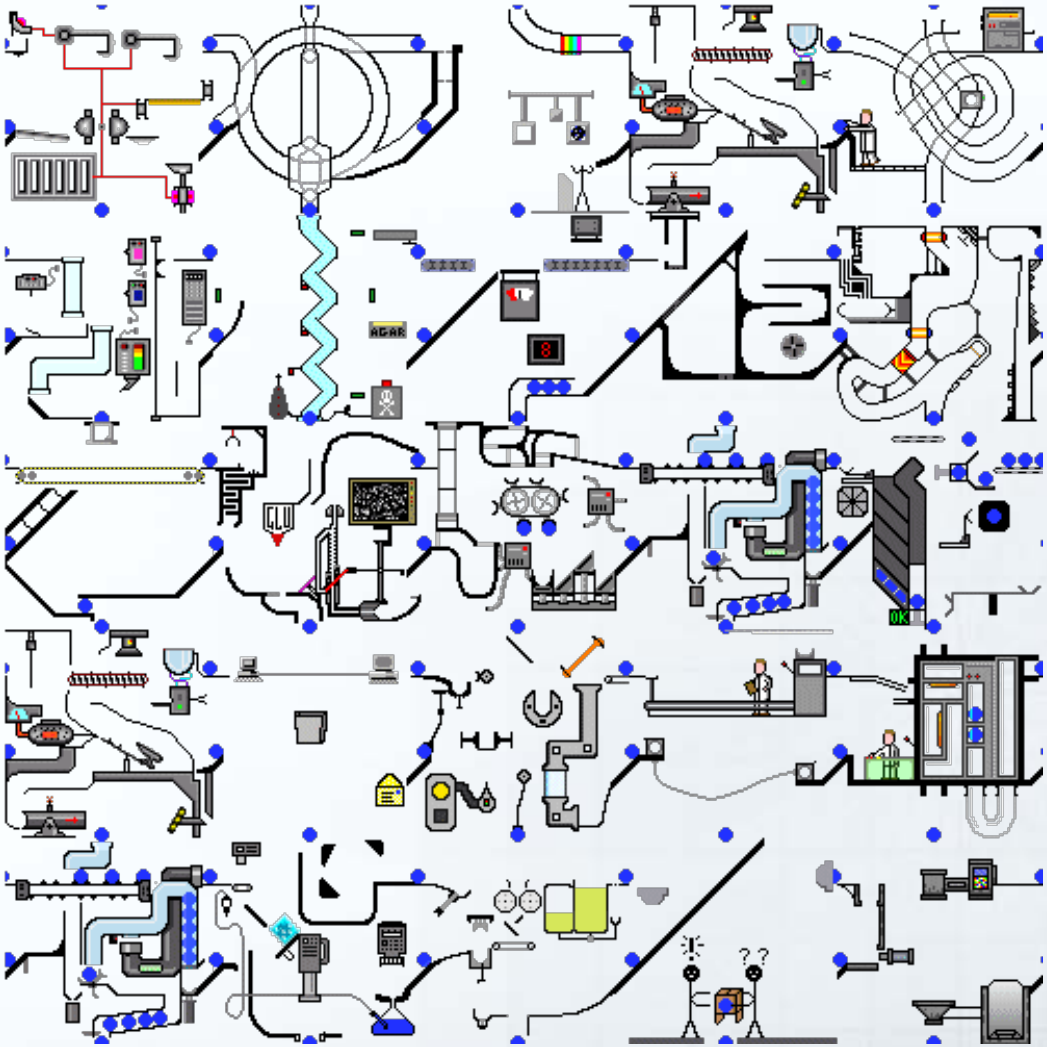
MITS Implementation and Evolution (2/2)

Intelligence Science and Technology Integration Platform (ISTIP)

Visionary Overarching Interaction Interface Layer for the Analyst (VOiiLA)



Questions ???

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