Decision-support Infosphere Services for Collaborative Operations and Virtual Environment Requirements (DISCOVER)

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Briefing Outline/Purpose

- **Introduction**
  - **What is DISCOVER and why are we doing it**
  - **Background (Joint Battlespace Infosphere and Fuselet Information Transformation Services)**
  - **Goals and objectives**
- **Experimentation Process**
- **System Architecture**
- **Project Status**
- **Preliminary Findings**
- **Next Steps**

What is DISCOVER?

- **DISCOVER is an AFRL project centered on the design and execution of an experiment**

  - **Goal is to measure the value and performance impact of a combination of technologies**

    - **Joint Battlespace Infosphere (JBI)**

    - **JBI fuselets**

    - **Collaboration and Visualization Software**

  - **Operational context focuses on the dynamic mission re-planning processes within an Air Operations Center (AOC)**

Joint Battlespace Infosphere (JBI)

- **A vision for an orchestrated information management system whose services adapt to the operational needs of users and the enterprise for universal access to tailorable, actionable information**

  - **Information sharing services (publish, subscribe, query)**

  - **Control services (policy, security, authentication, access control, authorization, QoS)**

  - **"Service contract" services (*force templates* to facilitate the effective plug-and-play-and-go of operational entities with an instance of an infosphere)**

  - **Information transformation services (*fuselets* which tailor the information space to the needs of the warfighter)**
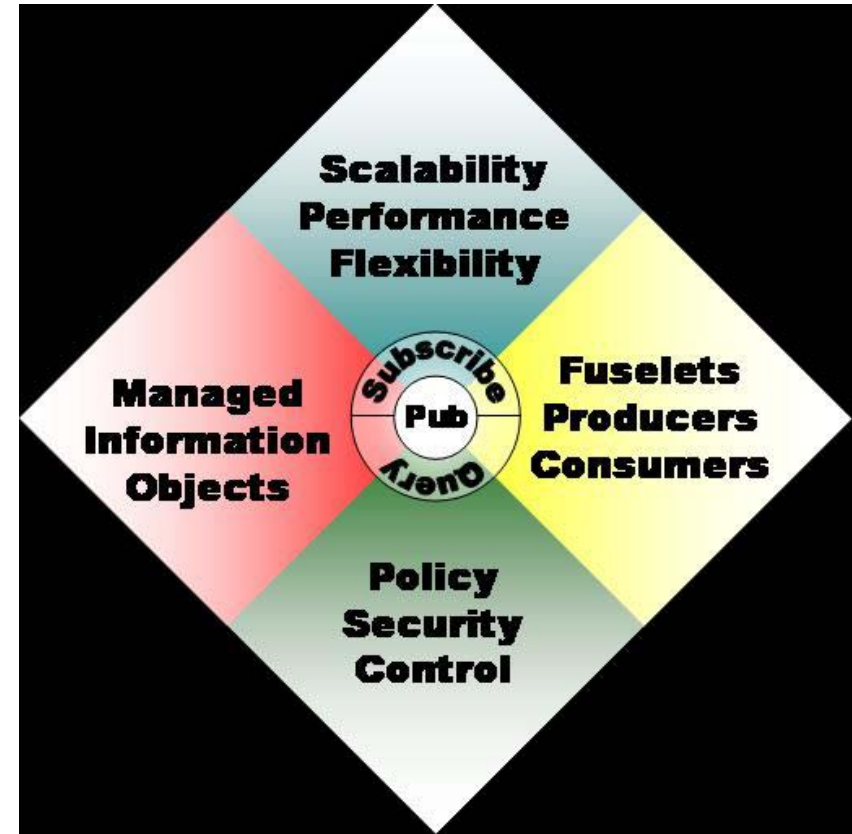
Realizing the Air Force Scientific Advisory Board (SAB) vision as delineated in two SAB summer study reports, **Information Management to Support the Warrior** *(1998) , and* **Building the Joint Battlespace Infosphere** *(1999)*
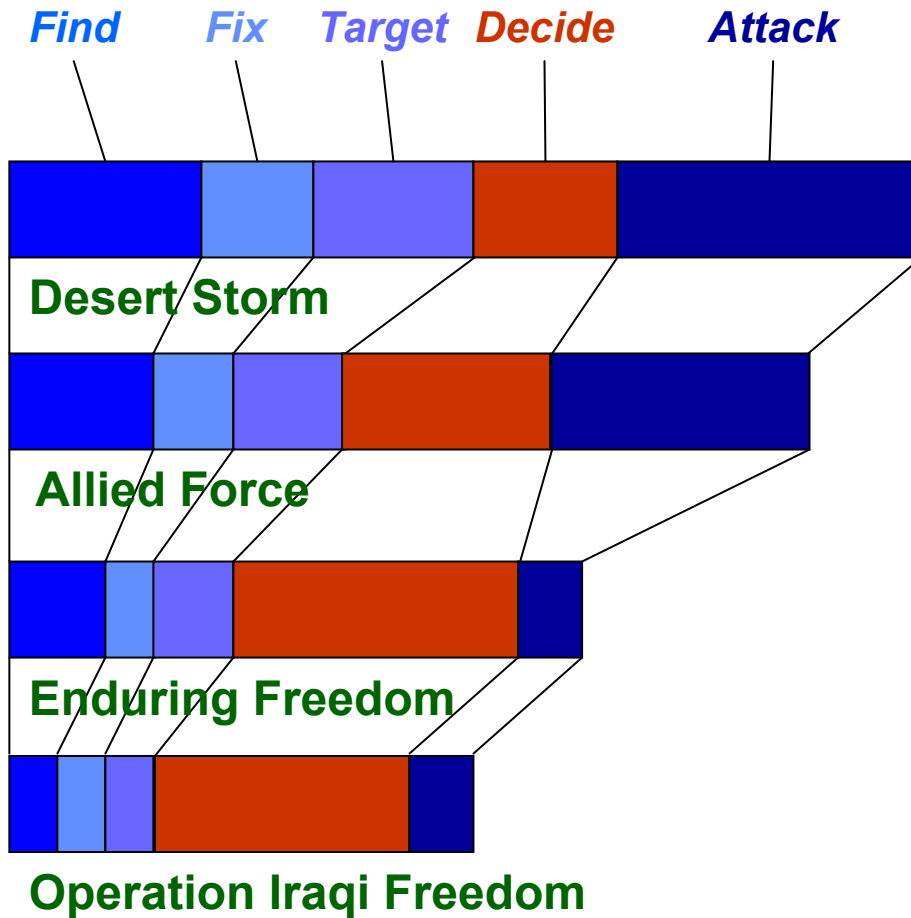
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Some Related ICCRTS Papers and Presentations from AFRL this Week

- **Joint Battlespace Infosphere: Information Management within a C2 Enterprise**
    - **Combs, Hillman, Muccio, McKeel**
    - **Information Operations/Assurance Track**
    - **Consulate**
    - **Day 3, Wednesday, 3:15-3:45**
- **A Reference Model for Information Management to Support Coalition Information Sharing Needs**
    - **Linderman, Siegel, Ouellet, Brichacek, Hains, Chase, O'May**
    - **Coalition Interoperability Track**
    - **Old Dominion**
    - **Day 4, Thursday, 1:30-2:00**

Find   **Fix**   **Target**   **Decide**   **Attack**

Desert Storm

Allied Force

Enduring Freedom

Operation Iraqi Freedom

Time

- **More intelligence data leads to *information overload***

- **Decision time has become the "long pole in the tent"**

- **Warfighters lack *actionable* information**

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Problems to be Addressed by Information Transformation

- **Multiple information systems** and sources can produce **duplicate or inconsistent information** that requires **significant human effort** to correlate, integrate and understand

    - Information overload and confusion

    - Inefficient and ineffective decision-making

    - Cumbersome and error-prone migration of information from one system to another (manual data entry often required)

- Current **information systems are difficult to change** to produce information that is tailored to the specific needs and context of end users

    - The information they produce is generally static

    - Application reengineering can be complex, costly and time consuming, potentially leading to significant downtimes

Information Transformation Objectives

- **Augment information systems with a flexible information production capability that is dynamically responsive to the changing needs of end users and imposes minimal impact to legacy systems**

- **Improve the efficiency and effectiveness of decision-making by correlating duplicative information, resolving inconsistent information, mediating between information sources, and fusing information together into comprehensible information products**

Fuselet Definition

- **A fuselet is a light-weight, special-purpose JBI client program that provides value-added information processing functions that are under the control of the JBI platform**

  - **These information processing functions take existing information objects as input and manipulate them in some way to produce new information objects**

  - **Light-weight means that they are intended to be easy to build and deploy, relatively modular, usually small in terms of lines of code, amenable to reuse, and utilize a low level of system runtime resources**
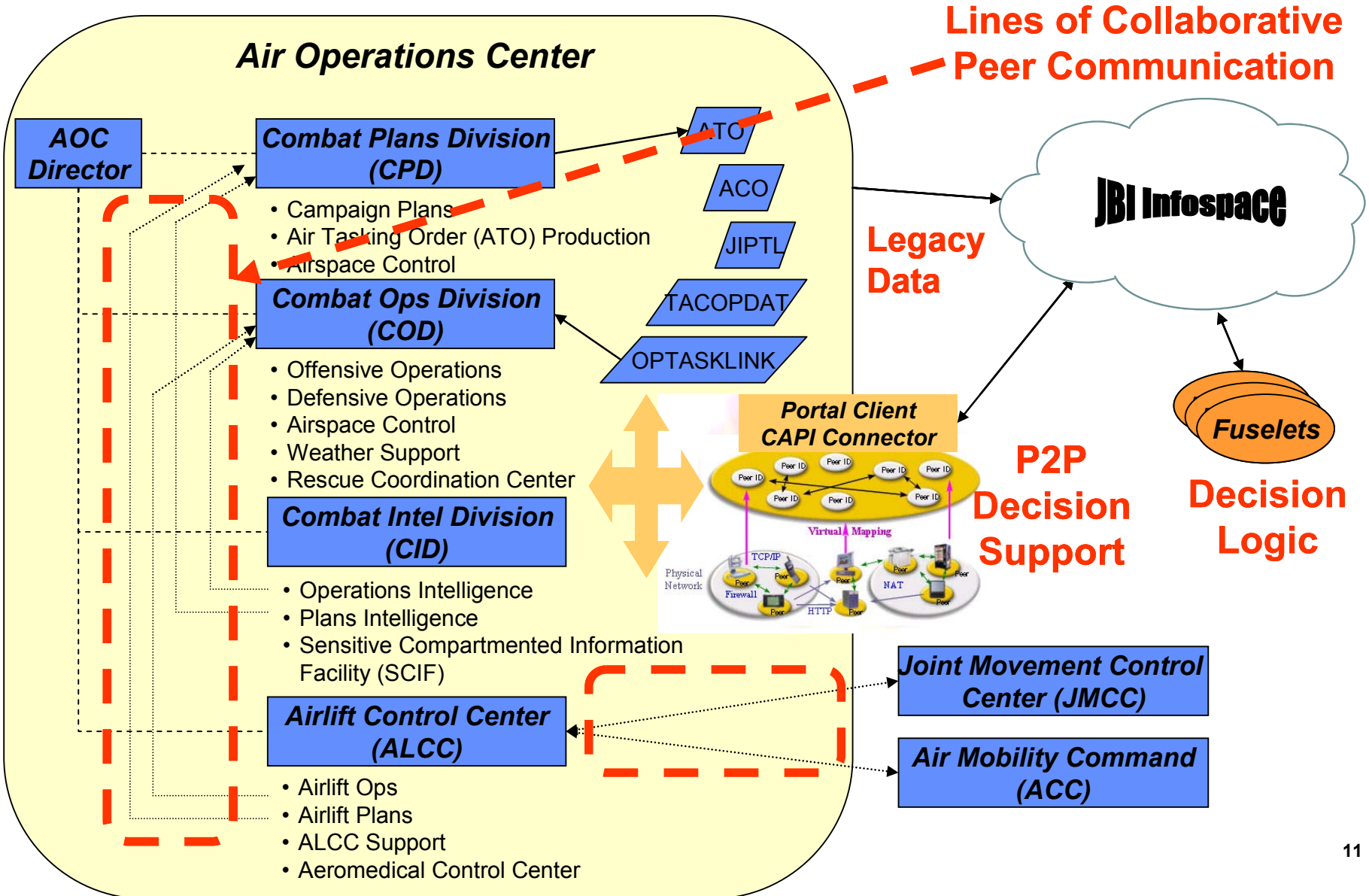
Collaboration and Visualization Software

- **We recognized the need to visualize (present) the information produced by fuselets to human operators within an AOC and the need for teams of operators to collaborate over this information**

  - **DISCOVER utilizes portal, messaging, and chat technology to support presentation and collaboration requirements**

AOC Collaborative Decision-Making Support

Air Operations Center

AOC Director

Combat Plans Division (CPD)
- Campaign Plans
- Air Tasking Order (ATO) Production
- Airspace Control

Combat Ops Division (COD)
- Offensive Operations
- Defensive Operations
- Airspace Control
- Weather Support
- Rescue Coordination Center

Combat Intel Division (CID)
- Operations Intelligence
- Plans Intelligence
- Sensitive Compartmented Information Facility (SCIF)

Airlift Control Center (ALCC)
- Airlift Ops
- Airlift Plans
- ALCC Support
- Aeromedical Control Center

ATO

ACO

JIPTL

TACOPDAT

OPTASKLINK

Lines of Collaborative Peer Communication

JBI Infospace

Legacy Data

Portal Client CAPI Connector

Peer ID
Virtual Mapping
Physical Network
TCP/IP
Firewall
NAT
HTTP
Peer

P2P Decision Support

Fuselets

Decision Logic

Joint Movement Control Center (JMCC)

Air Mobility Command (ACC)

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Why DISCOVER?

- **Provide objective experimental evidence** on the value of information management technologies (JBI, fuselets, collaboration)

- **Quantitatively demonstrate** how JBI and fuselets can improve the efficiency and effectiveness of dynamic mission re-planning process in an AOC

- **Identify areas for future R&D** to improve and advance these and other information management, interoperability, and transformation capabilities
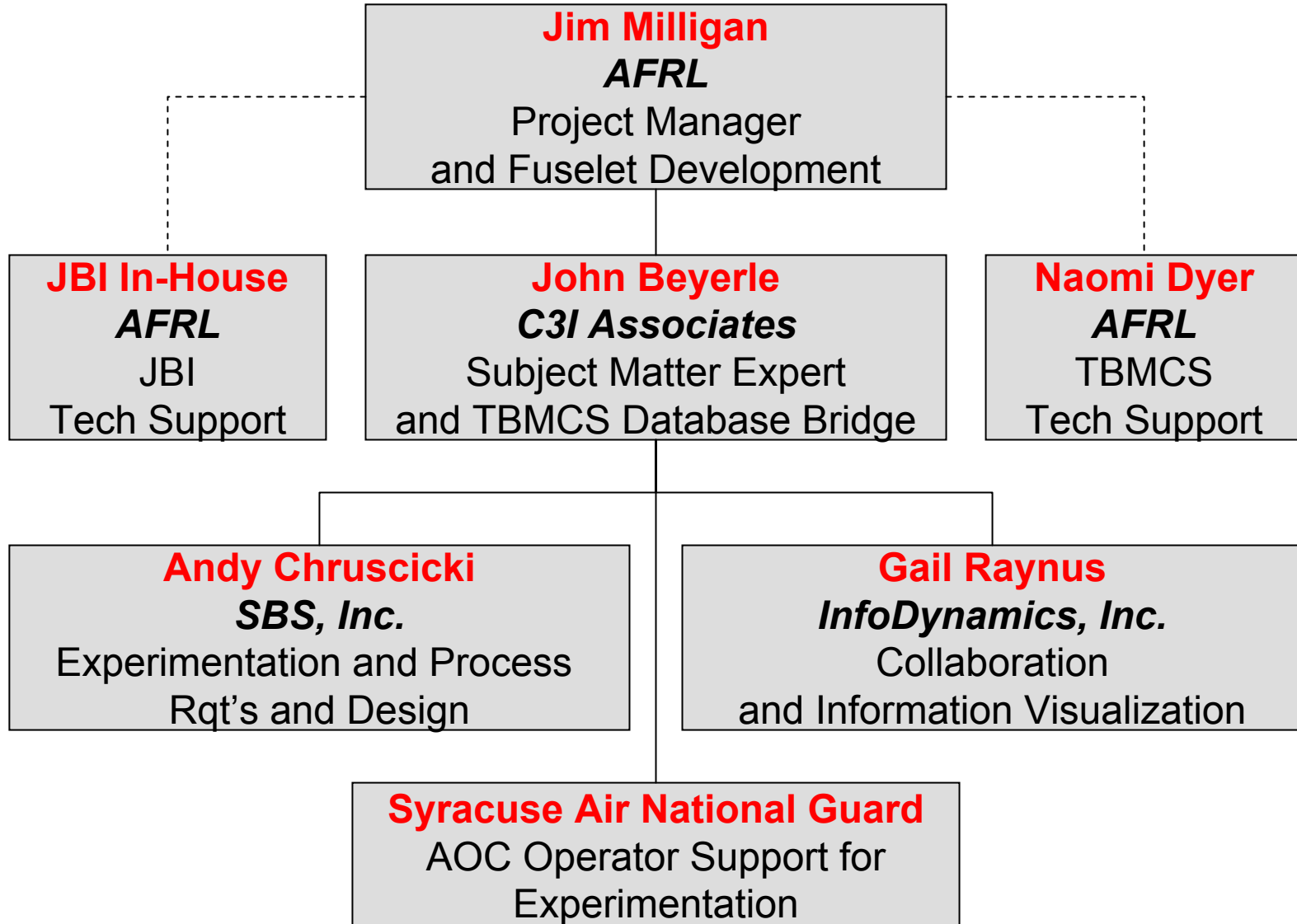
DISCOVER – Project Goals

- **Reduce the Footprint [Less People]**

  - Demonstrate how fuselets can perform tedious manpower intensive data collection and processing tasks that are currently done by military personnel

  - Allows the warfighter to focus on warfighting

- **Improve Efficiency [Faster]**

  - Demonstrate how fuselets can increase the speed of decision-making through the production of quality information

- **Improve Effectiveness [Better]**

  - Demonstrate how fuselets can improve the warfighters ability to make better, more optimized decisions

DISCOVER Team

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AFRL
JBI
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InfoDynamics, Inc.
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and Information Visualization

Syracuse Air National Guard
AOC Operator Support for
Experimentation

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Experimentation Process
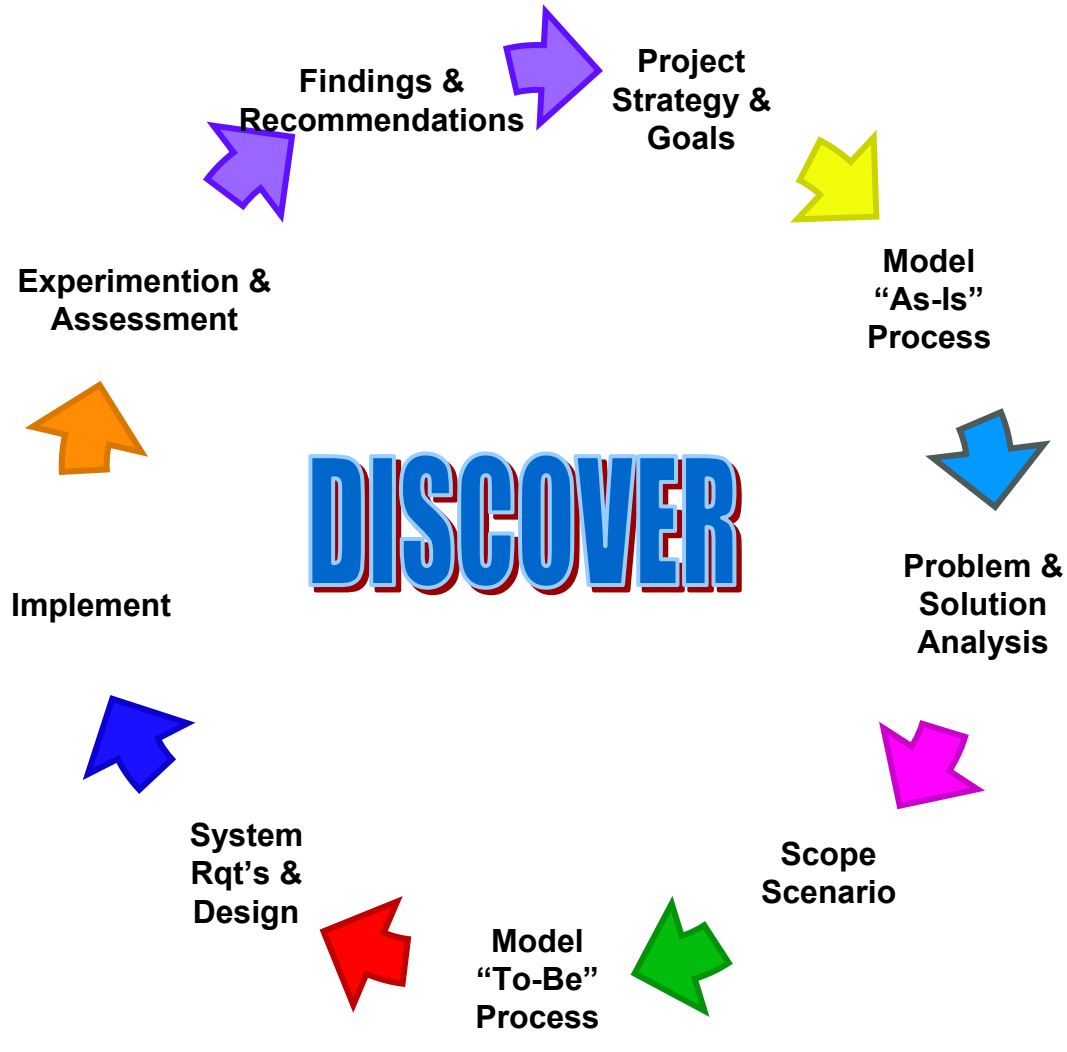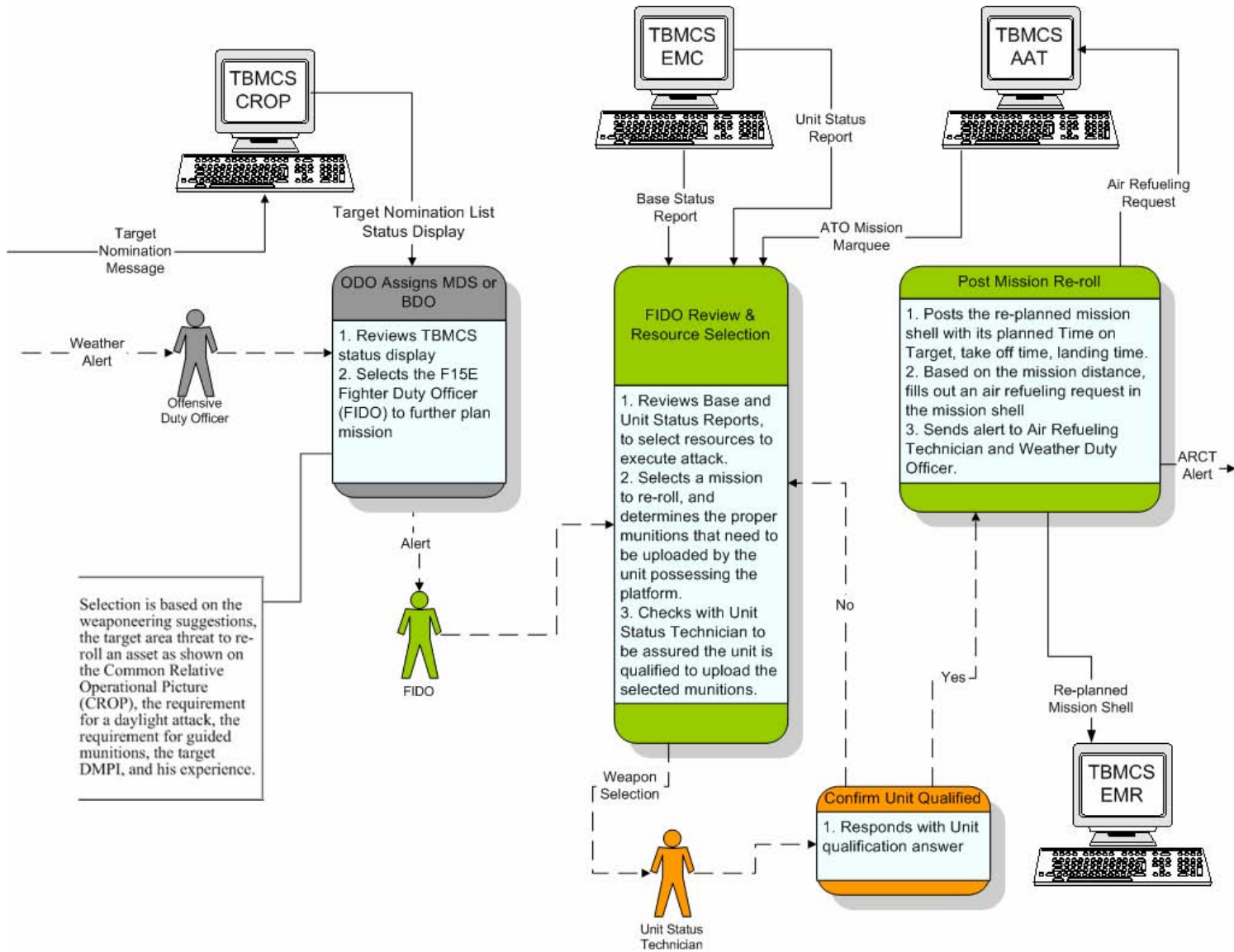
Problem & Solution Analysis

- **Subject Matter Expert (SME) interaction**

- **Operational briefings**

- **Legacy AOC system demonstrations**

- **Documentation review**

- **Legacy system capability analysis and data modeling**
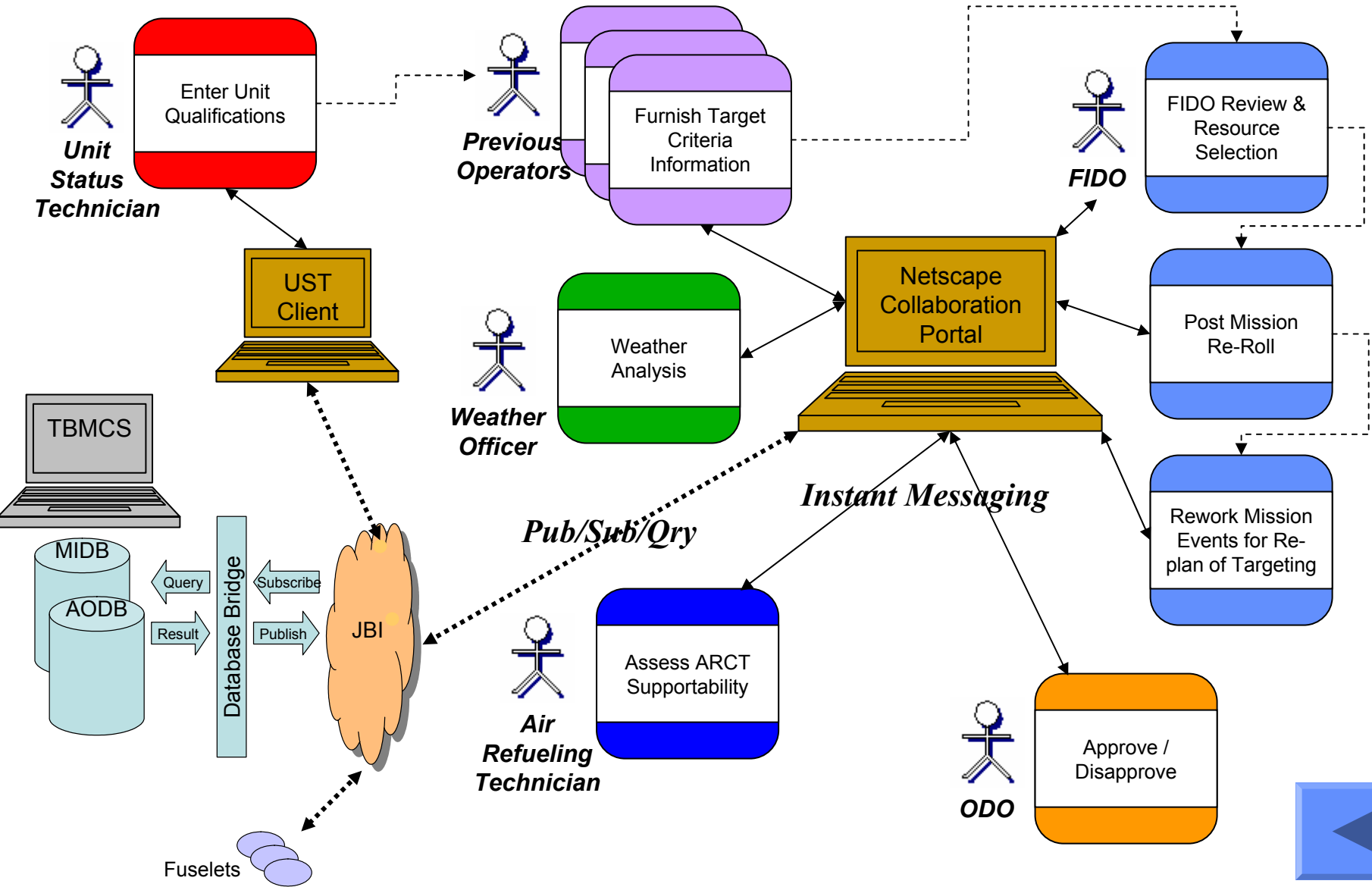
- **As-is scenario analysis**

F15E Fighter Duty Officer (FIDO) Collaborative Decision Making ("As-Is")

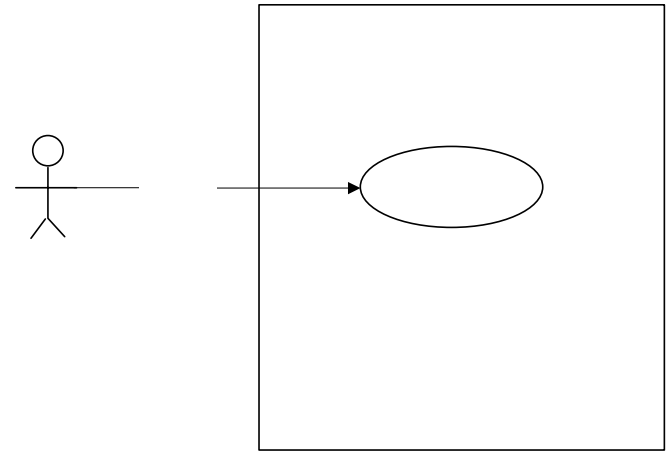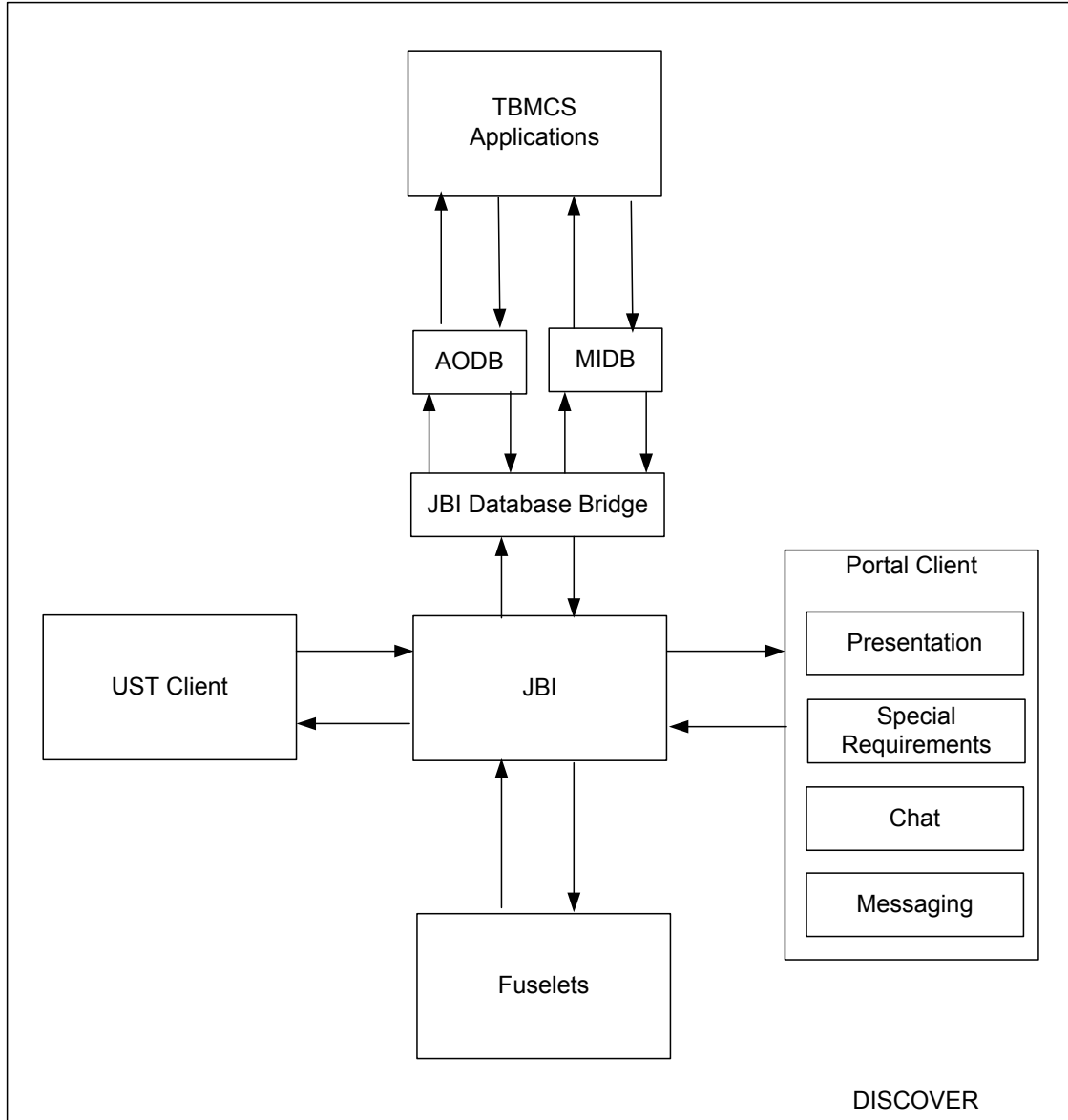# F15E Fighter Duty Officer (FIDO) Collaborative Decision Making ("To-Be")

Unit Status Technician — Enter Unit Qualifications

UST Client

TBMCS

MIDB

AODB

Database Bridge

Query / Result / Subscribe / Publish

JBI

Fuselets

Previous Operators — Furnish Target Criteria Information

Weather Officer — Weather Analysis

Netscape Collaboration Portal

Pub/Sub/Qry

Instant Messaging

Air Refueling Technician — Assess ARCT Supportability

ODO — Approve / Disapprove

FIDO — FIDO Review & Resource Selection

Post Mission Re-Roll

Rework Mission Events for Re-plan of Targeting

Requirements and Design

- **Information object engineering (XML Schema)**

- **GUI storyboarding (Visio)**

- **Scenario-based use cases (UML)**

- **Sequence diagrams (UML)**

- **Architecture context diagram (UML)**

- **Textual capability requirements specification**

System Architecture

Portal Client

Legacy / Other

Implemented

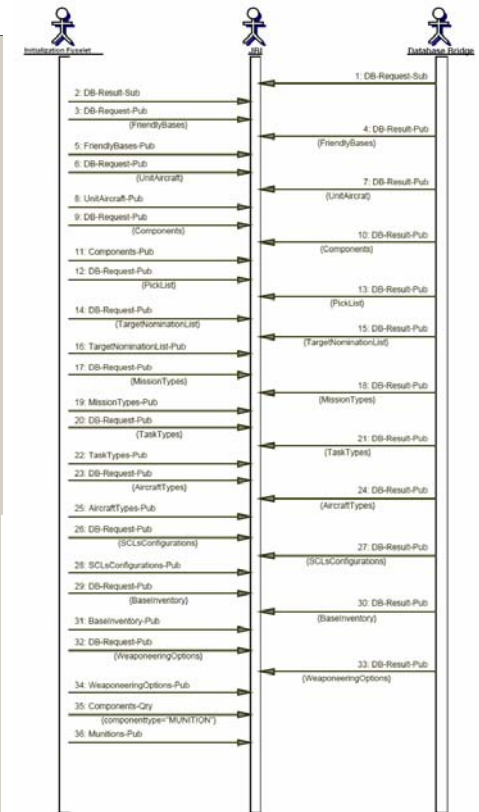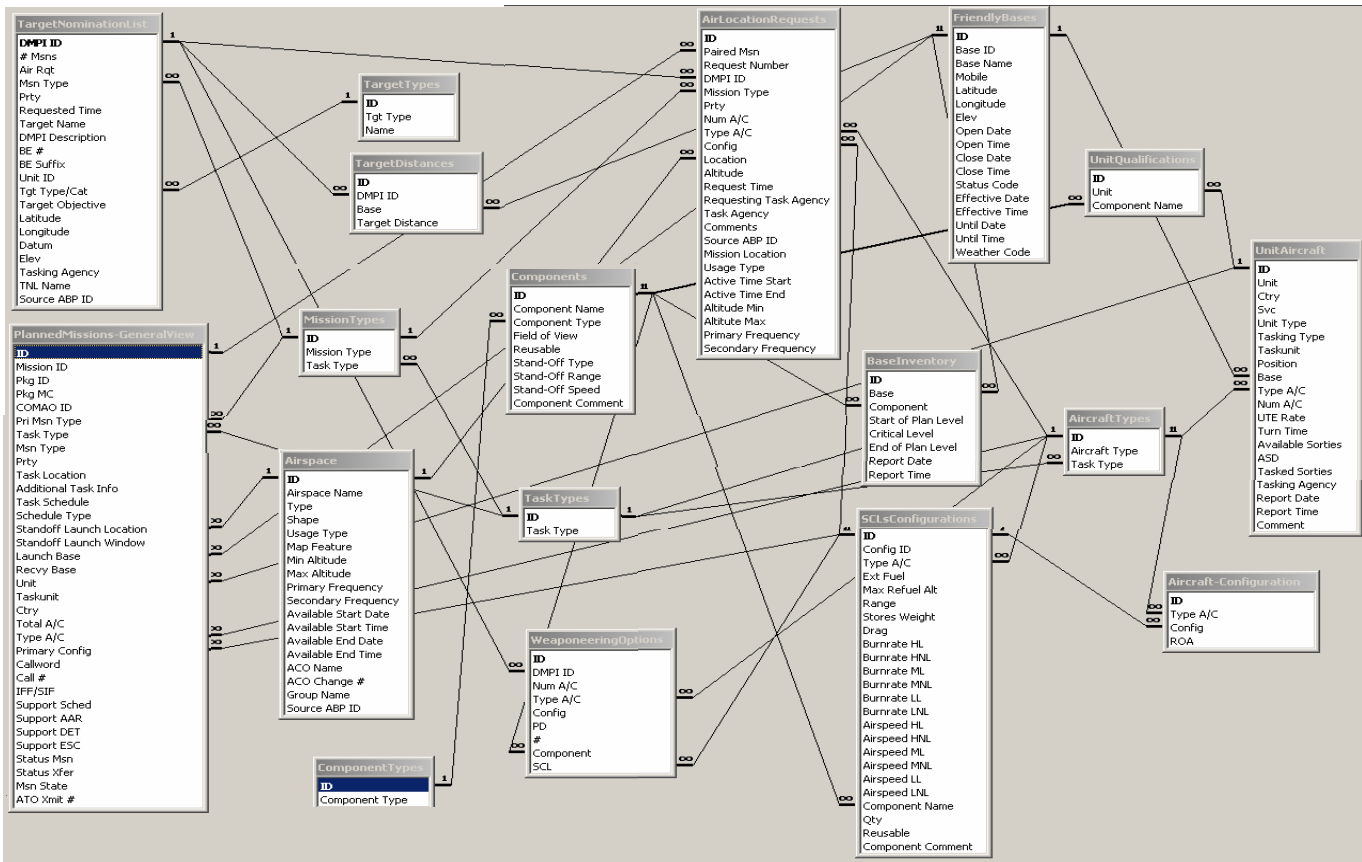Partially

Not Implemented

DISCOVER
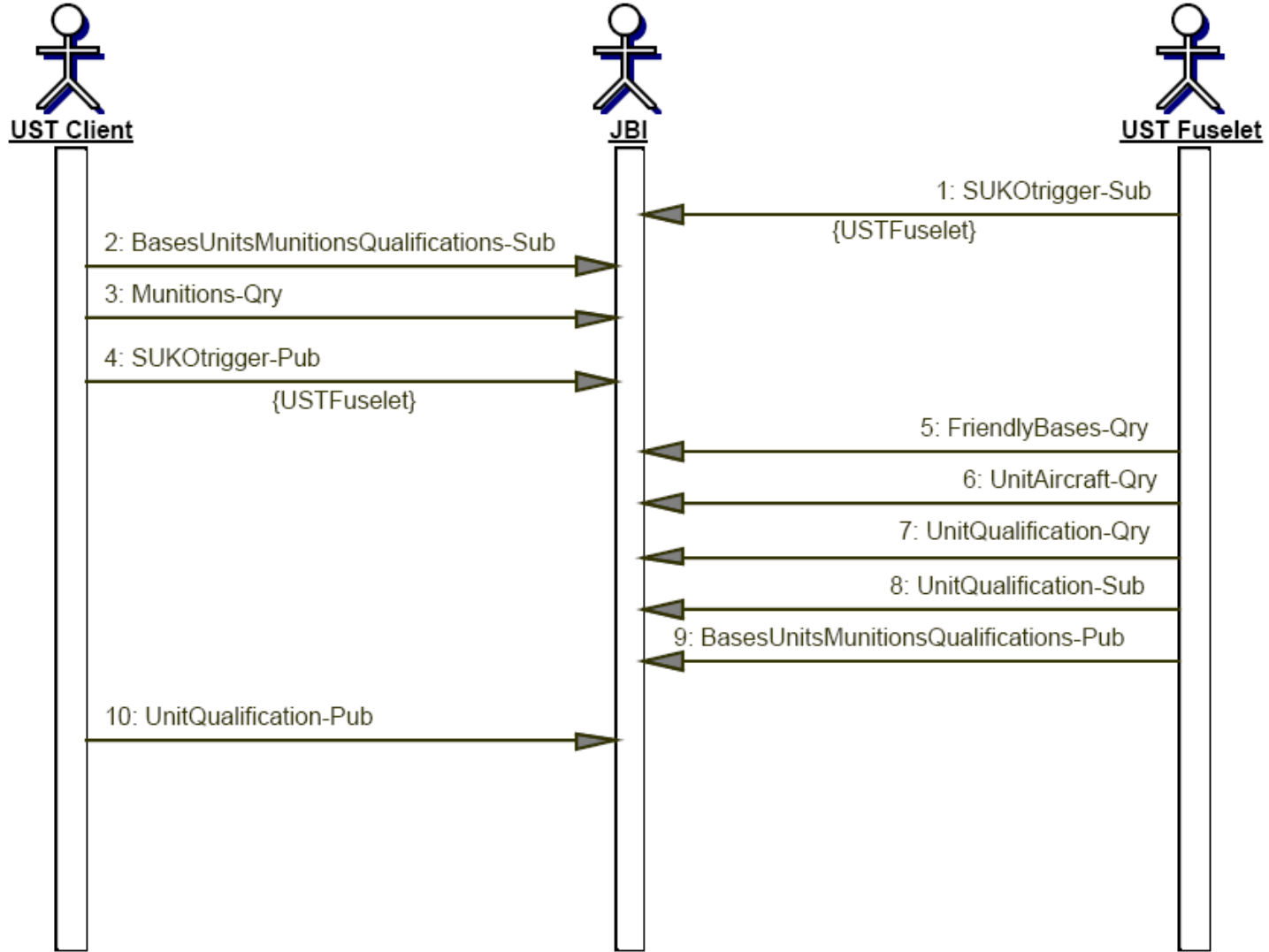
UST Client

Database Bridge

- **Modified to produce the "raw" TBMCS information objects required by the DISCOVER project**

Fuselets
Shared Updatable Knowledge Object (SUKO)

SUKO Publishes Internal State Upon Receipt of a Trigger

[{ 'baseid': 525, 'basename': 'Otis', 'unit': '7th Fighter Wing', 'munition': 'MK82' },
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Portal Client

Target Information
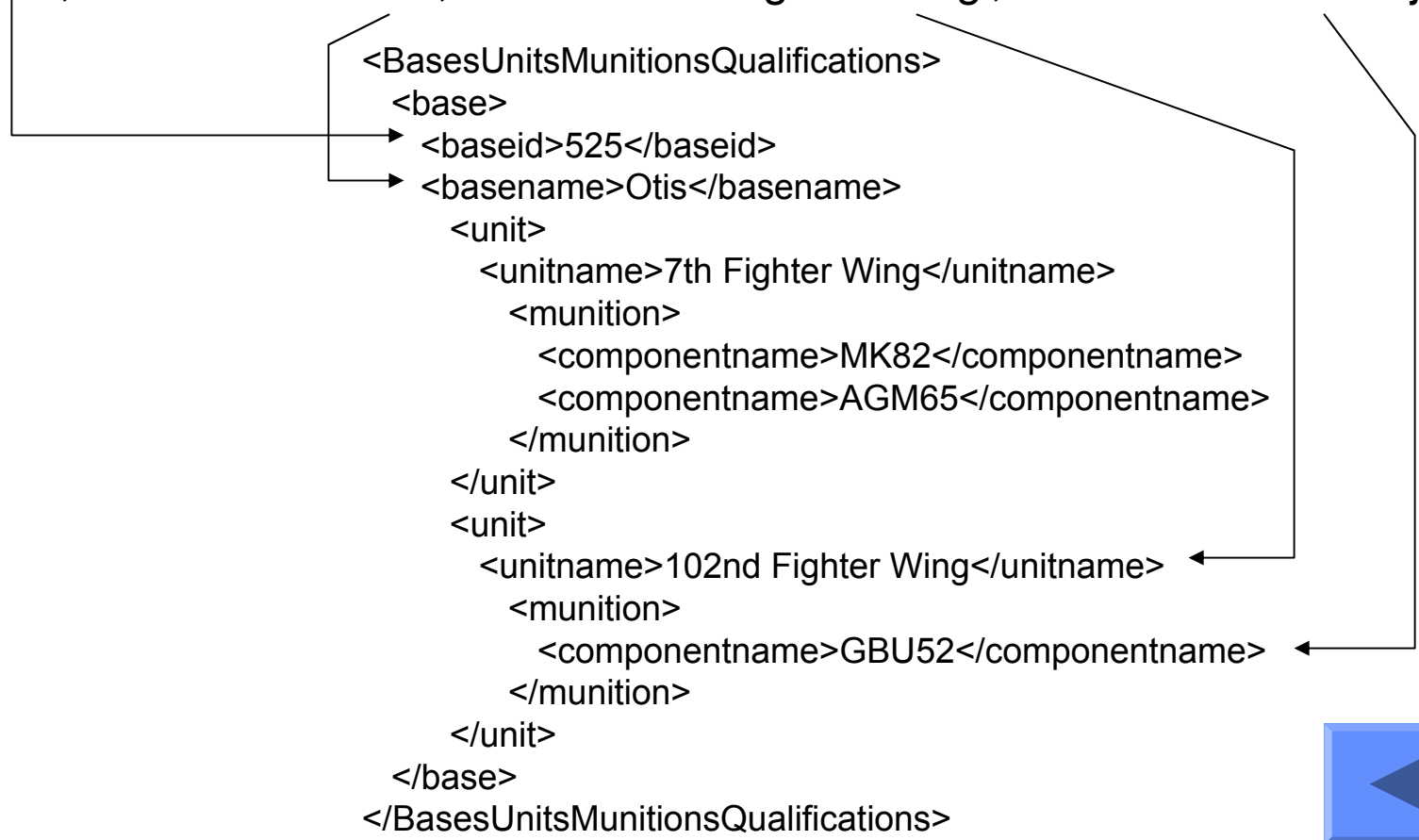
Preliminary Findings
Issues

- **Narrowing the gap between the SME and software developers**

  - **A great deal of application domain knowledge needs to be assimilated before an understanding of problems and the development of potential solutions can be embarked upon**

    - **It seems there will always be is a fairly steep learning curve, either for the fuselet/software developer to understand the problem domain, or for the subject matter expert to learn how to build fuselets and companion clients**

    - **Until we can empower the typical SME in this way, we will always have to employ a problem solving methodology such as we have under DISCOVER to understand and derive solutions to customer problems**

- **It is evident that we can accomplish this by eliminating the need for a Unit Status Technician (UST) to report unit qualifications by capturing this information in the JBI and associating it with the information captured from TBMCS**

- **This in turn leads to better decision-making efficiency and effectiveness…**

  - **Allows the UST to perform other mission-critical tasks**

  - **Makes target-platform-munition-unit-qualification correlation possible by fuselets to provide operators valid options to choose from promoting more efficient and effective decision making**

Preliminary Findings
Improving efficiency

- **Augmenting legacy systems with fuselet technology**

  - **One of the problems that we identified is that TBMCS is largely a sophisticated database query-response system**

  - **Evidence suggests that fuselets can increase the decision-making speed of AOC duty officers by automatically correlating a given target to valid mission re-roll options**

  - **Fuselets would provide a proactive decision-support capability, as opposed to a reactive one where there is a high potential for no-go decisions where replanning has to back up and repeat itself**

- **Distributed collaboration for distributed operations and improved communications**

  - **Today, much of the person-to-person communication is done by "tennis shoe" interfaces, which makes distributed AOC operations difficult and centralized operations vulnerable to attack**

  - **Therefore, automation for collaborative capabilities provided by chat, instant messaging, and portal technology would in theory be beneficial to speeding up communication between operators and enable it to be done in a distributed way**

Preliminary Findings
Improving effectiveness

- **Through controlled experimentation we can demonstrate how fuselets improve the warfighters ability to make better, more optimized decisions**

  - **Measure % improvement in missions re-rolled successfully (best selections) in a laboratory setting using realistic data sets**

    - **Do so first without our technology**

    - **Do so second with it**

    - **Compare the results**

Next Steps

- **Complete system/fuselet development**

- **Complete experiment design plan**

- **Execute phased experimentation**

- **Perform data analysis**

- **Document results and provide recommendations**

- **Initiate fuselet security study**

  - **Investigate and report on the operational security implications of JBI fuselet technology, particularly within the operational context of the DISCOVER experiment**

  - **Demonstrate in the DISCOVER prototype a role-based approach for addressing some of the security concerns uncovered by the study**

That's all for now…

- **Thank you.**

  – **Questions?**