Joint Unmanned Aerial Vehicle in Time-Sensitive Operations

Joint Test and Evaluation

PROGRAM TEST PLAN

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Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E)

Program Test Plan (PTP)

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PREFACE

The Joint Unmanned Aerial Vehicle in Time-Sensitive Operations Joint Test and Evaluation project was chartered by the Director, Strategic and Tactical Systems, Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics).

This document provides the overall framework for conducting a Joint Test and Evaluation concerning the incorporation of Unmanned Aerial Vehicles in Joint operations. The Joint Unmanned Aerial Vehicle in Time-Sensitive Operations Joint Test and Evaluation Program Test Plan details the techniques and procedures for test planning and execution; virtual rehearsal planning using legacy modeling and simulation tools; data management, collection, validation, and analysis; evaluation; and reporting. In addition to the Program Test Plan, individual Detailed Test Plans will be published for each test event.

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JOINT UNMANNED AERIAL VEHICLE IN TIME-SENSITIVE OPERATIONS

JOINT TEST AND EVALUATION

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Executive Summary

INTRODUCTION

U.S. military forces have used Unmanned Aerial Vehicles (UAVs) to support combat operations since the Vietnam conflict. Initially, UAV missions focused on classic intelligence, surveillance, and reconnaissance. In more recent conflicts, such as Desert Storm and Operation Allied Force in the Balkans, increased sensor capabilities have led to the tactical employment of UAVs to support dynamic, time-sensitive warfighting operations.

Today's Tactics, Techniques, and Procedures (TTP) for the tactical employment of UAVs can be characterized as platform-dependent and Service-centric. In October 2001, the Office of the Secretary of Defense (OSD) chartered the Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E) to evaluate the Services' ability to integrate UAVs into Joint, time-sensitive tactical operations. The JUAV JT&E Joint Test Force (JTF) will develop and test Joint Tactics, Techniques, and Procedures (JTTP) that are platform-independent.

This PTP provides guidance for conducting the JUAV-TSO JT&E. It describes the over-arching problem statement and the related issues and sub-issues that the JT&E will address. It outlines the test events that will provide data to address the issues and sub-issues and describes the resource requirements, team organization and management, and planned legacy products of the JT&E. This PTP also includes a comprehensive data management and analysis plan in Annex F.

PROBLEM STATEMENT AND ISSUES

The following is the problem statement for the JUAV-TSO JT&E:

Existing TTP do not adequately address Joint UAV employment in dynamic time-sensitive operations.

The JUAV Warfighter Advisory Group (JWAG) developed this problem statement during the Joint Feasibility Study (JFS) that preceded the chartering of the JT&E. The statement is built on test results and real-world combat experience, both of which suggest that a lack of JUAV procedures in existing mission-level JTTP limits the warfighters' ability to use UAVs effectively in TSO. For JUAV-TSO JT&E purposes, TSO are defined as operations requiring immediate response because of a clear and present danger to friendly forces, the value of the resources involved, or the fleeting nature of the situation.

In conjunction with the problem statement, the JWAG also developed three alternative Command and Control (C2) architectures for UAVs during TSO. An important distinguishing feature of the alternatives is the location of decision-making authority with respect to target engagement on the tactical level. In Alternative A, engagement decisions are made at a centralized C2 node. In Alternative B, engagement decisions are made at a forward Tactical C2 node. In Alternative C, engagement decisions are made at the UAV Ground Control Station (GCS). The three alternative C2 architectures are a major focus of the JT&E. Other alternative architectures will also be considered if test results suggest that they may be effective in particular situations.

The JTF derived three principal test issues from the problem statement:

(1) To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?

(2) To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?

(3) To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?

The JUAV JT&E problem statement and associated issues are the foundation for the test concept described in this PTP.

TEST APPROACH

The JTF plans to test the three alternative C2 architectures in three types of missions: Air Interdiction, Fire Support, and Combat Search and Rescue (CSAR)/Non-combatant Evacuation Operations (NEO). The JT&E project will include four live test events:

- The Risk Reduction Mini-Test (Ft. Irwin, January 2003) will serve as a rehearsal for the subsequent field tests.
- Field Test 1 (FT-1) (Desert Rescue XI, NAS Fallon, July 2003) will focus on combat search and rescue (CSAR) missions.
- Field Test 2 (FT-2) (Ft. Hood, January 2004) will focus on Air Interdiction and Fire Support missions.
- The Joint Validation Test Event (JVTE) (Southeastern U.S., spring 2004) will validate the proposed JTTP and C2 architectures that were developed and tested during the previous test events.

Preparation for the live test events will include several virtual rehearsals using legacy modeling and simulation (M&S) tools. Figure ES-1 shows the current schedule for the JUAV JT&E project.

The data obtained in the live test events will be thoroughly analyzed by the JTF and outside Subject Matter Experts (SMEs). The results will be presented to the operational community through individual test reports published after each test event. The JWAG, created for the JFS, will continue to function during the JT&E. It will meet at least twice a year to review test results and help answer test issues. In addition, a General Officer Steering Committee (GOSC) will provide senior leadership guidance to the JT&E throughout the project's existence.

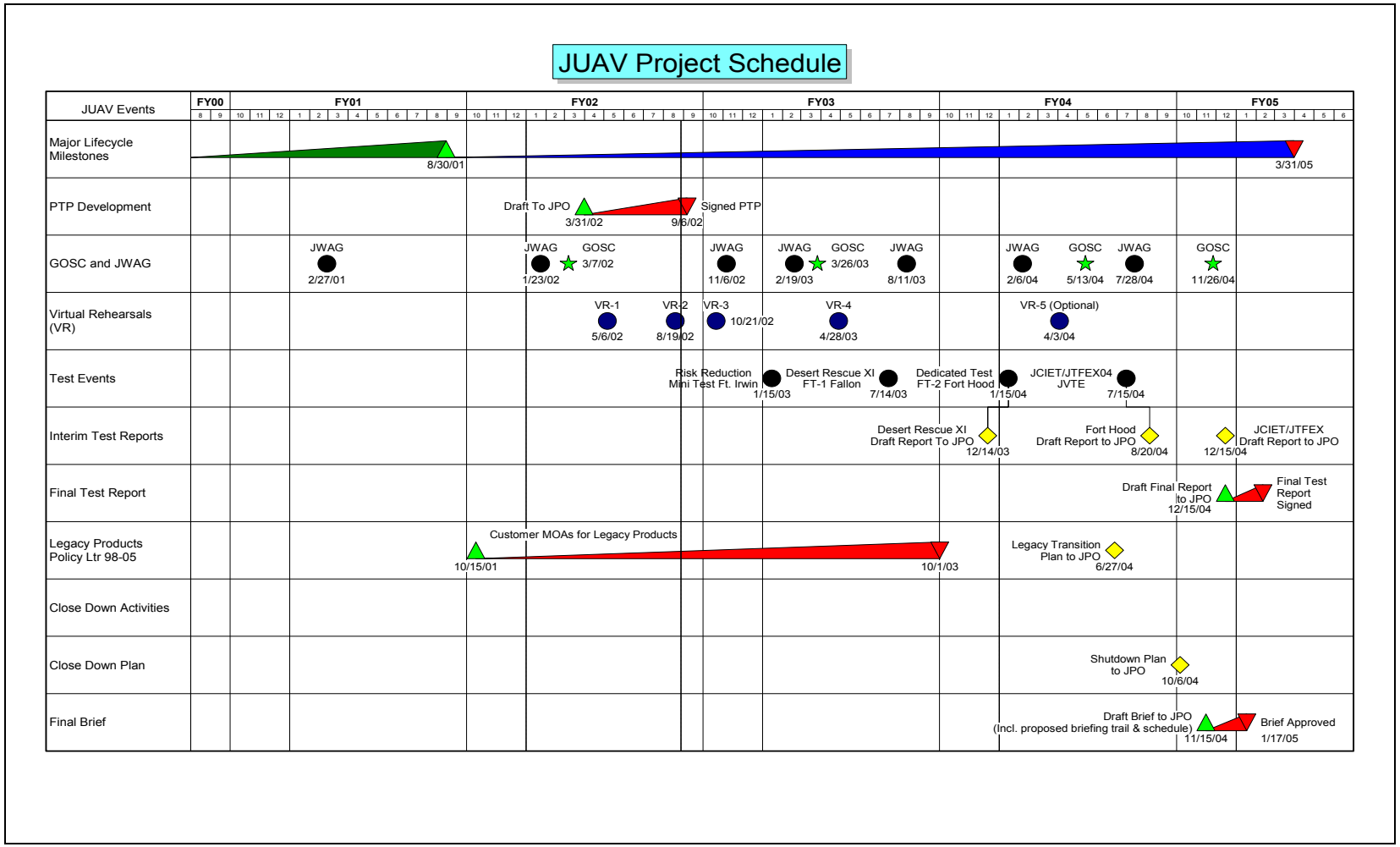

Figure ES-1 JUAV Project Schedule

LEGACY PRODUCTS

Legacy products of the JUAV JT&E project will include:

- *Updates to Joint and Multi-Service Documents.* The JTF will coordinate with the Joint Staff, Joint Forces Command, Joint Warfighting Center, and the Air Land Sea Application (ALSA) Center to apply test results, lessons learned, and recommendations to Joint and multi-Service publications. The JTF will also recommend modifications to appropriate sections of the Universal Joint Task List, which currently contains no operational or tactical UAV tasks for TSO.
- *Analytical Database.* The JTF will generate a database supporting the analysis of proposed JTTP for TSO at the Joint Task Force and Component levels. The database and analysis products will be available for use in developing new UAV operational concepts, new JTTP, and new definitions of UAV system operational requirements for Service and Joint acquisition programs.
- *Training Recommendations*. Developing and evaluating JTTP for UAVs in TSO may reveal shortfalls in current training procedures. The JTF will work with the appropriate agencies and commands to identify potential changes to UAV training curricula.
- *Other Products.* Other tangible products will include briefings to flag officers, test reports, technical papers, web sites, a newsletter, brochures, and information booths at operational test-related conferences and symposia.

JOINT UNMANNED AERIAL VEHICLE IN TIME-SENSITIVE OPERATIONS

JOINT TEST AND EVALUATION

PROGRAM TEST PLAN

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1.0 INTRODUCTION

This chapter introduces the PTP for the JUAV JT&E. This PTP provides the following information:

- Details of the test concept and test architecture
- Delineated data management and analysis processes
- Summarized test management, resources, products, and requirements

1.1 BACKGROUND

1.1.1 JT&E Program Overview

The OSD JT&E Program, a current and long-standing Department of Defense (DoD) program, was created with the aim of improving Joint operations. OSD sponsors the JT&E Program to conduct tests and evaluations and provide information required by Congress, OSD, the Unified Commands, the Services, and the DoD components relative to Joint operations. The Director, Strategic and Tactical Systems (D, S&TS), under the aegis of the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD for AT&L), is responsible for the JT&E Program. The Deputy Director, Developmental Test and Evaluation (DD, DT&E), directs the program and is assisted by the JT&E Program Manager.

The JT&E Program provides an avenue to rigorously evaluate multi-Service systems in a realistic Joint test environment to identify Joint operational problems and determine potential solutions. It is a prime vehicle for integrating multi-Service and Joint warfighting systems to leverage their combined capabilities and meet the changing demands of Joint operations. The JT&E Program brings currently fielded resources from two or more Services together to test and evaluate multi-Service and Joint operational issues and provide recommendations for improvement.

The JT&E Program is designed to accommodate projects in one or more of the following categories:

- Assess Service system interoperability
- Evaluate Joint technical and operational concepts and recommended improvements
- Validate testing methodologies that have multi-Service applications
- Increase Joint mission capability using quantitative data for analysis
- Provide feedback to the acquisition and Joint operations communities

1.1.2 Joint Test Charter

UAVs have been in use by the individual Services for decades, primarily in Intelligence, Surveillance, and Reconnaissance (ISR). TTP for UAVs were developed as platform-dependent and Service-centric. More recently, in Joint warfare situations, the tactical emphasis has shifted to Joint employment of UAVs. The lack of JTTP impedes the tactical use of UAVs and limits their effectiveness. This is particularly evident in time-sensitive operations, where immediate response is required due to a clear and present danger to friendly forces, the value of the forces involved, or the fleeting nature of the situation. Recent experience during Desert Storm and in the Balkans clearly demonstrated the need for integrated JTTP in the tactical employment of UAVs.

In July 2000, the OSD initiated a one-year JFS to determine the necessity and feasibility of a JT&E to improve UAV integration into time-sensitive Joint operations. The JFS team conducted extensive research of relevant Joint and multi-Service publications:

- TTP
- Combatant Commander Integrated Priority Lists
- Mission Needs Statements
- Operational Requirements Documents (ORDs) and Capstone Requirements Documents (CRDs)
- After action reports
- Lessons learned from recent operations (e.g., Desert Storm, Desert Fox, Allied Force, and Enduring Freedom)

Additionally, briefings and interviews were conducted with Flag Officers, UAV operational SMEs, senior members of Unified Commands, and Joint Staff (JS) officers. The lessons define a requirement for quick reactionary capability, yet the needed JTTP are not in place.

In addition, the JFS Director established a JWAG consisting of representatives and SMEs from the Services and the Joint Forces Command (JFCOM). From the research and discussions with the JWAG, the JFS team concluded that a JT&E was both necessary and feasible. The JFS Director submitted the JFS Report (JFSR) in September 2001. Based on the JFSR, the OSD chartered the JUAV-TSO JT&E on 2 October 2001.

In the JUAV Charter, the Navy was designated as the lead Service, and the JT&E duration was established as four years. The JUAV Joint Test Force (JTF) was directed to employ multi-Service and other DoD agency support, personnel, and equipment to investigate, evaluate, and make recommendations to improve the operational effectiveness of UAVs. Specifically, the JTF will test and evaluate the Services' ability to integrate UAVs into time-sensitive, Joint tactical operations. Assuming today's UAV TTP can be described as platform-dependent and Service-centric, the JUAV JT&E will measure and compare today's TTP against a set of alternative TTP that are platform-independent and Joint. The alternative TTP will be developed under the guidance of a GOSC with appropriate membership from the JS, the Unified Commands, and the Services.

1.2 JOINT TEST PURPOSE

The JUAV JT&E's purpose is to improve integration and enhance coordination of UAVs for Joint operations. Accordingly, the JTF will use currently fielded resources to test and evaluate JTTP and UAV C2 architectures and recommend improvements. By examining existing TTP, the JTF will redirect the development of UAV TTP away from the current tendency for specific UAV platforms to reflect only the tactical requirements of a particular Service. The JUAV JT&E will develop JTTP for integrating UAVs into Joint operations irrespective of the specific UAV platform and provide for consistent coordination across all Services and in diverse mission areas. The goal of the JUAV JT&E is to improve effective tactical utilization and integration of UAVs in multiple mission areas.

The JFSR proposed three basic C2 architectures for consideration in the JTTP. These architectures address nuances resulting from mission needs, specific UAV payloads, and performance characteristics. The JUAV JT&E test methodology will test and evaluate the effectiveness of the three architectures. The JTF has developed a three-phase test program to develop, refine, evaluate, and validate weapon systems, weapon-delivery methods, communications systems, control relationships, and command structures. The following are the three phases of the test program:

- Phase 1: Conduct Virtual Rehearsals (VRs) to rehearse test methods and practice data collection methods and tools
- Phase 2: Conduct field tests to evaluate the architectures
- Phase 3: Participate in a JVTE to demonstrate the effectiveness of the architectures

The JUAV JT&E will address the following:

- Evaluate and recommend improvements to Joint technical and operational concepts
- Assess mission performance under realistic, Joint operational conditions
- Provide standardized TTP across all Services

The JTF will develop, document, and disseminate findings, conclusions, and recommendations regarding UAV JTTP and alternative C2 architectures following each test activity. This immediate feedback from the JUAV JT&E will enable new and proven JTTP to be rapidly disseminated to the Joint warfighter and Services. In addition, legacy products in the form of tactical procedures, simulation architectures and procedures, and any operational constraints or limitations discovered during the JT&E will serve as the foundation for a continued expansion of the UAV's role in modern warfighting.

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2.0 JOINT TEST DESCRIPTION

This chapter provides an overview of the JUAV JT&E by delineating the JUAV Joint test problem, objectives, and project issues. The chapter continues with a brief explanation of the issues and sub-issues and the test approach and methodology used to answer the JUAV JT&E issues that resolve the Joint UAV problem and closes with a detailed test planning overview.

2.1 JOINT TEST PROBLEM

The DoD has used UAVs to support combat operations dating back to the Vietnam conflict. Because of on-board sensor capabilities, UAV missions have generally focused on classic intelligence, surveillance, and reconnaissance. In more recent conflicts (e.g., Desert Storm in Southwest Asia, Operation Allied Force in the Balkans, and Operation Enduring Freedom in Afghanistan), emphasis has increased in the area of tactical employment to support dynamic TSO.

Today's UAV TTP can be characterized as platform-dependent and Service-centric. The JUAV JT&E proposes to develop JTTP for the integration of tactical UAVs into the Joint Force Commander's (JFC) campaign strategy to respond to requirements of TSO.

The JWAG developed the following problem statement during the JFS that preceded the chartering of the JUAV JT&E. It is documented in the JFSR and approved in the JUAV-TSO JT&E charter:

Existing tactics, techniques, and procedures do not adequately address Joint UAV employment in dynamic time-sensitive operations.

The statement is built on test results (ASCIET 1999), other JT&E projects, analyses, and real-world combat experience (Operation Allied Force and Operation Enduring Freedom), which support the premise that the lack of UAV procedures in existing mission-level JTTP limits the warfighter's ability to integrate UAVs into TSO. For JUAV JT&E purposes, TSO are defined as operations requiring immediate response because of a clear and present danger to friendly forces, the value of the resources involved, or the fleeting nature of the situation.

Why focus on UAV support to TSO? Recent operations in the Persian Gulf, Bosnia, Kosovo, and Afghanistan have demonstrated the need to integrate UAVs into TSO. However, these operations have also highlighted the lack of JTTP for TSO for integrating the UAV into tactical situations. The lessons learned from these operations call for quick reactionary capability, yet the needed guidance normally provided by JTTP is not in place. Often, tactical operations are carried out with ad hoc procedures, developed while those operations are in progress, and therefore, lack the necessary formal documentation and analysis to demonstrate their validity or utility. To achieve full-spectrum dominance over an adversary, the U.S. Military must integrate all of its resources to provide an effective response in TSO. Alternative processes and procedures must be optimized by mission area and must be mission-dependent but not platform-dependent.

2.2 JOINT TEST OBJECTIVES

The primary objectives of the JUAV JT&E are to evaluate alternative C2 architectures and to develop JTTP for using those architectures to more effectively integrate UAVs into Joint TSO. The JTF will use the three C2 architectures developed in the JFS as a basis for the evaluation. These C2 architectures were developed in coordination with the warfighters on the JWAG and will serve as the test

articles. There are no JTTP for incorporating UAVs into Joint Force operations; therefore, there are no baselines for the test. The architectures collectively will serve as a substitute for a baseline. Each will be considered equally and each will be tested to determine its utility and vulnerabilities. None will be considered *a priori* as an improvement over another. After each test, the architectures may be refined as JTTP are developed and refined. All three alternative C2 architectures contain four basic elements:

- A Central or Joint C2 node, such as a Joint Air Operations Center (JAOC)
- A forward Tactical C2 node, such as an E-2, an E-3, or a Forward Air Controller (FAC)
- A GCS for the UAV
- One or more Weapon Delivery Platforms (WDPs) or Rescue Platforms (RPs)

The major differences in the architectures are the location of decision making authority with respect to engagements on a tactical level. To simplify discussion of the architectures, the JTF has defined two terms:

- The Battle Watch Functions (BWF) are the functions associated with the decision making and target engagement authority. Among these functions are asset management, engagement prioritization, airspace management, target-area airspace integration, and engagement decisions. The C2 architectures to be evaluated place the functions of airspace integration and engagement decisions at three different locations within the alternative C2 architectures.
- The Battle Watch Officer (BWO) is the senior officer or commander on station who has the authority to engage a target and who performs the BWF. The BWO must have a highly developed set of skills, training, and experience, must understand the commander's intent and the Rules of Engagement (ROE), and must have situational awareness to include the Common Operating Picture (COP). The skills and training of each BWO will be identified to determine how they affect the performance and execution of the BWF. The BWO training is a Service responsibility that the JUAV JT&E will not address; however, the JTF will note any particular skills or training that may better prepare the BWO to perform the BWF.

Brief descriptions of the three alternative C2 architectures follow. Annex G contains a more complete discussion of the BWF, BWO, and architectures.

Alternative C2 Architecture A (Figure 2-1) is structured to place the BWF at the Joint C2 node. Video from the UAV is transmitted to that node where all processing and analysis occurs. Engagement decisions from the Joint C2 node are then sent to the Tactical C2 node, which controls the WDP.

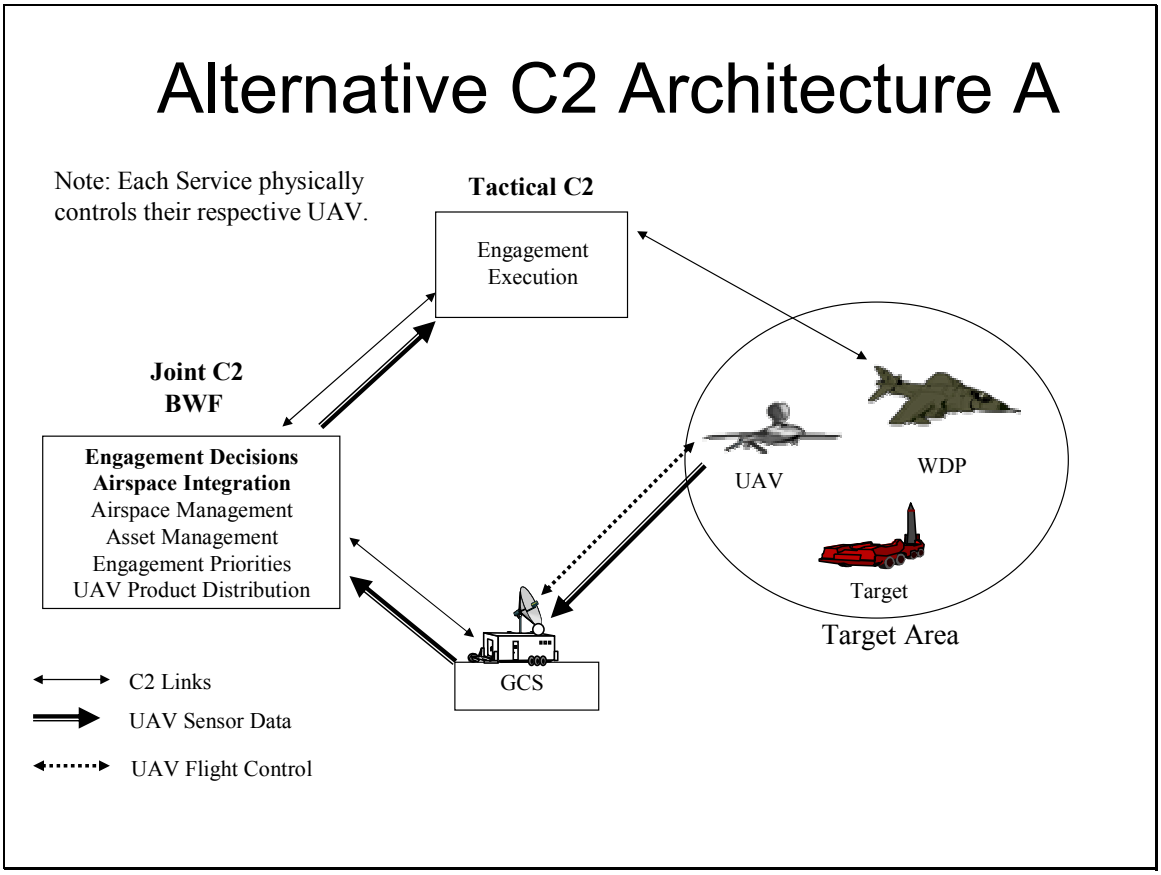

Figure 2-1 Alternative C2 Architecture A

Alternative C2 Architecture B (Figure 2-2) is structured with the BWF at the Tactical C2 node, which controls the WDP. The Tactical C2 node may receive intelligence and guidance from the Joint C2 node and will inform the Joint C2 node of BWO decisions. The BWO does not necessarily have engagement authority over the entire battlespace but is charged with engagement authority over a limited portion of that space.

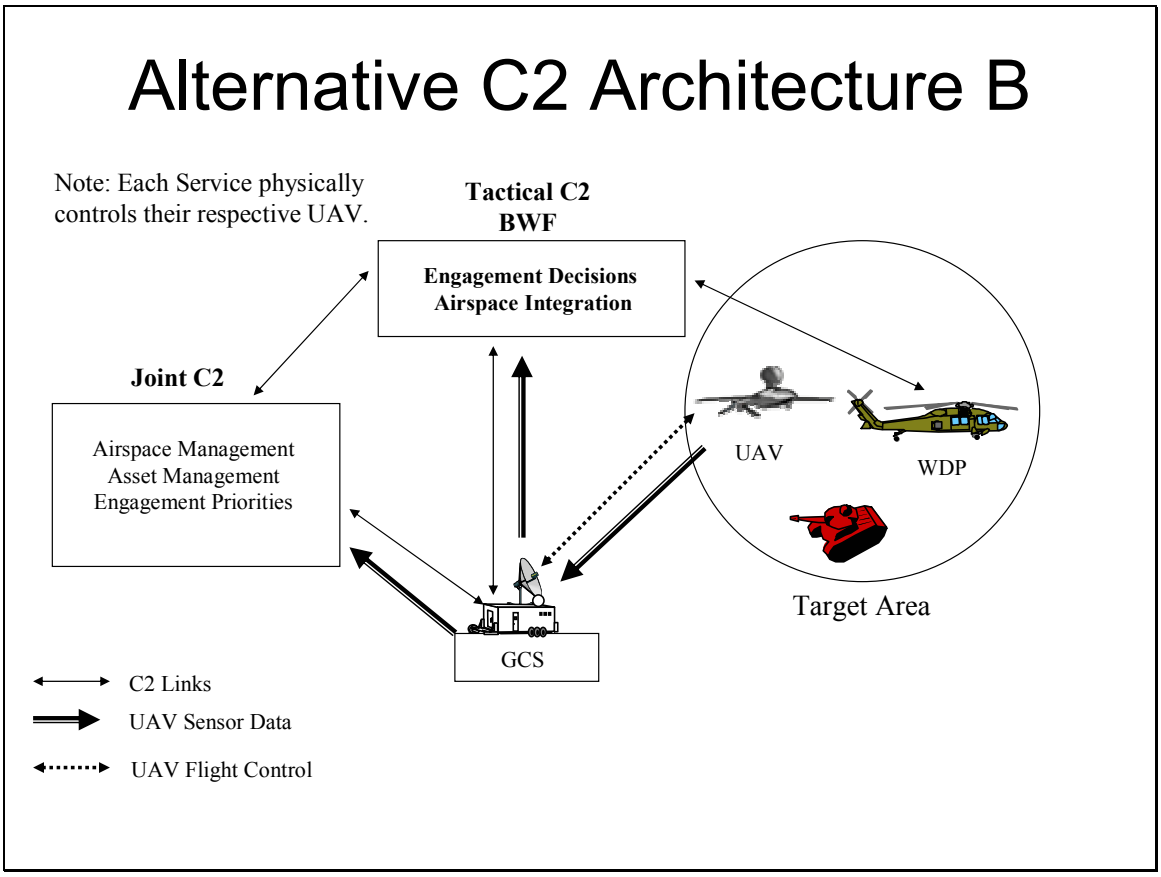

Figure 2-2 Alternative C2 Architecture B

Alternative C2 Architecture C (Figure 2-3) is structured with the UAV control and BWF co-located at the GCS. This configuration provides tightly coupled C2 of both the UAV and the WDP. The Joint C2 node is informed of BWO decisions and retains ultimate authority. As in Architecture B, the BWO does not necessarily have engagement authority over the entire battlespace.

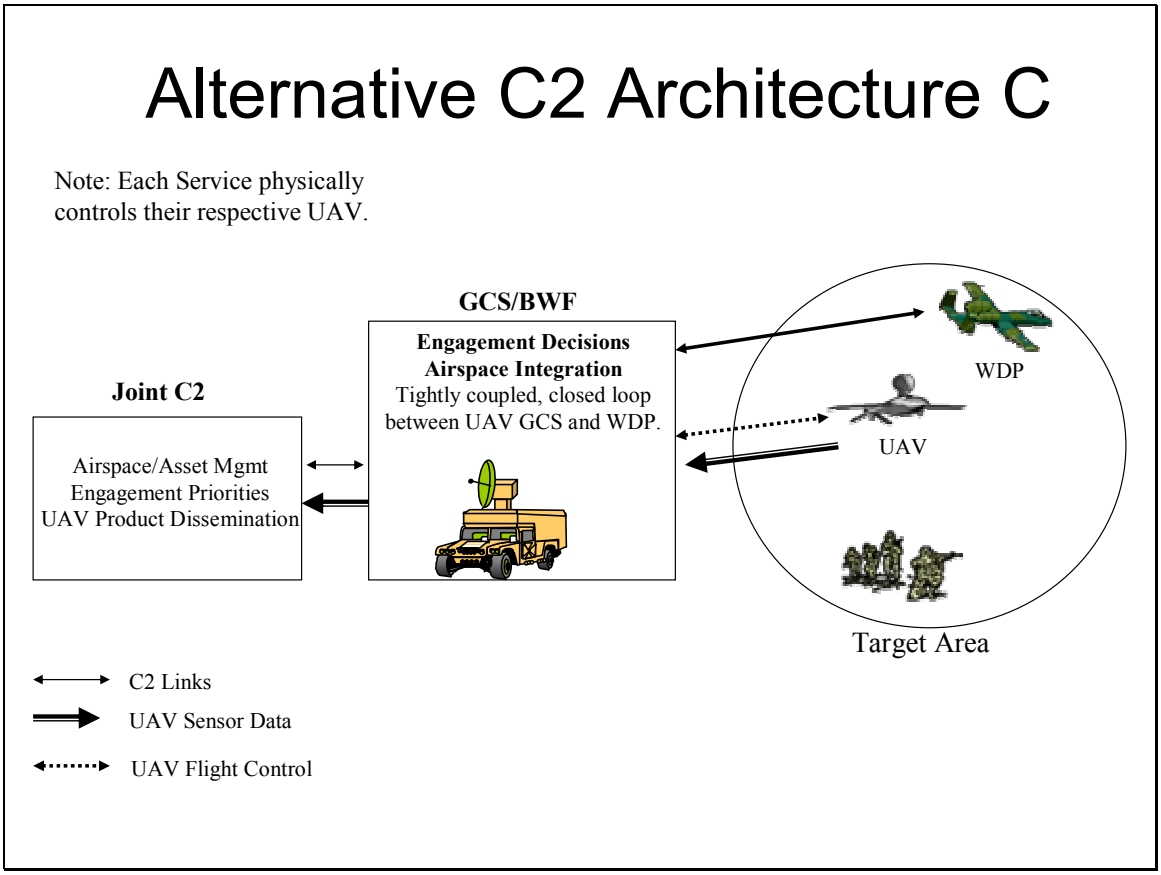

Figure 2-3 Alternative C2 Architecture C

The JTF will tailor and test the three alternative C2 architectures to address nuances that result from various mission needs, UAV payloads, weapon systems, weapon delivery methodologies, communications systems and platforms, control relationships, and command structures. The field tests will exercise the architectures under realistic operational conditions and will generate data needed to develop JTTP revisions. The tests will be conducted in a DoD-approved scenario and with Defense Intelligence Agency (DIA)-approved threat data, options for various levels of Blue Forces (BLUFOR) response, DoD-approved ROE, and objectives for both BLUFOR and threat forces.

2.3 ISSUES AND SUB-ISSUES

The JFS identified three issues to be answered by the JUAV JT&E. These three issues were decomposed into sub-issues, supporting Mission-Level Measures (MLM), Measures of Effectiveness (MOE), Measures of Performance (MOP), and data elements. This section provides an overview of the issues and sub-issues. The complete dendrite, including the measures and data elements, is presented in the Data Management and Analysis Plan (DMAP) in Annex F.

Table 2-1 lists the issues and sub-issues for the JUAV JT&E. The structure of these issues and sub-issues parallels the three mission phases that the JFS and JTF teams used to model a "typical" TSO mission:

- Targeting Phase: A target is located with sufficient accuracy for engagement to be considered, or a phase in which ingress routes and the landing zone are sanitized in the Personnel Recovery operations.
- Decision Phase: The controlling authority decides to allocate and commit forces to engage the target or rescue personnel.
- Engagement Phase: The actual employment of weapons or the actual rescue of personnel occurs.

Table 2-1 JUAV JT&E Issues and Sub-Issues

Issue	Sub-Issue	Description
1		To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?
	1.1	What is the effect of the alternative C2 architectures on sensor employment procedures?
	1.2	What is the effect of the alternative C2 architectures on target identification procedures?
	1.3	What is the effect of the alternative C2 architectures on providing target locations?
2		To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?
	2.1	What is the effect of the alternative C2 architectures on information flow in decision-making?
	2.2	What is the effect of the alternative C2 architectures on the ability to make key engagement decisions?
3		To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?
	3.1	What is the effect of the alternative C2 architectures on executing dynamic airspace integration procedures?
	3.2	What is the effect of the alternative C2 architectures on ability to laser designate?

Issue 1: To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?

This issue reflects questions regarding how quickly and how accurately the targeting phase can be completed using each of the architectures. The most important elements of targeting procedures in this phase are target acquisition, target identification, and target location determination.

Sub-Issue 1.1: What is the effect of the alternative C2 architecture on sensor employment procedures?

Sub-Issue 1.1 addresses how the UAV's sensors are employed in each architecture and how differences in sensor employment influence the time required to detect and recognize targets. Targets will be of such a type as not to test sensor capabilities or the ability of the sensor operator to find concealed targets.

Sub-Issue 1.2: What is the effect of the alternative C2 architectures on target identification procedures?

In Architecture A, the BWO will have the benefit of an imagery analyst co-located at the Joint C2 node. This may not be the case in Architectures B and C. Consequently, both the time needed to identify targets and the effectiveness of the identification may vary among the architectures.

Sub-Issue 1.3: What is the effect of the alternative C2 architectures on providing target locations?

The location of a target can be provided to a weapon system in a number of ways. The JTF anticipates several methods may be used in the test missions:

- Coordinates read directly from the UAV video display
- Coordinates determined independently by an imagery analyst
- Laser designation
- Verbal talk-on or adjust fire

Matters of interest related to Sub-Issue 1.3 include which method or methods dominate within a given architecture, how quickly the location is provided, and how accurate are the location coordinates.

Issue 2: To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?

Decision-making is the primary function of the C2 process. Issue 2 addresses the timeliness and effectiveness of decision-making in each of the alternative architectures. Of the three issues, Issue 2 is expected to reveal the most dramatic and operationally important differences among the architectures.

Sub-Issue 2.1: What is the effect of the alternative C2 architectures on information flow in decision-making?

Information flow is one of the most important differences in the alternative C2 architectures. A primary rationale for Architecture C is that removing two nodes from the C2 structure should speed up the flow of information and consequently reduce overall mission time. An associated risk is that short-circuiting the process may eliminate the flow of some essential information entirely. Analysis of the timing and quality of information flow in each architecture will be one of the most important components of this JT&E.

Sub-Issue 2.2: What is the effect of the alternative C2 architectures on the ability to make key engagement decisions?

The skill level and experience of the BWO, as well as the resources available to support the BWF, will vary depending on whether the BWF are carried out in the Joint C2 node (Architecture A), the Tactical C2 node (Architecture B), or the GCS (Architecture C). That variation may be reflected in the ability of the BWO to make correct and timely decisions regarding target engagement. The JTF will measure the time necessary for the BWO to accomplish the tasks required to complete the decision process and engage the target. The resolution of Sub-Issue 2.2 will include qualitative and quantitative measures of personal performance as it relates to task completion rate. The tasks will be evaluated for complexity, time-sensitive nature, and volume of tasks required for mission completion. A questionnaire will be developed to document the experience and skills of the BWO participating in the JT&E test events.

Issue 3: To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?

Issue 3 addresses the typically small and transitory airspace near the target during the engagement phase. This airspace normally will contain only the UAVs, any airborne weapons platforms participating in the engagement, and any weapons that have been released (Figure 2-4). In this context, "airspace integration" means the activities necessary to ensure that multiple aircraft and weapons operate safely and effectively in this airspace to accomplish a common mission. Other aspects of controlling the airspace (e.g., keeping other aircraft from entering it) are part of airspace management on a larger scale and will not be addressed in this JT&E.

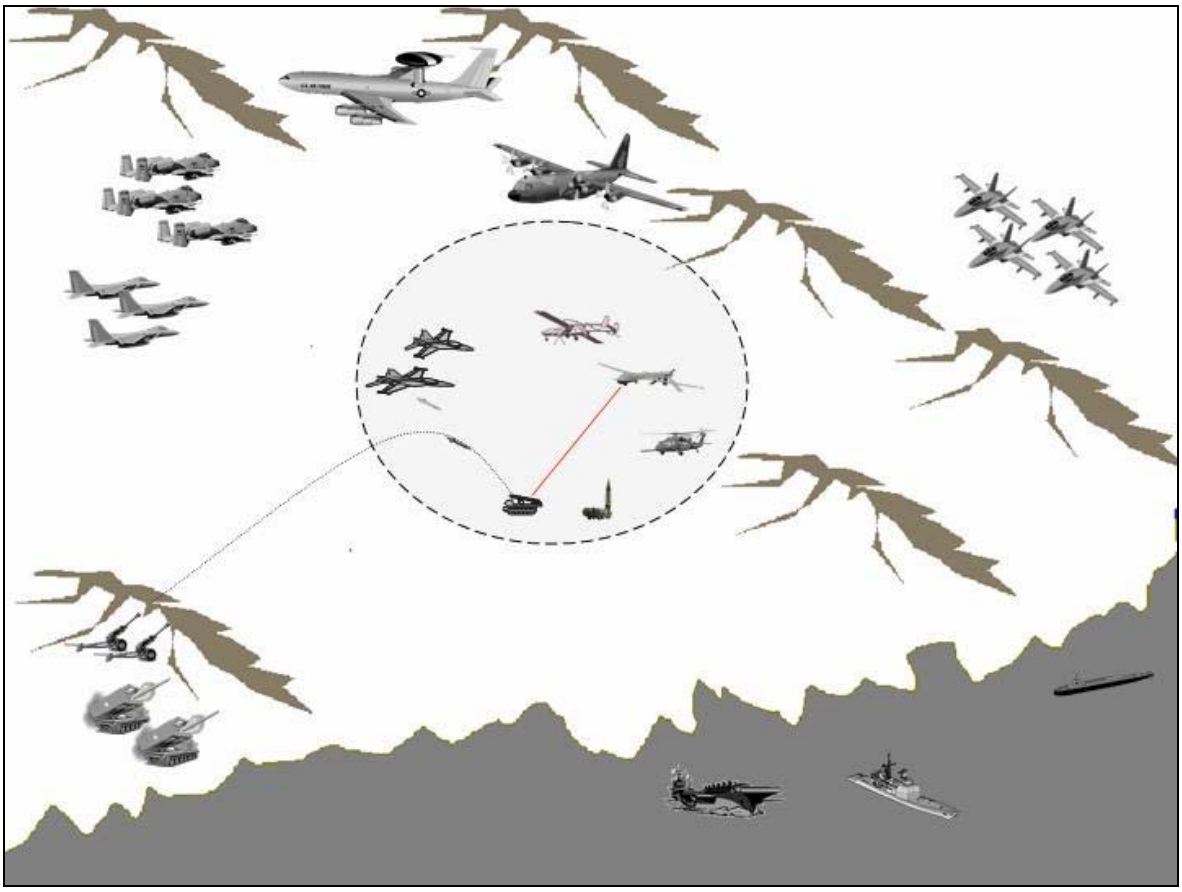

Figure 2-4 Target-area Airspace─Addressed in Issue 3

Sub-Issue 3.1: What is the effect of the alternative C2 architectures on executing dynamic airspace integration procedures?

Airspace integration addresses the procedures used for integration and separation (deconfliction) of multiple airspace users in close proximity. For JUAV JT&E purposes, airspace integration means ensuring that the UAV is adequately separated from engaging aircraft and weapons. Although procedures to ensure separation may be established before a mission, dynamic integration will normally take place during the mission to ensure that deviations from the mission plan do not cause a conflict. The ability of the BWO to maintain enough situational awareness to effectively manage the airspace is likely to differ in the alternative architectures.

Sub-Issue 3.2: What is the effect of the alternative C2 architectures on ability to laser designate?

Sub-issue 3.2 is similar to Sub-Issue 3.1: Laser designation requires careful coordination of the relative positions, headings, and speeds of the UAV and the attack aircraft. The location of the BWO will influence the BWO's ability to participate effectively in the process.

2.4 TEST SCOPE

A challenge for the JTF is to take an expansive problem and scope it to a size that is both executable and affordable without losing relevance to a DoD community that is becoming more reliant on UAVs every day. The JUAV JT&E will be conducted in operationally realistic environments during Joint and Service exercises and other training venues to assess the effectiveness and efficiency of UAV TTP in a Joint training and testing environment. The JTF will not evaluate hardware or systems but will focus specifically on the procedures used during Joint UAV operations within the confines of the three alternative C2 architectures.

The JUAV JT&E will evaluate the three alternative C2 architectures in the context of three mission areas. The mission areas were developed during the JUAV JFS and reflect the most likely mission areas where UAVs would provide support for TSO.

The following are the three mission areas:

- Air Interdiction: Armed Reconnaissance
- Fire Support
- Personnel Recovery

For JUAV JT&E purposes, Armed Reconnaissance is UAV targeting support for fixed-wing and rotary-wing ground attack aircraft while finding targets of opportunity. This mission is also known as Air Interdiction. Fire support is air, artillery, and naval gunfire support for friendly forces on the ground in close proximity of enemy forces being targeted. Fire Support from air platforms is known as Close Air Support (CAS). For JUAV JT&E purposes, CAS also includes organic air-ground combined operations in the Army and Marine Corps. Personnel recovery includes UAV support for CSAR and NEO. In these scenarios, the UAV detects and tracks the target whether it is an enemy platform or friendly personnel for evacuation. The BWO will directly inject intelligence and decisions that affect the success of the personnel recovery operations whether it is the successful avoidance of opposition forces or the destruction of hostile forces.

2.5 TEST CONCEPT

To address the problem statement and answer the issues, the JTF has developed a test concept consisting of a three-phase test approach. The three phases are VRs, field tests (including the Risk Reduction Mini-Test), and the JVTE (Figure 2-5).

The three alternative C2 architectures were developed during the JFS. Each alternative will be evaluated during rehearsal events using M&S provided by the Integrated Battlespace Arena (IBAR) facility and Multiple Unified Simulation Environment (MUSE) capabilities. The rehearsal phase will assist in validating and refining data collection procedures and test resources estimates. Analysis of the rehearsal events will facilitate the refinement of all aspects of the alternatives primarily through comments from the participating warfighters. The analysis may also provide indicators as to differences between the C2 alternatives that the JTF will collect data on in the field tests and may indicate the direction that recommendations for inclusion in JTTP could take.

The analysis of the Phase 2 field test data will be the basis of recommendations as to the use of UAVs in TSO. Finally, the analysis findings and results of the field test activities will be used to select the appropriate JTTP and C2 architecture that will be used in the Joint Combat Identification Evaluation Team (JCIET) 2004/Joint Task Force Exercise (JTFEX) JVTE. The JTF intends on producing interim legacy products after the Phase 2 field tests which will be refined after the JVTE. The three-phase approach allows tests of successively refined JUAV JTTP in increasingly complex venues.

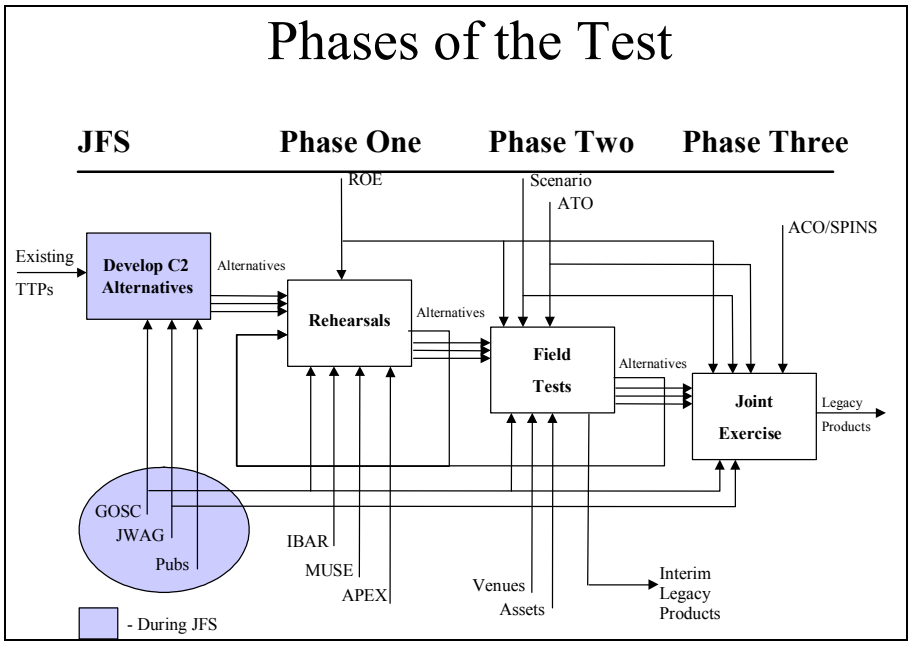

Figure 2-5 Three Phases of the Test

2.5.1 Planned Test Events

The JUAV JT&E will use four rehearsal events. The JT&E will also be conducted in an operationally realistic environment by using a risk reduction mini-test, two field tests, and a JVTE.

2.5.1.1 Rehearsal

The JTF will exercise the three alternative architectures and JTTP for initial investigation in a virtual simulation-based environment. The VR events will offer the JTF several opportunities to investigate differences in the alternative C2 architectures and to determine the key C2 nodes for data collection, the data to be collected at each C2 node, and data collection, data management, and data analysis requirements. This information will be useful in planning the live tests.

2.5.1.2 Risk Reduction Mini-Test

The JTF will take advantage of training exercises at the National Training Center (NTC) at Ft. Irwin, CA, to conduct the Risk Reduction Mini-Test. The mini-test will assist in transitioning the data-collection and management procedures, reviewed and rehearsed in the simulation-based environment, into the real-world procedures. Data collected at the mini-test will only be used to refine data analysis procedures and will not be integrated with data from field tests. The JTF will integrate the mini-test into the training exercises, which are based on a large-scale military exercise conducted by an Army brigade. This mini-test will also allow the JTF to identify any safety issues that may need mitigation and to identify risks that did not surface during the rehearsals. The JTF will integrate its operating procedures into the NTC training events on a non-interference basis. At Ft. Irwin, the mini-test exercises will be integrated into existing NTC force-on-force scenarios.

2.5.1.3 Field Tests

The field tests and the JVTE will employ UAVs and C2 support systems operated by current combat forces in realistic, Joint environments against realistic targets. Moreover, the warfighter participants will employ their C2 support systems according to pre-mission operations orders using the alternative C2 architectures as defined by the Test Cell Matrix. The test participants will make real-time mission execution decisions based on the tactical information available to them through their sensors and systems (real-time player actions and decisions will not be scripted). The JTF will use scripting with real-time adjustments to ensure the targets provide ample but realistic "presentations" to the UAVs during data-collection windows.

The field testing will focus on scenarios developed for the alternative C2 architectures. The JTF will use instrumentation to collect data that measure ground truth and real-time UAV processes that support TSO. Post-test activity analysis will establish performance parameters for JTTP refinement. Post-mission debriefings will use truth data to support the analysis and evaluation process.

- Planned Field Tests:
  - Field Test 1 (FT-1): Desert Rescue (DR) XI is an annual field training exercise conducted at the Naval Strike and Air Warfare Center (NSAWC) on Naval Air Station Fallon (NASF). The exercise incorporates numerous military units into a variety of scenarios centered on CSAR operations. The JTF plans to integrate UAV operational scenarios into the pre-planned exercises in addition to exercises designed by the JTF.
  - Field Test 2 (FT-2): Conducted at Ft. Hood, TX in FY04. The JTF is planning a field test that will include all mission areas with the alternative C2 architectures during day and night operations. The JTF has submitted Operational Test Plans (OTPs) to the Army Test and Evaluation Command (ATEC) which are entered into the ATEC Decision Support System (ADSS). The OTPs are used by the Army to identify and resource test and evaluation support requirments. Currently, the OTPs are under review, and the JTF has been working with III Corps to refine and resource the FT-2 requirements. The current high-level mission scenarios include a NEO, CAS using rotary-wing assets, rotary-wing

and fixed-wing Air Interdiction, and artillery support to block Opposing Force (OPFOR) reinforcements from attempting fire on the pick up and egress route.

2.5.1.4 Joint Validation Test Event

UAV JTTP and the alternative C2 architectures will be validated in a live JVTE in 2004. Current plans are to use the JCIET04/JTFEX for this purpose. The JVTE will provide test participants with UAV JTTP evolved and refined from FT-1 and FT-2 test events. The JVTE participants will vigorously exercise the JTTP in a complex, Joint operational environment. The location and date for JCIET04/JTFEX will be determined in 2003, and the JTF is planning around the current information available (spring-summer 2004 and in either the Georgia or North Carolina area).

2.5.2 Project Schedule

Figure 2-6 shows the JUAV JT&E project schedule. The JUAV JT&E will conclude 120 days after the final report is signed in January 2005.

2.5.3 Test Scenarios and Architectures

The JUAV JT&E project scenario concentrates on the pre-hostilities to initial hostilities phases of conflict (Figure 2-7). The JTF is working in conjunction with DIA and has an open dialog with analysts assigned to operations involving UAVs. The scenario is based on a third world country in Africa. This country has a consistent set of problems, including corrupt government officials, poverty, and a willingness to engage in hostilities in the region. In addition, its military possesses moderately sophisticated weaponry and operational capabilities. The scenario includes significant combat operations in built-up or urban areas. The JUAV will test with aircraft, personnel, and equipment representing the U.S. Army, Navy, Air Force, and Marine Corps. Furthermore, data will be collected under operationally realistic test conditions, and the test will be conducted using the three alternative C2 architectures.

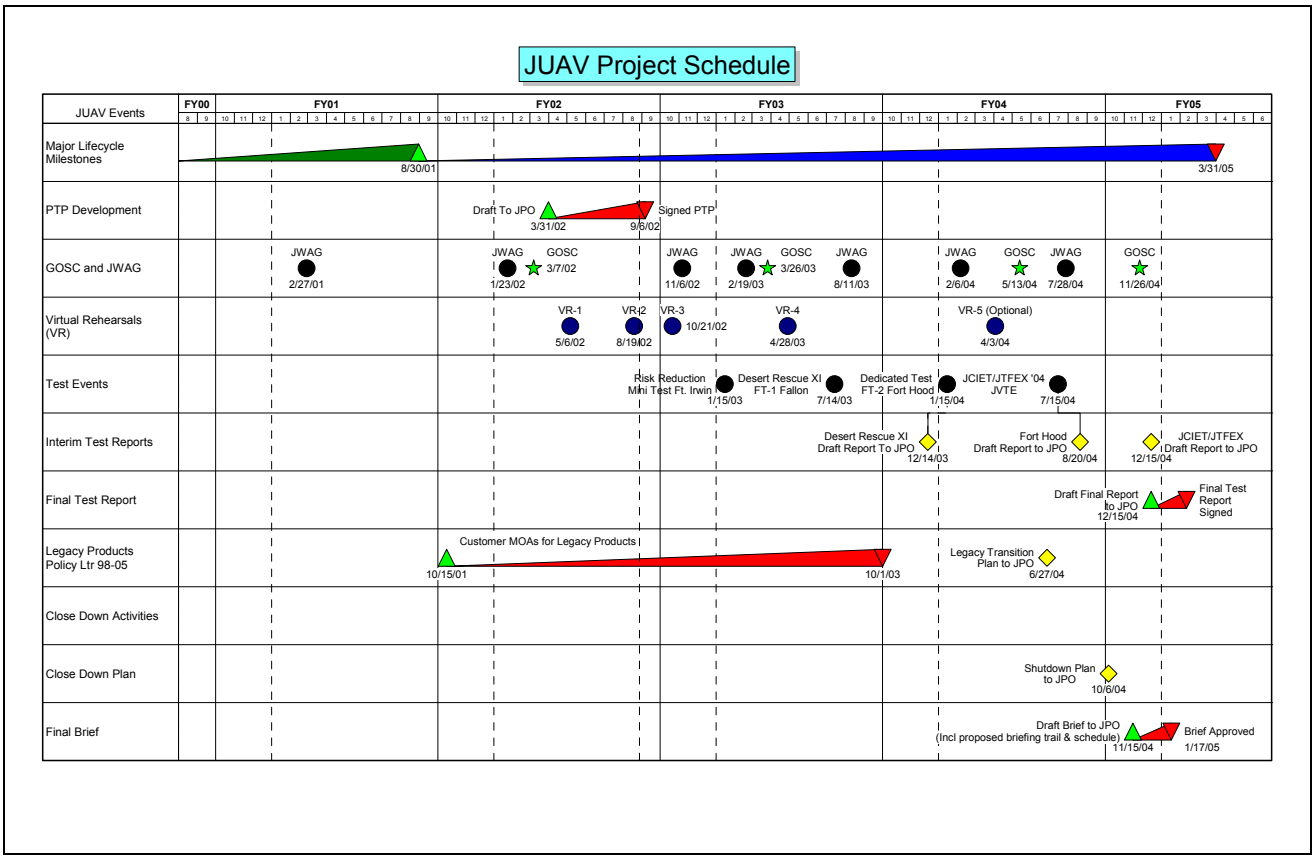

Figure 2-6 JUAV Project Schedule

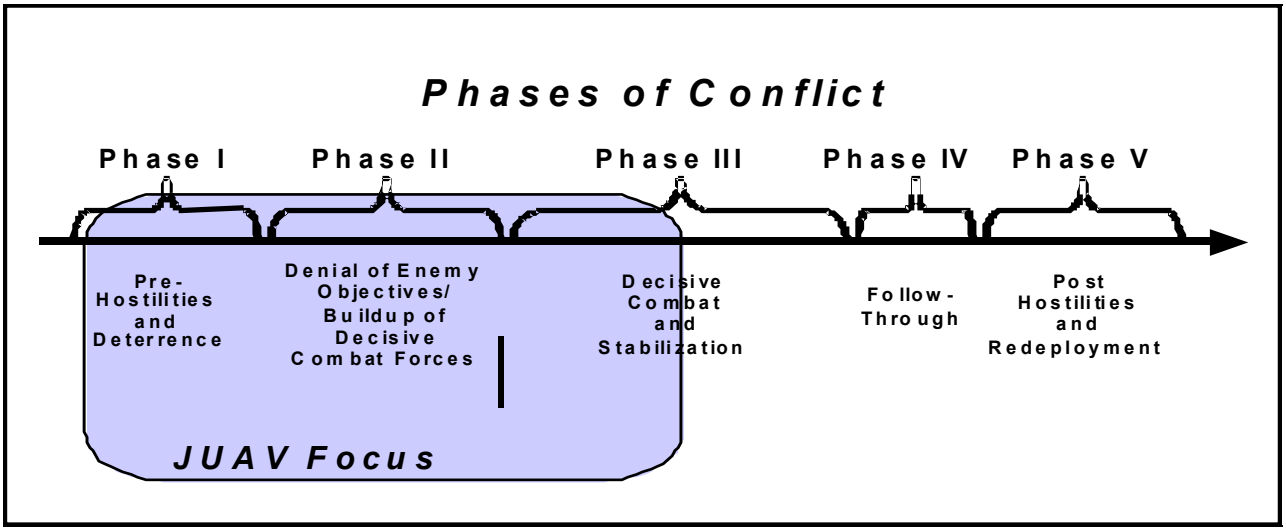

Figure 2-7 Phases of Conflict

2.5.4 Test Venues

Test venues for the JT&E were designed to address Air Interdiction: Armed Reconnaissance, Fire Support, and Personnel Recovery mission areas to test and evaluate three alternative C2 architectures. Table 2-2 is a summary of the number of test iterations planned for each mission area during the live test events. The planned test scenarios are provided in detail in Annex D.

Table 2-2 Test Venues and Mission Area Events

Test Venues	Mission Area Events				
	Air Interdiction	Fire Support		Personnel Recovery	
		Artillery	CAS	CSAR	NEO
Risk Reduction Mini-Test	36	30	26		
FT-1 (DR XI)	108		54	54	3
FT-2 (Ft. Hood)	108	54	54		6
JVTE	36	12	18	9	

2.6 TEST METHODOLOGY

The JTF will apply rigorous Joint test methodology to assess the effectiveness of the JTTP within conditions associated with the alternative C2 architectures. Moreover, the JTF will leverage existing, operationally realistic exercises to test UAV tactical airspace integration into Joint operations and to refine recommended JTTP as needed based on test data. In order to answer the JUAV issues described earlier, the JTF will conduct field tests and integrate testing into a JVTE to evaluate alternative C2 architectures in support of UAV integration into Joint tactical operations. Much of the data will be collected on a non-interference basis. The test methodology will evaluate data from dedicated field test activities and Joint test exercises using scenarios developed by the JTF to create consistent data elements. Non-JUAV (e.g., event participant) scenarios will be considered for use as long as they are consistent with JUAV requirements.

The JUAV JT&E high-level test objectives are tailored specifically to the evaluation of the three alternative C2 architectures as they are implemented during the conduct of mission scenarios in order to develop appropriate JTTP and UAV implementation guidance. The effects of the architectures on mission areas (Air Interdiction, Fire Support, and Personnel Recovery) will be evaluated through the test scenarios described in paragraph 2.5.3.

The test methodology steps that will be implemented are listed below:

(1) Detail specific test objectives for each specific test event.

(2) Determine whether test objectives were met during test execution.

(3) Perform a quick-look analysis on-site or as soon as possible after a test event to ensure test objectives are met.

(4) Interpret data relative to test objectives and ensure results make sense from the standpoint of a military mission commander.

(5) Calculate the MLM, MOE, and MOP using the collected test data.

(6) Answer the issues by determining which of the three alternative C2 architectures achieved the highest percentage of mission success based on the stated mission objectives.

(7) Perform detailed data analysis and evaluation of the analysis results.

(8) Extract data from other databases that are expected to feature automated data-collection systems that can track the activities of a large number of processes and targets, only some of which will relate to JUAV JT&E test objectives.

The JTF will calculate test measures with data collected from field and multi-Service Joint exercises. The JTF will collect data during day and night events. The test data will be analyzed for issue resolution and to support future recommendations. Central to the JT&E is the test dendritic structure, which is addressed in greater detail in Chapter 3 and Annex F.

2.6.1 Test Cell Matrix

The alternative C2 architectures and planned mission areas are organized into a Test Cell Matrix presented in Table 2-3 and based on the test design matrix in Table D-1 in Annex D. The Test Cell Matrix illustrates the number of live test iterations planned for each alternative C2 architecture and mission area combination. Mission areas for the alternative C2 architectures will be handled separately unless analysis shows there is no statistical difference between the sample populations. Further refinement of this and other matrices will be completed in a Detailed Test Plan (DTP) for each field test and the JVTE.

Table 2-3 Test Cell Matrix

Planned Number of Test Event Iterations[1]								
Alternative C2 Architecture	**Air Interdiction**				**Fire Support**			**Personnel Recovery**
	Fixed-Wing		**Rotary-Wing**					
	Non-Laser	Laser	Non-Laser	Laser	CAS[2]		Artillery	CSAR and NEO
					F/W	R/W		
A	20	22	20	22	21	21	22	24
B	20	22	20	22	21	21	22	24
C	20	22	20	22	21	21	22	24
Total	60	66	60	66	63	63	66	72

(1) The Risk Reduction Mini-Test is not part of the totals. The totals include FT-1, FT-2, and the JVTE.

(2) For JUAV JT&E purposes, CAS also includes organic air-ground combined arms operations in the Army and Marine Corps.

The Test Cell Matrix contains two critical variables: the three C2 architectures described in Annex G and the mission areas outlined in Section 2.4.

2.6.2 Sample-Size Considerations

The number of trials in each cell of the Test Cell Matrix is a tradeoff. Conducting more trials generally produces higher confidence in the results (less statistical error) but also increases cost. On the other hand, there is a limit to how many trials can be conducted in a two-week exercise period. Therefore, the JTF will collect enough samples to achieve adequate confidence in the result.

The primary objective of the JT&E is to compare the relative improvements in TSO capability attributed to the three alternative C2 architectures. A baseline Joint capability does not exist. Alternative A was designed after real-world experience and keeps engagement authority at the JAOC. Alternatives B and C push engagement authority forward to the Tactical C2 node or the GCS, respectively.

A rough idea of the number of trials needed for each cell in the matrix was computed based on the analysis of success rates in a 2x2 contingency table. If the observed success rate for Architecture A (for example) differs from the observed rate for Architecture B by 20%, that difference will always be declared statistically significant at the 75% level if the number of trials for each architecture is 17 or more. (See Annex F for details of the computations.) Based on this computation, and allowing for the loss of some trials due to weather, equipment failure, or other causes, the JTF has planned for at least 20 trials of each alternative C2 architecture in each mission area.

2.7 TEST ASSUMPTIONS AND LIMITATIONS

2.7.1 Test Assumptions

The JTF has made several assumptions that allow execution and analysis to support the program test concept for issue resolution. These assumptions are listed below:

(1) For every mission area and alternative C2 architecture, the UAV and GCS are considered to be normalized: the UAV is tasked to support TSO missions, the crews are qualified and current, and the GCS in use is compatible with the UAV. The JTF will collect demographic data for each UAV crewmember to validate qualifications.

(2) There will be a designated and defined target area.

(3) The GCS will be in direct and constant communication with the UAV (except for possible data link loss during execution and as part of the test).

(4) The Joint C2 node will control airspace management, engagement priorities, asset management, and BWF, which may include airspace integration.

(5) Tactical C2 functions will control engagement and execution functions and may include the BWF (Architecture B).

(6) Safety considerations will override test requirements.

2.7.2 Test Limitations

The JUAV JT&E has a three-and-a-half-year charter with events planned in each year. The individual tests must be structured to support this PTP and remain within the budgetary allowances. Some of the general test limitations imposed by these time and budgetary constraints are listed in Table 2-4 below.

Table 2-4 Test Limitations

Limitation Categories	Conditions
Field training environment	Weather restrictions Precludes the consistent employment of scenarios Precludes the consistent application of the control processes
Force-on-force evaluations	Limit the number of battles with CAS and talk-on missions Introduce variance in the conduct of the OPFOR given no actual weapon delivery
Hardware & software	Inconsistent hardware and software performance may affect data consistency and analysis
Units and individual performance	Inconsistent comparison of unit or individual performance

The JUAV JT&E will use accepted Services test and evaluation methodologies, which will minimize the anticipated limitations. However, the realities of executing a JT&E in an operational environment dictate a variety of limitations for safety, cost, environmental, and security reasons. The JT&E methodologies and analytical approaches are discussed in Chapters 2 and 3 and in Annex F. The impacts of these limitations will be mitigated primarily by considering their effects during analysis. The following are the main JUAV JT&E limiting factors. These limitations will affect JT&E execution and analysis but will not significantly affect the ability of the JT&E to resolve issues.

(1) Cost, time constraints, and available test sites limit the number and duration of the Risk Reduction Mini-Test and the field tests.

(2) The JT&E will be limited by restrictions imposed by the host venues:

a. Environmental and safety issues.

b. Range and airspace restrictions. Airspace and platform orbits may be restricted for flight safety including civilian traffic and compliance with requirements negotiated with the FAA. Scenarios will be adjusted to accommodate range and airspace restrictions.

c. Not all weapon systems will be represented, but a cross section will be available to exercise the alternative C2 architecture processes and procedures.

d. Testing will not be conducted on a 24-hour basis but will include both day and night conditions. This will have no impact on data collection requirements.

(3) The JT&E will be limited to the climatic conditions existing at the JT&E test sites during testing; however, those conditions will be representative of environments that occur in many potential combat theaters.

(4) The JT&E will be limited to the terrain available at the JT&E test sites.

(5) The JT&E will be limited to the test participants provided to support the JT&E. It is expected that the test participants will be representative of those who will deploy and operate the UAV systems in theater.

(6) The JT&E will be limited to the target sets available during testing.

(7) The JT&E will be limited to the UAV sensor platforms available during testing. If a planned UAV is unavailable, a validated surrogate will be used.

(8) Sensor coverage will be limited by the JT&E test site locations and by real-world tasking. The available test sensor platforms will have a limited test area to perform time-sensitive missions.

2.8 MODELING AND SIMULATION OVERVIEW

2.8.1 Purpose

The JTF will conduct VRs using legacy M&S capabilities to facilitate test planning and to reduce risk prior to conducting tests during live exercises. For JTF purposes, legacy is defined as any M&S tool that was developed either in the past or for a different purpose. The specific M&S systems and facilities, described in further detail in Section 2.8.2 and Annex E, consist of established M&S tools that have previously demonstrated capabilities related to JUAV JT&E requirements. Project M&S objectives can be achieved without developing new models or simulations. A federation of simulation facilities, using the Defense Research and Engineering Network (DREN) and the SECRET DREN (SDREN), is planned for the later stages of VRs. The JTF will use legacy simulations to accomplish the following objectives:

- Rehearse and improve test procedures for later live testing
- Develop and rehearse data collection forms
- Practice using data collection tools such as handheld devices, including palmtop computers and recording equipment
- Develop UAV mission planning tools for live testing
- Refine tactical terminology and communication practices for live testing
- Provide familiarization with the geographic operational areas
- Allow for direct interaction with warfighters (The invitation to participate in simulation sessions will always be extended to the JWAG for the JUAV JT&E and to the operational communities. If real-world operational demands preclude warfighter participation, members of the JTF and the simulation facility's engineering staff will work through rehearsals.)

The use of M&S will allow the JTF to rehearse test procedures for both warfighter participants and the test team in order to optimize tests conducted in live field exercises.

2.8.1.1 Role of Modeling and Simulation in Issue Resolution

Issue resolution for the JUAV JT&E will be done using test data from field tests and the JVTE. The primary role of the M&S effort will be in test planning. The simulation phase focuses on improving test processes and methods. Consequently, data generated from simulation sessions will not be used to resolve test issues. M&S will help design, refine, and rehearse the plans and procedures used for the live tests. The use of M&S for VRs optimizes the live field tests and the JVTE by allowing the test team to rehearse procedures and to practice data collection.

2.8.1.2 Role of Modeling and Simulation in Test Planning

M&S will be used to exercise the test procedures after their initial development. M&S will support the elaboration and improvement of plans and procedures in the following areas:

- Develop and evaluate test procedures for live tests and exercises by establishing timelines and stimulating decision-making
- Exercise operator employment of UAV sensor payloads (The full realization of this capability depends in part on the availability of warfighter participation in the VRs.)
- Rehearse communications procedures for simulation participants and for test control related functions
- Rehearse the three alternative C2 architectures by simulating the nodes in the architectures, the communications paths, and interactions between the nodes
- Rehearse procedures for data collection and data management
- Determine what data collection requirements are unique to individual C2 nodes
- Determine if all data requirements are within the control and measurement capability defined for each test
- Review measures for potential complexities or refinements necessary before live tests

2.8.1.3 Role of Modeling and Simulation in Test Analysis

As discussed in paragraph 2.8.1.1, data from live tests will be used for resolving test issues and for test analysis. M&S will be not be used for test analysis. M&S will be used for test planning as discussed in Paragraph 2.8.1.2.

2.8.2 Modeling and Simulation Architecture

This section provides an overview of the legacy simulation facilities, systems, and federations that will be utilized to refine JTTP and rehearse test procedures. For detailed descriptions of IBAR and Advanced Prototyping Engineering and Experimentation (APEX), refer to Annex E, Section E.4, and Figure E-2.

2.8.2.1 Integrated Battlespace Arena

The IBAR, at the Naval Air Warfare Center Weapons Division (NAWCWD), China Lake, CA, is a high fidelity, human-and-hardware-in-the-loop M&S facility. IBAR was the subject of a proof-of-concept demonstration by members of the JFS team in April 2001. The purpose of the demonstration at IBAR was to assess the feasibility of using the simulation facilities to develop procedures and demonstrate the JUAV test concept. JUAV Air Interdiction events were executed in the facility over a two-day period. This effort was accomplished using UAV and attack aircraft SMEs including active-duty military personnel from the NSAWC, plus JTF test-design personnel and the IBAR technical support staff. The IBAR facility was assessed to be a useful tool for rehearsing test procedures, using test data collection equipment, and refining initial procedures for JUAV Air Interdiction. Although the facility currently is not capable of supporting all aspects of the proposed JUAV test concept, it proved to be of sufficient fidelity to support meaningful rehearsal of test procedures and practice data collection, and enhance the test team situational awareness for live tests. Refer to Annex E for detailed discussion of the IBAR configuration and specific M&S systems.

2.8.2.2 Advanced Prototyping Engineering and Experimentation Laboratory

The other legacy simulation facility used by the JUAV JT&E is the U.S. Army Aviation and Missile Command (AMCOM), Aviation and Missile Research Development and Engineering Center (AMRDEC) APEX Lab, Redstone Arsenal, AL. APEX is a research and development facility that provides a full-spectrum systems-engineering approach for evaluating emerging systems and concepts in

a virtual prototyping environment using advanced distributed simulation technologies. APEX supports the simulation of ground warfare with rotary-wing air platforms included. A more detailed discussion of the facility's capabilities and functions is provided in Annex E.

2.8.2.3 Legacy Networking and Federations

The JTF will make use of Distributed Interactive Simulation (DIS) over the DREN when federating IBAR and APEX. DREN is a DoD recognized research and engineering network. The DREN is a robust, high-speed network that provides connectivity among the High Performance Computing Modernization Programs (HPCMP) geographically dispersed user sites and shared resource centers. DREN is the official DoD long haul network for computational research and testing to support the DoD Science and Technology (S&T) and test and evaluation communities. IBAR and APEX have physical connectivity to DREN and have utilized the secret version, SDREN, in the past for data transactions with other geographic locations. The SDREN will be utilized when appropriate. Refer to Annex E, Section E.4 for more detailed discussion regarding connectivity between facilities.

2.8.3 Verification, Validation, and Accreditation

Verification, Validation, and Accreditation (VV&A) will not be conducted on M&S used by the JUAV JT&E. The use of M&S for risk reduction serves a useful but non-critical purpose for the JUAV JT&E. The JFS determined that there were sufficient field tests to gather data, and M&S would not be used for test data generation. Use of M&S is limited to legacy simulations for risk reduction prior to tests conducted in live exercises and live range tests. That use is consistent with the capabilities available from current M&S with some modification and supports the overall project schedule. The M&S being used are all existing legacy simulations ranging from a familiar "standard" DoD system such as MUSE to a research and development prototype such as the IBAR Virtual Prototype Facility (VPF) (none of which have any prior VV&A). As stated previously, M&S is not used in JUAV issue resolution, test data generation, or in JTTP recommended to the Services.

2.8.4 Virtual Rehearsal Schedule

The overall JUAV JT&E project schedule, including the VR events, is illustrated in Figure 2-6. A total of four VRs are scheduled to be conducted before live tests start in FY03:

- VR-1: May 2002, IBAR
- VR-2: August 2002, in conjunction with JCS-1, IBAR
- VR-3: October 2002, to prepare for the Risk Reduction Mini-Test, IBAR
- VR-4: Third quarter FY03, prior to FT-1, IBAR and APEX

A contingency fifth VR is tentatively planned for FY04, prior to the JVTE, but will be used only if rescheduling is required to accommodate other overall test schedule modifications. Further information about the M&S schedule is included in Annex E, Section E.8.

2.9 DETAILED TEST PLANNING OVERVIEW

The JUAV JT&E will include four live tests. The two field tests are designed to investigate various aspects of the issues described earlier. The Risk Reduction Mini-Test is designed to serve as a rehearsal for the larger scale field tests. The JVTE is designed for validation of the JTTP developed by the JTF. The following paragraphs provide an outline of the objectives and execution of each test. Many of the details are yet to be determined at the current stage of planning. Before each test, a DTP will be prepared that provides the details required to execute all facets of the scheduled test events. This includes

test venue coordination requirements, personnel, logistics, instrumentation placement, data collection methods and procedures, data collector training, data analysis methods, identification of data to be collected, evaluation of analysis results, and test control procedures. The aggregate of the live tests will provide the data required by the JTF to answer the test issues and resolve the Joint UAV problem. A copy of each DTP will be submitted to the JT&E Program Office for review and distribution. Comments will be provided to the Joint Test Director (JTD). An electronic and hardcopy of each signed DTP will be sent to the JT&E Program Office prior to testing. Table 2-5 provides an overview of these tests.

Table 2-5 Overview of Live Tests

Test Event	Date	Purpose	Test Location
Risk Reduction Mini-Test	FY03	Test TTP data collection methods and exercise data analysis	Ft. Irwin, CA
FT-1 (DR XI)	FY03	Answer Issues and Sub-issues and compute MLM, MOE, and MOP.	Fallon, NV
FT-2 (Ft. Hood)	FY04	Answer Issues and Sub-issues and compute MLM, MOE, and MOP.	Ft. Hood, TX
JVTE (JCIET04/JTFEX)	FY04	Verify JTTP – Issue, MLM, MOP, MOE	Ft. Stewart, GA and CRTC Savannah, GA or Ft. Bragg, NC and Camp Lejeune, NC

2.9.1 Overview of Design Options

Test design options were developed to overlay the three alternative C2 architectures and the three primary mission areas with a mix of fixed-wing and rotary-wing aircraft and conventional and laser-guided munitions. Table 2-6 lists the overall JUAV JT&E test design missions, sub-missions, and scenarios/vignettes. The scenarios are represented by a four-character scenario label. The first two characters identify the mission area (M_1=Air Interdiction: Armed Reconaissance, M_2=Fire Support, M_3=Personnel Recovery). The third character is the Alternative C2 Architecture A, B, or C. The final character references the means of engagement (WDP fixed-wing or rotary-wing with or without laser-guided weapon, artillery, and CAS).

Table 2-6 Test Design Matrix

Mission		Architecture A	Architecture B	Architecture C
Air Interdiction: Armed Reconnaissance				
Sub-Mission 1	Fixed-Wing ACFT with no UAV Laser Designation	M_1A_1	M_1B_1	M_1C_1
Sub-Mission 2	Fixed-Wing ACFT with UAV Laser Designation	M_1A_2	M_1B_2	M_1C_2
Sub-Mission 3	Rotary-Wing ACFT with no UAV Laser Designation	M_1A_3	M_1B_3	M_1C_3
Sub-Mission 4	Rotary-Wing ACFT with UAV Laser Designation	M_1A_4	M_1B_4	M_1C_4
Fire Support				
Artillery Fire Support		M_2A_1	M_2B_1	M_2C_1
CAS		M_2A_2	M_2B_2	M_2C_2
Personnel Recovery				
CSAR, NEO		M_3A_1	M_3B_1	M_3C_1

2.9.2 Risk Reduction Mini-Test

The Risk Reduction Mini-Test will serve as a rehearsal for the larger scale field tests and JVTE. The mini-test will focus on Air Interdiction missions, UAV laser designation operations, Fire Support/Artillery, and Fire Support/CAS. Table 2-7 displays the proposed number of events for the mini-test.

The JTF will not conduct testing that would adversely affect BLUFOR training. This requirement will prevent the JTF from using non-standard C2 architectures (i.e., alternatives B and C) on the BLUFOR and only alternative Architecture A data will be collected on BLUFOR. OPFOR will be used to test non-standard alternatives B and C. During operations, the weapon delivery platforms will consist of two F-16s and a Predator that will support UAV operations. The Tactical C2 node will consist of a BLUFOR manned ground Tactical Operations Center (TOC).

Table 2-7 Risk Reduction Mini-Test Events

Mission Areas		Architecture A	Architecture B	Architecture C	Totals	Comments
Air Interdiction	Test Days	1	1	1	3	Air Interdiction includes fixed-wing assets.
	Period/Day	2	2	2		
	Trials/Period [1]	3	3	3		
Laser Missions: M_1A_2, M_1B_2, M_1C_2	Laser Events	6	6	6	18	
Non-Laser Missions: M_1A_1, M_1B_1, M_1C_1	Non-Laser Events	6	6	6	18	
	Total Trials	12	12	12	36	
Fire Support/Artillery: M_2A_1, M_2B_1, M_2C_1	Test Days	1	1	1	3	
	Period/Day	1	1	1		
	Artillery Events	10	10	10		
	Total Trials	10	10	10	30	
Fire Support/CAS: M_2A_2, M_2B_2, M_2C_2	Test Days	3	1	1	3[2]	BLUFOR has 6 CAS sorties per period and will be used for alternative A. OPFOR has 4 CAS sorties per period and will be used for alternatives B and C.
	Period/Day	1	1	1		
	Trials/Period[1]	6	4	4		
	Laser Events	18	4	4		
	Total Trials	18	4	4	26	
Personnel Recovery						Personnel Recovery is not planned for the Risk Reduction Mini-Test.

NOTE: 1 Each trial will consist of two weapon releases. Combination Laser-Guided or Non-Laser.

2 BLUFOR and OPFOR data will be collected simultaneously for two days resulting in three test days not five.

2.9.2.1 Objectives

The following are objectives of the Risk Reduction Mini-Test:

- Rehearse test execution and data management procedures based on the Risk Reduction Mini-Test DTP
- Exercise data collection, data management, and data analysis procedures
- Ensure that safety considerations are adequately addressed

2.9.2.2 Venue

The Risk Reduction Mini-Test will be conducted at NTC, Ft. Irwin. NTC provides maneuver brigade force-on-force and live-fire exercises that last two weeks and occur ten times a year. The visiting BLUFOR units are challenged by the permanently stationed OPFOR represented by the 11th Armored Cavalry Regiment (ACR). Air support is provided from Air Warrior participants staging from Nellis Air Force Base, NV. Range instrumentation supports Real-Time Casualty Assessment for instrumented players. Time-Space-Position Information (TSPI) data for ground and air participants is viewable real-time and is recorded for post analysis. Audio of radio transmissions is available, although recording equipment is the responsibility of the user.

2.9.2.3 Schedule

The Risk Reduction Mini-Test will take place in January 2003. A test period of 15 days is planned. The mini-test will be held in conjunction with the 03-04 NTC rotation and the Air Force's Air Warrior.

2.9.2.4 Participants

The participants identified for the Risk Reduction Mini-Test include BLUFOR and OPFOR units:

The BLUFOR units include: 3rd Brigade, 1st Armored Division, which consists of the 1st Battalion, 13th Armored Regiment, the 1st Battalion, 41st Infantry Regiment, and the 1st Battalion, 87th Infantry Regiment. BLUFOR units also include the 5th Special Forces Group (5th SF), the 18th Aviation Regiment from 10th Mountain Division, the 7th Company, 158th Aviation Battalion, and the 12th ACCS JSTARS.

The OPFOR units include: The 11th ACR augmented by the 2nd Battalion, 8th Infantry; Company A, 1st Battalion, 125th Infantry; the 478th Engineer Battalion; the 1st Battalion, 119th Field Artillery; and a mortar platoon from the 36th Brigade, 49th Armored Division. The 421st Fighter Squadron from Hill AFB and the 310th Fighter Squadron from Luke AFB will provide F-16 air support. The Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) is expected to provide a UAV or UAV surrogate.

2.9.3 Field Test 1 (DR XI)

DR XI focuses primarily on CSAR operations with Air Interdiction and Fire Support. FT-1 test objectives will focus on CSAR and collect data from the other mission areas as feasible. Typical DR events are conducted in a low air defense threat environment. Table 2-8 is a representative schedule of the JUAV events planned for DR XI. Table 2-9 displays the number of tests planned for FT-1.

Table 2-8 Typical Field Test 1/Desert Rescue Events

DATE	TIME	EVENT	AIRCRAFT	SQUADRON	ORDNANCE	MSN	THREATS
18 Jul (Friday)	1130-1330 1830-2030Z	5-1	4xA-10 4xAH-1W 1xE-2 2xHH-60 1xEA-6B 1xPioneer 1xShadow 2xF/A-18C 4xA-10	118 FS HMLA-775 VAW HS/USAF VAQ-134 VC-6 1/4ID VFA-94 131FS	Bombs Laser 7.62mm 30mm Chaff Flares	RMC RESCORT AMC SRU SEAD I&W RESCAP CAS	Sites: 9, 7, 13, 22, 3, 25, 23 12 and MANPADS Van
18 Jul (Friday)	1400-1600 2100-2300Z	5-2	4xA-10 2xF/A-18F 1xE-8 1xEA-6B 2xHH-60H 2xF/A-18C SOF 1xPredator	190 FS VFA-41 93 OSS VAQ-134 HS VFA-94 NSW UAV BL	Bombs Laser 7.62mm 30mm 20mm Chaff Flares	RMC RESCORT AMC/I&W SRU SEAD RESCAP Recovery I&W	Sites: 9, 7, 13, 22, 3, 25, 23, 12 and MANPADS Van
18 Jul (Friday)	1630-1830 2330-0130Z	5-3	2xF/A-18F 4xA-10 1xE-2 2xUH-1N 2xEA-6B 1xPioneer 2xF-14 8xF-15 SOF	VFA-41 131 FS VAW HMLA-775 VAQ-134 VC-6 VF-213 110 FS NSW	Bombs Laser 7.62mm 30mm 20mm Chaff Flares 2.75 in Rockets	RMC RESCORT AMC SRU SEAD I&W CAS RESCAP Recovery	Sites: 9, 7, 13, 12, 22, 3, 25, 23 and MANPADS Van
18 Jul (Friday)	1900-2100 0200-0400Z	5-4	2x F/A-18F 2xF/A-18C 2xAH-1W 1xE-8 2xHH-60H 1xEA-6B 1xShadow 1xPredator SOF	VFA-41 VFA-94 HMLA-775 VAW HS VAQ-134 1/4ID UAV BL NSW	Bombs Laser 7.62mm 20mm Chaff Flares	RMC RESCORT RESCORT AMC SRU SEAD I &W Recovery	Sites: 7, 22, 13, 12, 31, 21, 19, 12 and MANPADS Van

Table 2-9 Field Test 1/Desert Rescue XI Test Events

Mission Areas		Architecture			Totals	Comments
		A	B	C		
Air Interdiction	Test Days	3	3	3	9	Air Interdiction includes fixed-wing assets.
	Period/Day	2	2	2		
	Trials/Period	6	6	6		
Laser Missions:	Laser Events	18	18	18	54	
M_1A_2, M_1B_2, M_1C_2	Non-Laser Events	18	18	18	54	
Non-Laser Missions: M_1A_1, M_1B_1, M_1C_1	Total Trials	36	36	36	108	
Fire Support/Artillery						Artillery is not planned for DR XI
Fire Support/CAS:	Test Days	3	3	3	9	CAS will be for laser weapons only.
M_2A_2, M_2B_2, M_2C_2	Period/Day	2	2	2		
	Trials/Period	3	3	3		
CAS Missions:	Laser	18	18	18	54	
M_2A_2, M_2B_2, M_2C_2	Total Trials	18	18	18	54	
NEO	Test Days	1	1	1	3	Plan will incorporate 1 event/day during 3 days based on number of participants.
	Period/Day	1	1	1		
NEO Missions:	Trials/Period	1	1	1		
M_3A_1, M_3B_1, M_3C_1	Total Trials	1	1	1	3	
CSAR	Test Days	3	3	3	9	
	Period/Day	2	2	2		
CSAR Missions:	Trials/Period	3	3	3		
M_3A_1, M_3B_1, M_3C_1	Total Trials	18	18	18	54	

2.9.3.1 Objectives

The objectives of FT-1 are to collect data on a single UAV and the effectiveness of the three alternative C2 architectures in the following mission areas:

- CSAR and NEO
- Fixed-Wing Air Interdiction
- Urban CAS

2.9.3.2 Venue

FT-1 will be integrated into the DR XI exercise conducted at NASF on the Fallon Range Training Complex (FRTC) which encompasses more than 10,200 square miles of airspace east of NASF. The FRTC includes a vast array of electronic systems that support squadron, airwing, and Strike Fighter Tactics Instructor training The FRTC has four bombing ranges that support high impact, inert, and No-Drop Bomb Scoring (NDBS) as well as laser operations. The heart of the FRTC is the Advanced Digital Display System (ADDS). This computer-supported real-time digital display allows monitoring of each training event as it occurs on the ranges and recording capability for debriefing. Information is transmitted instantaneously from each aircraft to large-screen displays at NSAWC and recorded for playback to the aircrews for post-flight analysis of procedures and tactics.

Typically DR ground participant events take place on the highly instrumented Bravo 17 (B-17) complex. B-17 has a vast array of electronic air defense threat simulators as well as Man Portable Air Defense Systems (MANPADS), which are shoulder-launched, infrared (IR) threats. A full-scale mock-up of an emerging third world country POW camp is also maintained on B-17. This camp is instrumented for NDBS of numerous weapons. NDBS allows for near real-world training between aircrews and ground participants.

Recently, the Navy was able to withdraw enough public land to allow for Special Operations (SPECOPS) personnel to be inserted with helicopters, transit to objectives, and be extracted at another landing zone. UAV support for Personnel Recovery and integration with SPECOPS transit support has been demonstrated.

2.9.3.3 Schedule

DR XI is tentatively scheduled for 14 July 2003 through 1 August 2003. Fifteen days are available for JUAV testing.

2.9.3.4 Participants

DR XI is a multi-Service exercise with participants from the USA, USAF, ANG, USMC, and USN. Platforms attending include C-130s, F-14s, A-10s, AH-1Ws, E-2Cs, UH-1Ns, HH-60Hs, F-15s, F/A-18s, and F-16s. It is anticipated that a JFCOM Joint Operational Test Bed System (JOTBS) Predator and the USN VC-6 Pioneer will be the participating UAVs.

2.9.4 Field Test 2

FT-2 will focus on rotary-wing NEO, CAS, rotary-wing and fixed-wing Air Interdiction, and Fire Support missions. Artillery support for fixed targets will be incorporated into the UAV targeting procedures for direct fire and OPFOR counter-attack scenarios. The JTF may incorporate CSAR scenarios to validate data and TTP that are developed during DR XI. Typical events planned for FT-2 are illustrated in Table 2-10 below. Table 2-11 displays the number of test events planned for FT-2 at Ft. Hood, TX.

Table 2-10 Typical Field Test 2 Events

Date	Time	Event	Aircraft/Vehicles	Unit	Mission
11 Jan 04	0800-1100	MSN-001	1x Shadow 2x FA-18 3x AH-64 2x155mm 2x105mm	TBD	Fire Support (Target ID), Fixed and Rotary-Wing Air Interdiction, Artillery support for fixed targets
11 Jan 04	0800-1100	MSN-002	4x H-60 2x AH-64 1x Shadow	TBD	NEO with Rotary-Wing CAS
11 Jan 04	0800-1100	MSN-006	4x H-60 2x AH-64 1x Shadow	TBD	Rotary-Wing Armed Reconnaissance
11 Jan 04	1300-1430	MSN-005	2x Shadow 2x FA-18 2x A-10 2x155mm 2x105mm	TBD	CAS with Fixed-Wing and Dynamic UAV Re-tasking, Artillery to suppress OPFOR counter attack
11 Jan 04	1430-1600	MSN-003	1x FA-18 1x Shadow	TBD	Air Interdiction with UAV Lasing

Table 2-11 Field Test 2 Test Events

Mission Areas		Architecture			Totals	Comments
		A	B	C		
Air Interdiction	Test Days	3	3	3	9	Air Interdiction includes rotary-wing assets
	Period/Day	2	2	2		
	Trials/Period[1]	3	3	3		
Laser Missions:	Laser Events	18	18	18	54	
M_1A_4, M_1B_4, M_1C_4	Non-Laser Events	18	18	18	54	
Non-Laser Missions: M_1A_3, M_1B_3, M_1C_3	Total Trials	36	36	36	108	
Fire Support/Artillery	Test Days	3	3	3	9	Artillery support for fixed targets and to suppress OPFOR counter attacks
Artillery Missions:	Period/Day	2	2	2		
M_2A_1, M_2B_1, M_2C_1	Trials/Period	3	3	3		
	Total Trials	18	18	18	54	
Fire Support/CAS	Test Days	3	3	3	9	CAS includes rotary-wing
	Period/Day	2	2	2		
	Trials/Period	3	3	3		
	Total Trials	18	18	18	54	
NEO	Test Days	2	2	2	6	Plan will incorporate one event per day during six days based on number of participants
NEO Missions:	Period/Day	1	1	1		
M_3A_1, M_3B_1, M_3C_1	Trials/Period	1	1	1		
	Total Trials	2	2	2	6	
CSAR						CSAR events may be introduced at a later time to support data and TTP validation

[1]Each trial will consist of laser and non-laser events

2.9.4.1 Objectives

The following are objectives of FT-2:

- Incorporate multiple UAVs in rotary-wing Air Interdiction
- Incorporate multiple UAVs in rotary-wing Fire Support
- Incorporate UAV into artillery direct Fire Support
- Incorporate TTP developed from FT-1 for UAVs in NEO operations

2.9.4.2 Venue

FT-2 will be conducted at Ft. Hood, TX. Unlike the other live tests, FT-2 will not be integrated into an existing exercise. Instead, the JTF will develop its own JT&E-specific scenarios for the test. The concept of operations is based upon a NEO mission, Air Interdiction using rotary-wing assets, and artillery direct Fire Support. The tactical context of this exercise is that U.S. Forces will conduct a NEO and hostage rescue operation in a third world African nation requiring significant suppression of enemy forces of fixed and mobile threats. There is substantial potential for combat against indigenous forces with moderately sophisticated weaponry and operational capabilities. This scenario includes significant combat operations in built-up or urban areas. Also planned in the NEO scenario is an operation to prevent reinforcements from firing on the pick-up or egress routes.

Ft. Hood is the home of the Army Operational Test Command (OTC) as well as the Air Defense Artillery Test Directorate (ADATD) and the Fire Support Test Directorate (FSTD). Ft. Hood also has the Test and Evaluation Support Activity (TESA) which provides logistical and instrumentation support to the operational test community. Ft. Hood has a resident Army Hunter/Shadow company that will be a major player and contributor to this test.

FT-2 events will take place on the Ft. Hood Training Reservation. This training facility includes a tactical airfield, large maneuver areas for ground vehicles, live fire artillery range, and numerous buildings to support the urban scenario. The availability of electronic instrumentation for monitoring test events is limited and may need to be augmented.

2.9.4.3 Schedule

FT-2 will take place in January 2004. A dedicated test period of 15 days is planned.

2.9.4.4 Participants

The military units that will participate in FT-2 have not yet been identified. It is anticipated that a Shadow or Hunter, coordinated through the ATEC, will be available for the test. Coordination with OTC and III Corps has identified several potential units including a mechanized infantry brigade and its associated direct support artillery battalion from Ft. Riley, KS. Platforms planned to attend are Shadow, Hunter, F/A-18s, E-2s, C-130s, UH-60s, AH-64s, 105mms, 155mms, M2A2s, M113As, M998s, HMMWVs, and numerous other ground support vehicles.

2.9.5 Joint Validation Test Event

The JUAV JT&E will include one JVTE. This is a Joint exercise for JTTP validation. The JTF anticipates using JCIET04/JTFEX in spring 2004 as a JVTE. The JTF, along with JFCOM, continues to examine possibilities for other Joint exercises but believes that JCIET04/JTFEX is likely to be sufficient for JTTP validation. Table 2-12 displays the number of test events planned for JCIET04/JTFEX.

Table 2-12 JCIET04/JTFEX Mission Events

Mission Areas		Architecture			Totals	Comments
		A	B	C		
Air Interdiction **Laser Missions:** M_1A_2, M_1B_2, M_1C_2 M_1A_4, M_1B_4, M_1C_4 **Non-Laser Missions:** M_1A_1, M_1B_1 M_1C_1 M_1A_3, M_1B_3, M_1C_3	Fixed-Wing Non-Laser	2	2	2	6	Laser weapon tests have a higher level of complexity and may have higher aborted run rates. Therefore, the number of trials is increased over non-laser.
	Fixed-Wing Laser	4	4	4	12	
	Rotary-Wing Non-Laser	2	2	2	6	
	Rotary-Wing Laser	4	4	4	12	
Fire Support/Artillery **Artillery Missions:** M_2A_1, M_2B_1, M_2C_1		4	4	4	12	
Fire Support/CAS **CAS Missions:** M_2A_2, M_2B_2, M_2C_2	Fixed-Wing Laser	3	3	3	9	CAS will use laser weapons only.
	Rotary-Wing Laser	3	3	3	9	
NEO						Not planned for JCIET04/JTFEX
CSAR **CSAR Missions:** M_3A_1, M_3B_1, M_3C_1	Rotary-Wing and Fixed-Wing	3	3	3	9	

2.9.5.1 Objectives

The objectives of the JVTE are to test C2 architectures and validate modifications to the JTTP developed and tested during the previous field tests. Dedicated training packets developed for BWF performed by selected BWOs and for the UAV GCS crews will be incorporated as a basis for comparison.

2.9.5.2 Venue/Schedule

The venue planned for the JVTE is the JCIET04/JTFEX. The timing for this event has yet to be determined, but it is anticipated in the spring-summer 2004 timeframe. The event will leverage a Navy JTFEX but is expected to have all of the customary Joint (and UK) players that JCIET usually has. JCIET is also planning for a more robust ground component than in JCIET02. JCIET anticipates the venue will likely be located either at Savannah Combat Readiness Training Center (CRTC) and Ft. Stewart (GA) or at Ft. Bragg and Camp Lejeune (NC). It will also include offshore naval participants. JFCOM and JCIET are still working out details for this exercise.

2.9.5.3 Participants

The units that will participate in JCIET04/JTFEX have yet to be identified. It is anticipated that a Pioneer and a Shadow will be available for the test.

2.9.6 Live Test Summary

Table 2-13 summarizes the mission areas, issues, sub-issues, and scenarios across the test venues. All issues and sub-issues are addressed in FT-1 and FT-2.

Table 2-13 Test Cell Summary Matrix

Test Event	Mission Area	Issue and Sub-Issues Addressed	Scenario Number
Risk Reduction Mini-Test	Air Interdiction, Fire Support (CAS and Artillery) Fixed-Wing	Data Collected, but not used for Issue Resolution	M_1A_2, M_1B_2, M_1C_2 M_1A_1, M_1B_1, M_1C_1 M_2A_1, M_2B_1, M_2C_1 M_2A_2, M_2B_2, M_2C_2
FT-1 (DR XI)	Air Interdiction, Fire Support (CAS) and Personnel Recovery (CSAR and NEO) Fixed-Wing	1.0, 1.1, 1.2, 1.3 2.0, 2.1, 2.2 3.0, 3.1, 3.2	M_1A_2, M_1B_2, M_1C_2 M_1A_1, M_1B_1, M_1C_1 M_2A_2, M_2B_2, M_2C_2 M_2A_2, M_2B_2, M_2C_2 M_3A_1, M_3B_1, M_3C_1 M_3A_1, M_3B_1, M_3C_1
FT-2 (Ft. Hood)	Air Interdiction, Fire Support (CAS and Artillery) and Personnel Recovery (NEO) Rotary-Wing	1.0, 1.1 ,1.2, 1.3 2.0, 2.1, 2.2 3.0, 3.1, 3.2	M_1A_4, M_1B_4, M_1C_4 M_1A_3, M_1B_3, M_1C_3 M_2A_1, M_2B_1, M_2C_1 M_3A_1, M_3B_1, M_3C_1
JVTE (JCIET04/JTFEX)	Air Interdiction, Fire Support (CAS and Artillery) and Personnel Recovery (CSAR) Fixed and Rotary-Wing	Data collected for validation of proposed JTTP 1.0, 1.1, 1.2, 1.3 2.0, 2.1, 2.2 3.0, 3.1, 3.2	M_1A_2, M_1B_2, M_1C_2 M_1A_4, M_1B_4, M_1C_4 M_1A_1, M_1B_1, M_1C_1 M_1A_3, M_1B_3, M_1C_3 M_1A_1, M_1B_1, M_1C_1 M_2A_2, M_2B_2, M_2C_2 M_3A_1, M_3B_1, M_3C_1

3.0 DATA MANAGEMENT AND ANALYSIS PLAN OVERVIEW

3.1 DATA ANALYSIS PLAN

The Data Analysis Plan outlines the processes and procedures that will be used to calculate measures, perform analyses, develop data presentations, and evaluate results. These tasks will contribute to the successful evaluation of JUAV issues. The successful execution of the Data Analysis Plan will be the responsibility of the JUAV Analysis Team, which includes government and contractor personnel with analytical and operational expertise. Data analysis activities will occur at the JUAV facility at NASF, except for quick-look analyses. Quick-look analyses will occur at the field tests and the JVTE. The specifics of the JUAV analysis are contained in the DMAP (Annex F).

3.1.1 Data Analysis Requirements

The data analysis will focus on mission performance of the JTTP applicable to the three alternative C2 architectures employed in the test events across three mission areas. These architectures and mission areas are presented in Section 2. The architectures are summarized in Table 3-1 and are presented in detail in Annex G.

Table 3-1 BWF Locations for Alternative C2 Architectures

Architecture	BWF Location	Description
A	At the Joint C2 node.	The C2 is provided to the Tactical C2 node, which controls the weapon system that is assigned to respond to the target area serviced by the UAV.
B	At the Tactical C2 node.	The Tactical C2 node directly controls the weapon system that is assigned to respond to the target area serviced by the UAV. The Joint C2 node is still informed and may influence the action.
C	At the GCS, collocated with the UAV control crew.	This configuration provides tightly coupled C2 of both the UAV and the weapon system that is assigned to respond to the target area serviced by the UAV. The Joint and Tactical C2 nodes are informed and may influence the action.

The following are the three mission areas:

- Air Interdiction: Armed Reconnaissance
- Fire Support
- Personnel Recovery (CSAR and NEO)

The three alternative C2 architectures and the three mission areas are combined in a series of test scenarios that are illustrated in Annex D. The scenarios are combined into the Test Cell Matrix (Table 2-3). The Test Cell Matrix is the top-level document controlling which data elements can be combined to form sample populations of independent variables from the architectures and mission areas. Mission areas will be handled as separate test cells, and their performance data will be handled separately. The data collected for each cell of the Test Cell Matrix will be used to calculate the measures listed in Table F-8, Annex F. These measures, along with other supporting analyses, are the primary end products of the analysis team. They will be used by the JTF and the SMEs for the basis of evaluation and resolution of the JUAV issues.

3.1.2 Data Analysis Methods and Techniques

Test data provide the means to compute test measures, evaluate the alternative C2 architectures and their respective effects on the three mission areas, and answer JUAV JT&E issues. Initially, analysts will perform exploratory data analysis using statistical and graphical tools and methods to understand, characterize, and evaluate the collected test data. These explorations provide descriptive statistics, measures of statistical properties (e.g., shapes and scaling of underlying distributions, central tendency and dispersion, and multivariate correlation), and insight for handling outliers and missing data.

3.1.2.1 Descriptive Analysis

Analysts will use descriptive analysis to characterize the data for each alternative C2 architecture and mission area and to develop tentative conclusions addressing issues and sub-issues based on sample data populations. For JUAV JT&E purposes, descriptive analysis refers to the use of descriptive statistics to portray the central tendencies of test measures. In addition, graphic plots, such as stem and leaf plots and box plots, provide visual indication of test measure distribution properties. Reviewing the statistics will provide additional insight into the alternative C2 architectures and may indicate promising approaches for JTTP development or improvement. The results of the descriptive analysis will establish process performance for each architecture and mission area, indicate general deficiencies, and may suggest the focus for subsequent tests.

3.1.2.2 Comparative Analysis

The JTF analysts will use a similar descriptive analysis process to characterize each of the C2 alternatives. Comparative analysis methods will then be used to assess the effects of the three C2 alternatives on mission execution. Hypothesis testing will determine if a C2 alternative has a positive effect compared to the other C2 alternatives. Both nonparametric and parametric statistical techniques may be used in the comparative analysis. The real-world nature of large-scale live tests in operational environments precludes collecting large data samples under identical conditions; therefore, the sample size will be limited. Analysts will therefore use statistical tests [confidence intervals, t-test, analysis of variance (ANOVA), etc., and process modeling of measured sub-processes to quantify confidence in the conclusions. The MOE and MOP will be aggregated using design of experiments techniques to address their influence on the MLM. For example, one mission-level measure is the probability that the mission is completed successfully. The measure will be computed directly. MOE and MOP will also be computed to examine components of the mission (target acquisition, command decision, and engagement)

that might drive the overall result and enable further focusing of effort. This analysis process is expected to produce a more robust evaluation of the effects of the alternative JTTP on mission outcome.

3.1.2.3 Process Analysis Methods

Process analysis is an analytic technique that explores and identifies information flow and decision-making in complex networks or organizations. Process analysis is used to describe the process being analyzed and also to explain impacts of changes to key variables. With this technique, the JTF will study cause-and-effect relationships for performance areas important to the issues and sub-issues. Analysts and SMEs will study the performance and process results in depth using time-correlated, multi-media tools to fuse tactical voice communications, participant logs, video recordings, digital communications, tactical system data, and truth data (TSPI and target signature) using computer workstations. This technique will allow SMEs and analysts to understand the process limitations and potential improvements. This technique will help identify potential JTTP that may be implemented and tested in future tests. Process analysis tools, which may be applied during this phase, include the following:

- Process Modeling: Diagramming tools showing component parts and interrelationships between them.
- Cause-Effect Charts: Charts that represent the relationships between an effect (problem) and potential causes.
- Scatter Diagrams: Diagrams that depict the relationship between two factors.
- Pareto Charts: Bar charts that display the relative contribution of each sub-problem to the total problem. Bars are arranged in descending order with the largest to the left.
- Control Charts: Method for determining the cause of variation based on a statistical analysis of the problem. Uses probability theory to control and improve processes.
- Work Flow Analysis: Structured system to improve a process by eliminating unnecessary tasks and streamlining the workflow.

The analysts will work with staff and participant SMEs to identify and analyze possible JTTP that promise to resolve observed operational deficiencies. Analysts will be careful to differentiate between theoretical JTTP considered during analysis and actual JTTP tested under field conditions.

Analysts will use the deficiency analysis method to identify deficiencies in the JUAV JT&E processes associated with the three C2 architectures. They will review descriptive statistics and identify test measures that show shortfalls and deficiencies. Analysts will search for possible causes by factoring test measures with different combinations of variables. A Chi-Squared Test of Independence can be performed using a 2 x 2 contingency table to cross-tabulate the observations and demonstrate whether there is a statistically significant effect between dependent and independent variables.

3.1.2.4 Quick-Look Analysis

Quick-look analysis is not a formally defined analytical method but a necessary concept in order to ensure quality data collection. Quick-look analysis is the analysis performed on site, or as soon as possible after a test event, to ensure that test objectives are met. Preliminary quality assurance checks, focusing on key indicators, will help ensure data completeness and that parameters fall within anticipated ranges. Both are important aspects of risk reduction. The quick-look analysis may also identify problems with data collection and test methods that need to be corrected. All data-related problems must be corrected immediately to avoid a no-test before the next test. Quick-look findings may also help to scope, prioritize, and expedite the more detailed mission reconstruction and subsequent analysis.

3.1.3 Data Analysis Pre-Test Rehearsals

The JUAV JT&E will use the IBAR facility in Naval Air Weapons Center (NAWC) China Lake to simulate the procedures that are used in the three alternative C2 architectures. The primary use of the IBAR in VR-1 will be to narrow the list of possible effective procedures in each architecture before they are executed in the field tests. Properly analyzing the IBAR data will require the same analytical procedures as those planned for use in the field tests and will provide JUAV analysts ample opportunity for data pre-test rehearsals. Other data rehearsal opportunities include the Risk Reduction Mini-Test and an additional two weeks of IBAR simulation before FT-1.

3.1.4 Evaluation Plan Overview

Evaluation is the process that uses data analysis results to reach test findings, conclusions, and recommendations. The evaluation phase includes extended analysis, assessment, and reporting of technical results focused specifically on answering the test issues. Extended analysis will address the cause-and-effect relationships of the issues and sub-issues in each mission area. It will consist of ANOVA techniques to evaluate quantitative data and analysis of scaled questionnaires. It will explain and document rationale for anomalous analysis results. It will help identify potential JTTP that may be implemented and tested.

Evaluation begins with the dendritic structure explained in the DMAP (Annex F). During the preceding data analysis phase, the analysis team will have identified and reconstructed the events (e.g., detection, identification, engagement, etc.) and certified the resulting data (see Section 3.2.2). In this phase, analysts will use the certified data elements to compute measures defined in the DMAP. Analysts will analyze these measures using a variety of statistical and process analysis tools with the analysis database to develop answers to the issues and sub-issues. This procedure includes detailed parametric and non-parametric analysis, assessments, and investigations to develop the technical results. Operational SMEs who have an in-depth understanding of UAV C2 architectures as applied to the mission areas will review the analytical results and apply operational experience to ensure that the JT&E findings, conclusions, and recommendations are operationally focused. The evaluation phase is intended to merge the scientific statistically-based results of a rigorous Joint test project with the operational considerations that are difficult to replicate in an exercise environment.

3.1.4.1 Evaluation Methodology

JTF analysts will use the analytical methodologies depicted in Table 3-2 to address the JT&E project issues and sub-issues. JTF analysts will apply the methodology separately for each of the alternative C2 architectures to each mission area. These methodologies will determine the effects of each architecture on mission capabilities. As noted previously, this will be done using a variety of applicable statistical techniques that provide the means to determine the effects of each architecture on TSO and provide the means to compare the attributes of alternative architectures.

Table 3-2 Issues and Analysis Objectives and Methods

Project Issue	Analysis Objectives	Analysis Methods
Issue 1. To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?	I. Architecture impact on sensor employment II. Architecture impact on target identification III. Architecture impact on providing target coordinates	Comparative Analysis Process Analysis Descriptive Analysis
Issue 2. To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?	IV. Architecture impact on information flow V. Architecture impact on decision making	Comparative Analysis Descriptive Analysis
Issue 3. To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?	VI. Architecture impact on airspace integration VII. Architecture impact on laser designation ability	Comparative Analysis Process Analysis

3.1.4.2 Use of Warfighter Subject Matter Experts

The JTF will use warfighter SMEs as participants at key points in the JT&E process. Warfighter SMEs have been, and will continue to be, used in test design and development. Specifically, the warfighter SMEs will be used to review results of the VRs, the field tests, and the JVTE. Warfighter SMEs will help ensure the results are understandable and defensible. They will help identify relationships that are only apparent when different analysis categories are compared. These reviews will most likely occur during a JWAG when these warfighter SMEs will be gathered to help review JUAV test designs and review results of tests. Findings, conclusions, and recommendations generated by the JTF will be reviewed by JWAG members for operational credibility and applicability. Additionally, inputs will be obtained on how to best disseminate JUAV products. Warfighter SMEs from operational units will assist in developing DTPs and will be part of the JT&E IBAR simulation team. As part of the IBAR team, they will provide guidance in developing credible architectures and procedures.

3.1.4.3 Operational Impact on Test Results

The JTF acknowledges several limitations that may affect JT&E execution. Potential impacts include unavailability of UAV platforms for field tests because of tasking by higher-echelon authorities. Memoranda of Agreement (MOA) (Annex C) are being, and have been, established to minimize this limitation. In the event of UAV unavailability, an alternative is to use surrogates like the CIRPAS Pelican.

Operational impact issues may be experienced but will not likely significantly affect the JTF's ability to resolve issues. Expected operational impact issues are listed in Table 3-3.

Table 3-3 Operational Impact Issues

Operational Categories	Impacts	Mitigation
Training Environment	Limits the consistent repetition of scenarios	Measures designed to produce common binning of data
	Missions and scenarios not always ideal for JT&E	IBAR and some dedicated sorties to determine difference between control and non-control
	Weather	25% more test runs will need to be planned
Units	Variance in systems because of differences in equipment	Tests designed for common envelopes among equipment
	Differing experience levels among participants	Surveys of participant experience and training to allow normalization of test data
	Differing JTTP	None. Currently, there are no JTTP for including UAVs in tactical operations. JUAV will be examining potential JTTP.
Regulations	FAA UAV airspace rules may prevent using some UAV JTTP	Manned surrogate

3.2 DATA MANAGEMENT PLAN

Effective data management is a prerequisite for any rigorous test project. Data management processes include identifying, collecting, controlling, processing, archiving, and disseminating test data from multiple sources and locations. Specific data management activities include data source identification or development, data media identification, data collection instrumentation, data processing, database development, quality checks, storage and distribution, security and control, and data disposition. Data collection methods and processes will be integrated with the host Risk Reduction Mini-Test and field test venues: the JTF will not duplicate data collection that is adequately accomplished by a host venue or another participating agency. However, the JTF will coordinate closely with these agencies to ensure required data are recorded in the required formats and structures that are compatible with analysis software. In addition, the JTF expects to furnish some of its data to the host agencies. Detailed data management planning processes and schedules will be synchronized with those of the host agency, and MOA will document these data sharing arrangements. The output of the data management process will be a media library and online database that will support the data analysis and evaluation phases.

Effective data management will be the responsibility of the JUAV lead analyst and the JUAV Data Manager. The JUAV lead analyst is responsible for quality of the analysis product and for the staff and augmentee analysts who will perform much of the data collection. The JUAV Data Manager is the individual tasked with the responsibility to ensure high quality data are collected and available for analysis. The JUAV Data Manager will be supported by an instrumentation engineer who will plan and execute the collection and verification of automatic data from such sources as TSPI, UAV data links, and communications systems. The JUAV Data Manager will also be supported by a data librarian who will receive, catalogue, and archive all data collected during the test.

3.2.1 Data Collection Procedures and Methods

The JTF will collect data using automated and manual methods. Digital instrumentation, video, and audio systems will record raw test data. Manual data collectors will record data that cannot be collected using automated methods. In a few cases, participant questionnaires and surveys will be used to record information not available using other methods. The JTF will also collect paper or soft copy documents as data sources, including participant-developed documents (e.g., operational plans) and other data (e.g., munitions and target-lethality data).

Analysts and other JT&E data collectors will observe mission execution at specified C2 and ISR nodes to operate instrumentation, collect data, provide test control, and record real-time observations data. These real-time data can provide important insights during debrief, reconstruction, and analysis. In all cases, JT&E data collectors will keep manual notes to record any observations not adequately covered in preplanned data collection. Manual notes will be hand-written or typed into a word processor file on a laptop or other computer. To the extent allowed by the daily execution schedule, JT&E data collectors will transcribe their hand-written manual data into designated areas in the online database. Designated areas in the database will correspond to observations about each mission area, each alternative C2 architecture, each measure, and levels of training of UAV and C2 personnel and will include a free format on miscellaneous observations. The hand-written notes will be retained by the JTF and the transcribed data will be validated by a second person.

3.2.1.1 Data Collection

The detailed DMAP for each test event will designate data collectors for each data source. These data collectors may be JT&E staff members or augmentees. They will ensure that required data collection instrumentation is installed, configured, operational, calibrated, and time-synchronized. Data collectors will receive required blank media before each mission, load the media, pre-check the instrumentation, operate the instrumentation, and return the used media to the data library following each mission. The detailed DMAP will include procedures and countdown timelines for data collectors. Data collectors will report their pre-mission operational status to the site JUAV Data Manager and will immediately report instrumentation anomalies to the appropriate technicians for priority repair. The JUAV Data Manager will conduct data collector training for augmentees and use the rehearsal missions (e.g., rock drill) to ensure that all data collectors understand their responsibilities and are able to perform their assigned tasks. The JUAV Data Manager will also ensure all instrumentation is ready and functional.

The JTF Subject Matter Analysts (SMAs) will execute the tactical system data collection plan. Tactical system data include sensor data, United States Message Text Format (USMTF) reports, data link reports, and voice communications between participants. Typical SMA expertise will include both analytical skills and recent operational experience with the class of system to be analyzed. All SMAs are expected to participate in test execution (e.g., data collectors, coordinators, and debrief facilitators) in addition to their planning and analysis responsibilities.

Early in the detailed planning for each test, the JUAV lead analyst will designate a JT&E SMA responsible for instrumentation on each participating tactical system identified as a probable source for Integrated Data Requirements List (IDRL) data. Often, one analyst can handle several tactical data sources. Following guidance from the JUAV Data Manager, the designated SMAs will manage instrumentation and data collection planning for their assigned tactical systems. This task includes ensuring the media and data are formatted as required by the IDRL, developing data reduction capabilities, and validating data processes using sample data media. SMAs will also document their detailed data collection plans for their assigned tactical systems in the DTP for each test.

In addition to the instrumentation-based data, the JTF will use forms (e.g., data collection logs), interviews, and questionnaires to collect data that are not easily collected by automated systems. Forms

will be used to collect subjective data from participants in a systematic way. These data include written responses to questions about how specific tasks were executed and why specific decisions were made. Scaled questionnaire construction methods will be the primary means for collecting subjective data that is based on the Ft. Hood Questionnaire Construction Manual provided by the JT&E Program Office. For example, this information might include the participant's perceptions on the following:

- Effectiveness of preplanned JTTP
- Attempted use and effectiveness of new JTTP
- Observed anomalies and successes
- Suggested improvements

When practical, the JTF will use scaled questionnaire construction techniques for interviews and questionnaires to quantify respondents' inputs for statistical analysis. Assigned SMAs who have expertise in survey research methodologies will develop the required data collection forms based on the IDRL and tailored to the participants. When practical, paper media will be designed so that it can be automatically scanned into the online database after each mission. Surveys and manual data collection forms will be handled like other media in terms of data control, security, verification, validation, certification, and incorporation into the analysis database.

Assigned SMAs will also develop data collection procedures, checklists, and instructions for data collectors. They will identify any requirements for additional data collectors (augmentees) when requirements exceed the JT&E manning.

3.2.1.2 Data Quality Review

Data will be assessed for accuracy, quality, and completeness via data quality reviews after each rehearsal, test mission, and during the subsequent debriefing process. When the data quality review identifies problems, data collectors or technicians will make necessary corrections to ensure the highest possible data collection quality. These near-real-time on-site reviews will minimize lost data and allow the JT&E to optimize the use of assembled resources. Assigned data collectors and debrief personnel will screen collected data to ensure the following:

- Format is complete, consistent, and readable by conversion and analysis tools
- Accuracy is reasonable, consistent, and within bounds
- Data are complete and cover full-time intervals (Missing data will be identified and resolved.)
- Questionnaires are completed and legible
- Data are properly controlled using correct labels and media type and are archived and logged into the data library
- Anomalies are recorded such as unplanned conditions or variations when specific tactical systems and JTTP were used or not used, actual configuration and architectures the participants used, and any periods when tactical or instrumentation systems were degraded or participants were fatigued or ill

Test data will be assessed as soon as practical after the test event. Data quality review begins at the data collection point. To the extent possible, data collection systems and the data collected will be monitored in real-time to identify problems. As a minimum, all data will be spot-checked after each mission to ensure integrity and identify required corrective actions. Key field-test data will be thoroughly reviewed during post-mission debriefings using data replay systems. Anomalies will be immediately identified to the JUAV Data Manager and the appropriate data system expert.

3.2.1.3 Data Handling and Control

The JUAV Data Manager will develop and operate a responsive, positive-control media-accounting system to label, issue, receive, check, store, and disseminate data collection media throughout test execution and subsequent analysis. The JUAV Data Manager will label all media prior to issue to maintain positive control. During test execution, the JUAV Data Manager will issue blank media to data collectors and ensure that used media are turned in, properly labeled, and logged into the data library. The JTF positive-control system will provide accountability so the JUAV Data Manager and JUAV lead analyst can monitor the data collection progress. The system will include an online data collection status matrix for each data source, which will be keyed to the IDRL. This matrix will store all data quality review comments and conclusions obtained from data collection personnel. The JUAV lead analyst and JUAV Data Manager will review the data collection status after each test mission and take action as required to optimize data collection.

Because data will be generated at several locations, the JUAV Data Manager will not be able to provide continuous on-site supervision. Therefore, the JUAV Data Manager will establish a data librarian at each test location who will operate a secure data library, issue blank media and labels, and receive, inventory, and store the used media following each mission. Generally, data collectors will accomplish their data quality reviews before delivering media to the data library. The data librarians will be proactive in identifying, locating, and obtaining any outstanding media that are not returned on schedule. Problems in returning used media to the on-site data libraries will be reported to the JUAV Data Manager.

3.2.1.4 Data Archiving

After each test mission, the JUAV Data Manager will generate a backup copy, on removable media, for any IDRL data that do not exist on removable media (e.g., network server drives). In cases where the JTF is sharing data with the host venue, the JUAV Data Manager will generate a JTF-owned copy of the shared data on archival removable media. All new removable media copies will be verified to ensure they contain valid readable data before being stored in the data library. After they are verified, the archival media will become part of the local data library like the other test-data media.

3.2.2 Quality Control of Data

A key aspect of the data handling process (data management, planning, collection, validation, certification, storage, and analysis) is quality control that occurs throughout the process. The data described in this section will be derived from live tests. Quality control factors are summarized here.

3.2.2.1 Data Verification, Data Validation, and Data Certification

Data verification ensures that data streams have integrity and are consistent with other related data. Correlation of data ranges (e.g., negative aircraft altitudes), sources, and time-related information can be accomplished using automated software. Data elements that have redundant collection sources or known relationships to other elements will be examined and compared to ensure that the data correlate. If data values conflict, the affected elements will be flagged as suspect and the JUAV lead analyst will appoint an analysis team to adjudicate the suspect data. This team will determine if the data are suitable for analysis and, if required, recommend corrective action.

Specific individuals will be assigned to verify tactical systems data (e.g., digital data, audio, and video), and the instrumentation engineer will verify other truth data streams. The JUAV lead analyst will monitor the data collection process and adjust assignments to balance workload and avoid unnecessary work (e.g., verifying support data for periods when primary data are unusable). In some cases (e.g., TSPI), verification may require reprocessing significant original source data to correct for factors like

data link dropouts, timing offsets, and other anomalies that frequently occur during test missions. During data verification, assigned individuals will carefully review the data for the following:

- Completeness (data cover all mission periods)
- Quality (format and accuracy as well as audio and video quality)
- Consistency (the data agree with plans, real-time observations, and other data sources)

Data validation establishes those portions of the test data that can be used in subsequent analysis to answer the JUAV JT&E issues. Some of the data from live tests may be unusable for analysis purposes. Typical causes of unusable data include power failures, instrumentation failures, instrumentation operator error, mislabeled data, and media failure. Data may also be unusable because the wrong TTP were used or tactical systems were inoperative or incorrectly configured. These causes may not be apparent from individual data streams. As a minimum, validation establishes those time periods when the test data are reliable, degraded, or unusable for each data source. An Analysis Review Board will review all data and adjudicate any data that are not usable for analysis. Unusable data will be removed from the online database and valid data will be organized to support reconstruction and analysis.

Data certification is the milestone indicating the analysis database is correct, stable, and ready to be used to develop results. Prior to database certification, all results developed from the database are preliminary. The raw and processed data in the analysis database have been validated previously; however, reconstruction may produce additional insights as to the correctness and utility of the data. In addition, reconstruction produces new data that are added to the database. Typically, this is an iterative process as data fusion reveals problems that may dictate changes to portions of the database.

The JUAV lead analyst will chair an Analysis Review Board and conduct formal data certification. The Analysis Review Board will include senior analysts, programmers, the JUAV Instrumentation Engineer, analysts, and the JUAV Data Manager. Certification will ensure data consistency, completeness, and validity. Suspect data will be validated, corrected, or removed. Invalid test data will not be used for subsequent analysis. The certified digital data become the basis for evaluation. Following certification, the JUAV Data Manager will remove invalid data from the accessible portion of the online analysis database. The JUAV Data Manager will control access permissions (read and write) to the certified database to protect the integrity of the certified data.

3.2.2.2 Data Anomaly Adjudication Process

Data anomalies can be found at different stages of the data flow process. During mission reconstruction, using the initial or raw database, differences in data between sources may occur. Two or more different sources may show differences in not only the time an event occurred but also whether or not the event occurred. Time differences will be noted, and additional data sources will be applied to resolve and definitively determine the time. For example, if data from the GCS showed an event occurred at 13:42:37 and JAOC data showed the event occurring at 13:43:15, the mission reconstruction will note the 38-second discrepancy, and other data sources, such as audiotapes of communications or videotapes of operators, will be used to determine the certified time that the event occurred.

A more complicated anomaly analysis process would occur if two or more data sources conflicted in whether the event occurred. For example, if the JAOC data showed no weapon was released, but the F/A-18 data showed that a weapon was released, analysts will compile the relevant data from these sources, compare the data with audio and video, and if necessary, a board of analysts and SMEs will convene for a final decision. Issues that the board is unable to decide will be presented to JUAV JT&E management for final adjudication. The adjudication processes are described in more detail in the DMAP.

3.2.3 Instrumentation and Calibration for Ground Truth

Data collection instrumentation requirements are specified in the IDRL for each required data element. The IDRL also specifies the data format and applicable structures that the instrumentation must support.

Most analysis issues will require certain common data support, typically truth data, needed to reconstruct data elements. Examples include telemetry, timing, TSPI, video, and audio. Several government and commercial-off-the-shelf solutions exist to collect these data, and these solutions may be different at each test. The strategy to obtain these data requires the instrumentation engineer to be knowledgeable about the various commercial and government off-the-shelf options at selected test venues and other locations that can be leveraged to collect these data with the least cost and risk.

The JUAV Instrumentation Engineer will manage the truth data collection by performing functions similar to the SMAs assigned to the tactical systems. This responsibility includes determining and implementing data collection methods, developing data reduction capabilities, establishing data collection media requirements and data formats, and validating all data processing using sample data media. The JUAV Instrumentation Engineer will develop any required data collection forms, identify additional data collector or system operator (augmentee) requirements, and develop instructions for augmentees. The JUAV Instrumentation Engineer will develop the instrumentation requirements sections for truth data systems in the DTP for each test.

3.2.4 Joint Test Database

The analysis database will be populated incrementally: first with raw data, then with processed data, and finally with certified reconstruction data. To prevent database contamination, no data will be added to the certified analysis database without explicit approval of the JUAV Data Manager.

The JTF will use three databases. An initial database will be built with the raw data and the data quality review reports. Initial database analyses (including mission reconstruction, anomaly analysis, and briefing analysis) will provide initial examination of the data and additional insights. These results will be converted into an intermediate database. Initial data verification and validation will be conducted during development of the intermediate database. Data from the intermediate database will be fused, verified, validated, and certified in the analysis database, which will be approved for use in the analysis to answer the JUAV JT&E issues.

The database design will be based on the IDRL. A data dictionary will be developed to provide a consistent, well defined interface between data management and analysis processes. The analysis database supports all analysts and remains under the continual management and configuration control of the JUAV Data Manager. The analysis database is a logical versus physical concept, so the JUAV Data Manager can structure the physical database to leverage technology and simplify development and maintenance.

3.2.5 Data Collection Pre-Test Rehearsals

The JTF will conduct rehearsals prior to each test to exercise the data collection plan and data analysis methods. These rehearsals will minimize problems likely to be encountered during test event execution and maximize usability of the data collected during the field tests. Effective planning at this stage is the key to successful data collection and timely post-test analysis. The JUAV lead analyst will direct and review these detailed planning activities and brief the status, options, and recommendations to the JTD at periodic management reviews.

To the extent possible and as dictated by the schedule, prior to each field test, the JTF will conduct a VR. These events will be used to rehearse and refine data collection procedures. However, the data obtained from the VR will not be integrated into any of the test databases. A database of VR data may be maintained separately.

The first day of each field test will be dedicated to equipment and facility familiarization, especially venue-specific issues, and may include training on radios, briefings on the ranges, and instruction on procedures. During the afternoon, the JTF will conduct a dress rehearsal for the data collectors to practice data collection procedures.

3.2.6 Data Security Procedures

The JTF will produce unclassified data and collateral classified data up to SECRET. All removable data media, including unclassified, will be labeled by content and marked with the appropriate classification. During planning for each test, the appropriate classification level for each anticipated media product will be determined from classification guides or by an original classification authority. Data classifications will be verified with participants during execution. Where classification is uncertain, data will be classified at the highest potential classification level until the JUAV Security Manager establishes the true classification.

General processes for handling classified data are similar to unclassified data except for protection and accountability. DoD Directive 5200.1-R, DoD Information Security Program, will govern classified data procedures. The JUAV Security Manager will provide oversight and technical guidance for all processes involving classified data. The JUAV Data Manager, programmers, analysts, and other staff will develop and execute data processes in accordance with guidance from the JUAV Security Manager and DoD Directive 5200.1-R.

Unclassified data, when necessary to facilitate transportation, storage, and analysis, may be mixed with classified data (e.g., data stored in the same container, server, or file). Merged classified and unclassified data shall be treated as classified data. In rare cases, it may be necessary to extract unclassified information from classified computer systems. The JUAV Security Manager will develop a rigorous process for extracting unclassified information from classified systems that ensures that the resulting file is truly unclassified.

In some cases, information derived from data analysis could have a higher classification than the raw data. The JUAV JT&E Security Classification Guide will establish criteria to determine the classification of information derived from analysis.

3.2.7 Data Management Organization

The data management and analysis organizations will be related. The JTF includes a Data Manager with overall responsibility for ensuring the quality and usability of the data. The JUAV Data Manager and JUAV lead analyst will work closely together to ensure that the appropriate data are collected. The JTF also includes an Instrumentation Engineer, a Programmer/Analyst, and a Data Librarian. The data management organization will be led by the Service Deputy for Test Operations and Data Management.

For each test, a data collection organization will be established from permanent JTF staff and augmentees. Augmentees may come from the venue, be detailed from the Services, or come from organizations that supply personnel for data collection and analysis. The data collectors will be organized into teams. These teams will be organized as necessary for the test, but each test should have a UAV team, a JAOC team, a forward Tactical C2 node team (e.g., E-2, E-3, TOC, FAC), and a WDP team. A central data collection team will be established that will accept collected data and convert them into a data

library and an initial database. The central data collection team will include the JUAV Instrumentation Engineer and will coordinate with personnel at each venue. The team will ensure the data are transported back to the JUAV facility at NASF.

3.2.8 Data Sources

Data sources depend on the test venues and on the mission areas for the trial. The data sources provide the opportunity to collect the required data.

3.2.8.1 Ft. Irwin/National Training Center

The JTF plans to conduct the Risk Reduction Mini-Test at NTC in January 2003. The JTF is coordinating with the Joint Close Air Support (JCAS) JT&E and NTC to conduct the test using existing NTC and JCAS infrastructure. The mission focus will be on Fire Support and Air Interdiction. Data will be collected from the GCS, JAOC, forward Tactical C2 node, and WDPs. Data will include automated data, such as TSPI, audio from organic radio and communications systems, videotapes, surveys of participants, and data from questionnaires, interviews, and manual data collection forms.

3.2.8.2 Naval Air Station Fallon

NASF will be used for FT-1. FT-1 will occur in July 2003 and will use the annual DR XI multi-Service training exercise as the venue. The mission focus will be on Personnel Recovery missions (CSAR and NEO). Additionally, Air Interdiction and CAS trials for fixed-wing aircraft will be conducted. Data will be collected from the GCS, from the Bravo Papa (BP) C2 center at NSAWC NASF, from E-2 (or E-3), and strike fighters. Data will include automated data, such as TSPI, audio and video tapes, surveys of participants, and data from collection forms.

3.2.8.3 Ft. Hood

FT-2 will be a dedicated test in January 2004 during a break in normal Ft. Hood rotational training. Initial plans for this test have been submitted to the Army Test Schedule and Review Committee (TSARC). Fire Support, including CAS and artillery, will be the primary mission area tested. Additionally, the Air Interdiction mission area for rotary-wing aircraft will also be tested. Instrumentation plans are being developed to collect TSPI, audio from radio systems, videotapes, surveys of participants, and data from collection forms.

3.2.8.4 Joint Validation Test Event

The JTF plans to validate JTTP, developed in the field tests, in a JVTE. The venue will be the JCIET04/JTFEX in the spring 2004 time frame. The JVTE will utilize collection systems in place within that venue, to be augmented as needed by the JTF. The exact date of the exercise has yet to be determined by JCIET and JFCOM.

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4.0 JUAV LEGACY PRODUCTS

4.1 DESCRIPTION

This chapter describes the legacy products of the JUAV JT&E project and the communities that will benefit from them.

Past experience has shown that early identification of customers and potential legacy products to meet customer requirements, as well as planning how to transition these products to customers, are critical to a successful JT&E project. Beginning with the inaugural JWAG meeting in August 2000, the JUAV staff has involved the customer in developing the JT&E to ensure products will be institutionalized after the project is completed. The JTF continues its efforts to formalize customer and legacy-product requirements. At this time, the primary customer base has representatives on the JWAG.

Legacy products are the items that need to be implemented based on the conclusions and recommendations of the JUAV JT&E project. The JUAV JT&E conclusions, recommendations, and legacy products will serve as catalysts for the future development and refinement of UAV JTTP for TSO after the JUAV JT&E concludes. JT&E products and recommendations will serve as the key items for future Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities (DOTMLPF) implementation plans. The JUAV JT&E will provide the following in support of a DOTMLPF implementation plan:

- Identified warfighter needs
- Recommendations for potential sponsors
- Validation of the needs with analysis from the field and validation tests
- Recommended goals
- Recommendations on measures
- Recommendations for the selection of C2 architectures employing UAV in TSO
- Recommendations of JTTP relating to C2 architectures employing UAV in TSO

The draft JUAV JT&E Legacy Product Plan will be submitted by 2 October 2002. It is expected that the Legacy Product Plan will remain a "living document" through the life of the JUAV JT&E project. The JTF will develop, document, and disseminate test findings, conclusions, and recommendations regarding dynamic Joint UAV operations to the warfighters, Combatant Commanders, JFCs, JS, and Services throughout the course of the JT&E.

4.2 LEGACY PRODUCTS

4.2.1 Updates to Joint and Multi-Service Documents

The JUAV JT&E will coordinate with the JS, JFCOM, Joint Warfighting Center (JWFC), and the Air Land Sea Application (ALSA) Center to apply relevant test results, lessons learned, and recommendations to Joint and multi-Service publications. As a minimum, these will include inputs to JTTP, Service TTP, Service SOPs, Training Syllabi, Manning Documents, ORDs, and JT&E conclusions and recommendations to address JUAV operational concepts. The JUAV JFS screened Joint and multi-Service publications and identified at least 40 that are deficient in terms of UAV JTTP. Among these are such publications as: FM 34-43, *RECCE-J Multiservice Procedures for Requesting Reconnaissance Information in the Joint Environment*; JP 3-05.2, *Joint TTP for Special Operations, Targeting, and*

Mission Planning (Draft); JP 3-09, *Doctrine for Joint Fire Support*; JP 3-09.1, *Joint TTP for Laser Designation Operations*; JP 3-09.3, *Joint TTP for Close Air Support (CAS)*; JP 3-50.2, *Doctrine for Joint Combat Search and Rescue;* JP 3-50.21, *Joint Tactics, Techniques and Procedures for Combat Search and Rescue*; JP 3-56.1, *Command and Control for Joint Air Operations*; and JP 3-60, *Joint Targeting* (Draft). The JUAV JT&E will also provide recommended modifications to appropriate sections of the Universal Joint Task List (UJTL) CJCSM 3500.04, which currently contains no operational or tactical UAV tasks for TSO.

4.2.2 Documentation of JUAV Processes to Support TSO at the Joint Force and Component Levels

The JUAV JT&E will focus on UAV operational concepts to support TSO in the Joint environment. Documenting and promulgating these concepts will allow operational commanders to objectively scrutinize their Service TTP. The JUAV JT&E will generate a compendium of data that will support developing concepts of operations and JTTP that most effectively support the prosecution of time-sensitive targets. This compendium will be structured to allow operational commanders to select appropriate JTTP with regards to the employed C2 architecture. It will serve as a guideline in the selection and structure of C2 architectures employing UAVs in TSO. Recommendations may concern proficiency standards, changes in the mix of UAV assets to support TSO, and UAV operator training improvements. The JS, JFCOM, combatant command staffs, Service staffs, and commanders and staffs of operational units will use these test results.

4.2.3 JUAV Analytical Database

The JUAV JT&E will generate a database that supports analysis of proposed JTTP for TSO at the JFCOM and component levels. The JUAV JT&E analysis products and validated database will be readily available to develop new UAV operational concepts, new JTTP, and new UAV systems operational requirements definitions for Service and Joint acquisition programs. In addition, the JUAV JT&E will provide the Combatant Commanders with a better understanding of current UAV combat-support capability.

4.2.4 JUAV Recommendations

Developing and evaluating proposed JTTP to integrate the UAV into TSO may highlight shortfalls in current training procedures. The JTF will work with appropriate agencies and commands to drive DOTMLPF changes to training UAV operators, JFCOM, and component staffs. Joint schools, as well as Service training schools, will be able to access test results and supporting data. The JTF will recommend potential changes to the UAV training curricula, if applicable. This approach will provide Service and Joint trainers with building blocks for tomorrow's training curriculum.

4.2.5 Other Tangible Products

The following are other tangible products from the JUAV JT&E:

- Briefings to flag officers
- Test reports
- Newsletter
- Multiple Web sites
- Variety of brochures
- Information booths at operational test-related conferences and symposia
- Technical papers

- Videos
- Interactive multimedia compact disks-read-only memory (CD-ROM)

4.3 LEGACY PRODUCT CUSTOMERS

4.3.1 Joint Force and Component Commanders

Identifying users, stakeholders, and sponsors is an important part of the DOTMLPF process. The JTF has identified the Combatant Commanders, JFCs, and their respective staffs who are responsible for planning, integrating, synchronizing, and executing Joint UAV operations as among those who will directly benefit from the JUAV JT&E project's DOTMLPF recommendations. These stakeholders and sponsors will provide equipment, personnel, and other operational resources necessary to conduct test activities. The JTF will, to the extent possible, conduct test activities as part of already scheduled training or testing events, often in a piggyback fashion. The Combatant Commanders and respective JFCs and staffs will benefit from improvement in JUAV capability.

4.3.2 Joint and Service Doctrine Development Agencies

Joint and Service doctrine development agencies and those intelligence agencies that provide support to military organizations [e.g., DIA, National Security Agency (NSA), etc.] will also benefit from the project's legacy products and DOTMLPF recommendations. Service doctrine development agencies will benefit from their participation in the JUAV JT&E through the improvement and testing of current TTP as well as through exercising approved multi-Service TTP (such as those developed through the ALSA and JWFC).

4.3.3 Joint and Service Training Organization

UAV units are organized, trained, and equipped according to their respective Service standards. Service participants in the JUAV JT&E will operate according to approved Joint and Service doctrine and TTP. The staffs of Joint and Service training schools will be the beneficiaries of the JUAV JT&E and will receive recommendations on revising their training curricula. Joint and Service training exercises will benefit from the results of this JT&E project by incorporating into their battle tactics UAV processes to support TSO.

4.3.4 Joint Terminology and Definitions

The JUAV JT&E will clarify key issues and identify ambiguous terms for Joint UAV TTP. Recommendations will be provided to the JS and appropriate organizations for possible publication into appropriate Joint media (e.g., Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms* series) and Joint doctrine.

4.4 INSTITUTIONALIZATION

The JTF will continuously provide feedback to the user community throughout the life of the JT&E. Using web-based technology and a continuous dialogue with customers, the JTF will be able to disseminate timely test results and recommendations during the execution of the JUAV JT&E. As these results are provided, customers can choose to implement recommended improvements.

4.5 LEGACY PRODUCT TRANSITION PLAN

The JTD will work with a variety of agencies and repositories to arrange for long-term proponents, funding, and management of the JUAV JT&E project's legacy products. This process began before the JUAV JT&E was chartered and will progress throughout the course of the project. After these arrangements have been formalized, the UAV community, Services, Combatant Commanders, and JFCs will be able to access what was learned and reap benefits long after the JUAV JT&E has concluded its charter.

5.0 JOINT TEST RESOURCES

This chapter describes anticipated resource requirements for the JUAV JT&E project. The Consolidated Resource Estimate (CRE) developed in the JFS remains valid. Information sources are identified throughout the text. As part of the normal project analysis process, the JUAV JT&E will conduct a review after each major test event. The CRE will be revised as necessary at that time to ensure project costs are realistic, relevant, affordable, and current. Revisions to the CRE will be presented to the DD, DT&E on an annual basis via the JT&E Program Office.

5.1 SITE REQUIREMENTS

5.1.1 Test Support Services

Executing test activities will require a broad range of support services. DTPs, developed and published in advance for the test events, will contain administrative and logistics sections which will specify the support services required and the responsible agencies that will provide the services. At the test facilities and ranges, the normal program introduction documents and statement of capability (PID/SOC) process will be used. This process will specify host services, such as on-site billeting and messing, instrumentation, communications, photography, meteorology, personnel administration, medical, morale and welfare, security, technical support, data services (quality control, collection, handling, reduction and processing), transportation, maintenance, supply, contract services, safety, environmental services, utilities, laboratory requirements, geodetic survey, flight-line services, and simulation support. Anticipated costs have been identified in the CRE and will be developed in detail as the DTP process matures and formal support agreements and arrangements are finalized.

5.1.2 Office and Test Equipment

The JTF will be based at NASF. The facility currently designated for the JTF is on the third floor of Building 304. Renovation of the space commenced in April 2001 and was completed in July 2001. These are Navy facilities provided under an agreement with NASF. Normal base facilities and services are available to the JTF.

Currently, the JUAV JT&E facility is capable of accommodating approximately 25 team members. Construction of a new building, located near the NSAWC, is currently supported by NASF and scheduled to be completed by summer of 2003. The JTF will move into the new facility upon completion of construction.

The JUAV JT&E will acquire and use support equipment from multiple sources. It will procure computers, office equipment, supplies, and communications equipment [e.g., radios, pagers, cell phones, electronic whiteboards, and presentation and video teleconference (VTC) equipment]. Test equipment will range from Personal Data Assistants (PDAs) to specialized instrumentation and notebook computers. Equipment may be rented or leased to support special projects or tests. If available, the required equipment will be redistributed from JT&E projects that are reaching the end of their charter.

5.2 JUAV JT&E MANNING

The JTF will be a dedicated, full-time test team that will manage all test planning, programming, execution, data collection, analysis, and reporting activities. Table 5-1 is a functional manpower requirement chart (see CRE for corresponding costs).

Table 5-1 Manpower Requirements

SOURCE	MILITARY	CIVILIAN	FFRDC	CONTRACTOR	TOTAL
USN	7	3	1	N/A	11
USA	6	0	N/A	N/A	6
USAF	3	0	N/A	N/A	3
USMC	2	0	N/A	N/A	2
Contractor	N/A	N/A	N/A	26	26
TOTAL	18	3	1	26	48

Government manpower requirements have been coordinated with the Army, Air Force, Navy, and Marine Corps, and Table 5-1 provides "high probability" Service staffing levels. Contractor staffing levels will be readdressed should the Services provide more or less than the planned staffing levels. The JTF will be augmented by designated part-time SMEs recruited for specific tasks, events, and surge periods. SMEs will be drawn from the operational and test and evaluation communities of each Service and selected agencies and will include military, civilian, and contractor personnel. SME support will be tailored to provide expertise in specific knowledge and experience areas of doctrine, training, tactics, operations, equipment, testing, planning, and analysis.

The JTD has been assigned by the Navy. Each of the participating Services will assign a Service Deputy or liaison who will serve as a focal point for his or her respective Service's concerns. Service deputies are each Service's senior representative and function as experts on UAV operations, TTP, resources, and technical support capabilities.

5.3 JUAV JT&E BUDGET

OSD provides the majority of JT&E funding. The Navy, as the Lead Service, provides additional Operations and Maintenance (O&M) funding as outlined in DoD Directive 5010.41 and the *Joint Test and Evaluation Handbook*. The JUAV JT&E forwards funding requirements to each participating Service and agency.

JT&E funding is governed by DoD 7110.1-M, *Budget Guidance Manual*, and applicable Service budget regulations. DoD 7110.1-M specifies that OSD reimburse incurred costs for the execution of the JT&E. The JUAV JT&E obtains funding from other government offices through Military Inter-departmental Purchase Requests (MIPRs). Anticipated overall costs are summarized in Table 5-2.

Table 5-2 Anticipated Overall JUAV JT&E Costs

	FY02	FY03	FY04	FY05
Service Personnel	$8,686,000	$13,501,000	$15,918,000	$10,577,000
Navy Infrastructure Support	$500,000	$600,000	$600,000	$300,000
OSD	$2,142,000	$4,368,000	$5,900,000	$2,000,000
TOTALS	**$11,328,000**	**$18,469,000**	**$22,418,000**	**$12,877,000**

5.4 RESOURCES PROVIDED BY LEAD AND SUPPORTING SERVICES

The Navy provides O&M funding support and manpower to the JTF. Funding is for civilian personnel, utilities, rentals, and administrative items. Administrative items are not specific or unique to a certain test (administrative computers and office equipment). Other Service resource support is manpower (each Service funds its own personnel), direct test support, and Service unique requirements.

The JUAV JT&E will coordinate with the Services to obtain project resources (funding, personnel, and materiel) required to support the JTF and test activities. The JTD will sign Letters of Agreement (LOA) and MOA to formalize arrangements and assign responsibilities and requirements between the JTF and external agencies. The JTF will review and update resource requirements as necessary, and will initiate, modify, or terminate agreements as required for the successful execution of its charter. New requirements will be forwarded through Service channels in accordance with the respective Service and DoD Directives. Annex C contains MOA that have been negotiated to date.

5.4.1 Air Force Test Resource Plan

Initial JUAV JT&E resource requirements have been submitted to the Air Force Operational Test & Evaluation Center (AFOTEC) to be included in the annual AFOTEC Test Resource Plan (TRP). To date, the JTF expects requested personnel to be available.

For follow-on resource reviews, the USAF Service Deputy will identify Air Force resources required by the JTF and will forward the requirements to AFOTEC to include in the TRP development process.

5.4.2 Army Outline Test Plan (OTP)

Initial JUAV JT&E resource requirements have been submitted to the ATEC to include in the annual ATEC OTP. To date, the JTF expects requested personnel to be available.

For follow-on resource reviews, the USA Service Deputy will identify Army resources required by the JTF and will forward the requirements to the ATEC to include in the OTP development process.

5.4.3 Navy Resources

Initial JUAV JT&E resource requirements have been discussed and coordinated with various elements within the Navy. The Navy does not have a systematic process or dedicated funding and manpower to support JT&E programs. For support other than manpower and direct funding, the Navy Service Deputy identifies required Navy resources and forwards them through the Test and Evaluation Division, Office of the Director of Test and Evaluation and Technologies Requirements (Reference

OPNAV N912). The Test and Evaluation Division assigns a Test and Evaluation Identification Number (TEIN) and allocates Navy resources to support the JT&E.

5.4.4 Marine Corps Resources

The USMC is very supportive of the JUAV JT&E and is providing support.

For follow-on resource reviews, the Marine Corps Service Deputy will identify respective Service resources required by the JTF and will forward the requirements to Headquarters Marine Corps for consideration.

5.5 RESOURCES PROVIDED BY OTHER PROGRAMS

The overwhelming majority of resources provided by other programs that will benefit the JUAV JT&E effort lie within the chosen test venues. These venues also provide embedded infrastructure, test planning, instrumentation, data collection and processing, logistics, security, and a host of other test support functions. Other programs and organizations will provide additional resources. A series of LOA and MOA will document resources to be provided by external agencies to support JUAV JT&E testing. External programs or organizations will be sought to provide funding for the JUAV JT&E legacy product implementation. Annex C contains MOA that have been negotiated to date.

6.0 JOINT TEST PROJECT MANAGEMENT OVERVIEW

This chapter addresses JUAV JT&E management issues and responsibilities. It also includes project reviews, reports, and additional items, as identified in the *JT&E Handboo*k.

6.1 ORGANIZATION

The JUAV JT&E has been established at NASF under the direction of a Navy Captain (O-6). Base facilities dedicated to the JTF will be capable of housing a test team of up to approximately 55 military, contractor, and civilian personnel. Figure 6-1 depicts the planned JTF organizational structure.

Within the organization, a small staff consisting of a Technical Director and Executive Assistant will directly support the JTD. The JTF organizational structure aligns functional responsibilities under active duty Service Deputy JTDs. Each Service Deputy will exercise functional oversight of his or her directorate for the purposes of project operations, test management, and support. Emphasis will focus on obtaining the correct mix of SMEs and analysts to support each directorate. The JTF will use temporary duty SME support on an as-required basis. Guardsmen and Reservists will be used when active duty personnel are unavailable. Additionally, the Service Deputies will represent their Service interests during the JUAV JT&E. Service representative responsibilities include advising the JTD and JTF on Service tactics, doctrine, techniques, resource requirements, JT&E technical support capabilities, and personnel issues. Table 6-1 describes the responsibilities of the key JTF members.

6.2 PROJECT REVIEWS

Project activities will be reviewed by three groups that provide management oversight for the JT&E:

- The GOSC includes representatives from all four Services, JFCOM, and OSD. Its purpose is to provide senior leadership guidance to the JT&E, advise the JTD on Service doctrine and priorities, and ensure adequate Service input and participation. The GOSC will meet annually to review test activities, update the charter as necessary, and receive an overview of future activities.
- The members of the JWAG are representatives of warfighting organizations at the O-4 and O-5 level. This group is a cross-section of the JUAV-TSO customer base, including the four Services, JFCOM, OSD, and other interested parties. The JWAG will meet at least twice a year to review the technical aspects of test results and planned test activities.
- The Technical Advisory Board (TAB) is an advisory group to OSD, external to the JT&E. It will provide a more general, macro-level technical review of and advice on JTF activities.

In addition, the JTF will meet with GOSC members, TAB mentors, and Combatant Commander sponsors to address Service issues and concerns as needed, and may participate in other program reviews as directed by DD, DT&E.

The JTF will conduct the following internal project reviews throughout the JT&E:

- Pre-test reviews will measure overall test readiness, with emphasis on training, coordination, data collection, and logistics preparations.
- Test progress reviews will occur daily during each test activity to monitor test execution.

- Post-test reviews will address housekeeping items, such as logistics of closing down the test site, safeguarding data, and redeployment issues.
- Internal-resource management review will occur periodically to ensure prudent financial management and effective budget execution.

All major documents, including DTPs, interim test reports, and the JT&E final report, will be reviewed externally prior to publication. These reviews will help ensure that test methods are appropriate and that the results are valid.

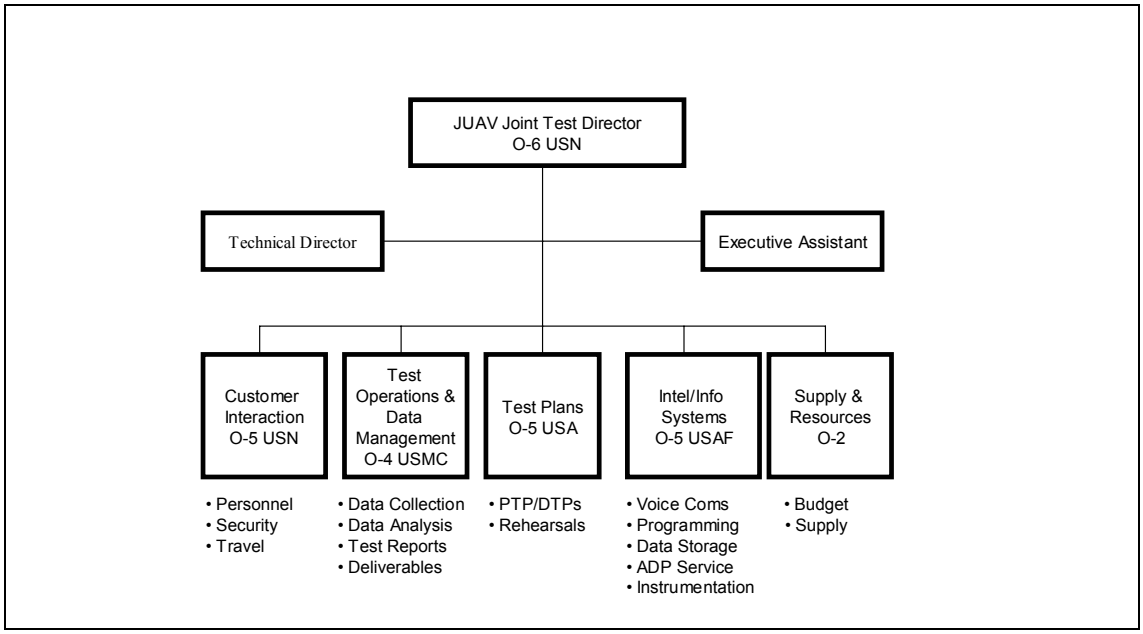

Figure 6-1 JUAV JTF Organization Chart

Table 6-1 Key Responsibilities

Position/Title	Key Responsibilities
Joint Test Director (JTD) **J00**	The ultimate responsibility of the JTD is to execute the JUAV JT&E project successfully and ensure project objectives are achieved on schedule and within budget. The JTD ensures that all aspects of each test activity are coordinated with Service components and that the results of these test activities are reported to OSD, the Services, the JS, and other appropriate agencies. The JTD is responsible for the safe execution of test events without adverse impact on the environment. The JTD is also responsible for the development and implementation of a comprehensive JUAV JT&E security plan and to protect sensitive aspects of the project.
Technical Director (TD) **J0T**	The TD acts as the principal advisor to the JTD on all technical matters pertaining to the JT&E. The TD is the coordinator for all discussions relative to project test objectives, data collection, analysis, and evaluations. The TD will participate in the review and approval of all test plans and reports.
Deputy for Customer Interactions (DCI) **J1**	The DCI is responsible for JTF administrative matters, physical information, personnel and operations security, facilities management, and coordinating the travel of the JTF. The DCI advises the JTD on Service-specific TTP and doctrine. The DCI team consists of personnel with administrative security and facilities management backgrounds.
Deputy for Test Operations & Data Management (DTODM) **J3**	The DTODM: • Is responsible for all test engineering, data collection and management, and data analysis efforts. • Is responsible for live test and live exercise coordination/integration, scheduling, operational test plan input, execution, data collection, and test reports. • Collects data on live test events and VRs to provide decision-making information on the adequacy of the procedures under investigation. • Advises the JTD on Service-specific TTP and doctrine. • Is responsible for legacy product management, transition planning and resourcing, and transition to recipient agencies. The DTODM's team consists of personnel with extensive technical experience.

Position/Title	Key Responsibilities
Deputy for Test Plans **J5**	The Deputy for Test Plans: • Is responsible for coordination of test planning, test support, and risk reduction operations. • Must ensure the simulations utilized are relevant to the project and provide appropriate fidelity to support VRs. • Develops the DTPs for each test event. • Advises the JTD on recommended JTTP inputs for investigation in risk reduction activities. • Advises the JTD on Service-specific TTP and doctrine. The Deputy for Test Plan's team consists of personnel with extensive operational experience.
Deputy for Intel/Info Systems (DIIS) **J6**	The DIIS: • Is responsible for design of the data archive, databases, tools, processes, and procedures for data retrieval and analysis. • Coordinates test plan and report inputs from the other directorates, has primary responsibility for developing the analysis- and data-related portions of test plans and reports. • Advises the JTD on Service-specific TTP and doctrine. The DIIS' team consists of engineers, data analysts and managers, operations analysts, and technicians who will ensure the security, validity, and quality control of all collected data.
Deputy for Supply Resources (DSR) **J8**	The DSR ensures contractual, financial, and logistic management support to the JTD, including budget tracking, financial data analyses, budget reporting, and financial information management activities. The DSR will maintain property book accounts, JTF inventories, and equipment accountability records.

6.3 JT&E REQUIRED REPORTS

The JTD must inform the DD, DT&E and JT&E Program Manager of the JUAV JT&E project's status. This appraisal will include problems encountered, solutions worked, unsolved problems, and assistance required. To facilitate this dialogue, the JT&E will publish the following reports:

6.3.1 Monthly Reports

In addition to technical and progress reviews, the JTD will provide a monthly project status or activity report to the JT&E Program Office. This report outlines JTF activities and summarizes plans for the near term. Details for completing this report are contained in the *JT&E Handbook*.

6.3.2 Joint Test Activity Reports

The Joint Test Activity Reports are submitted to communicate results of the field tests and the JVTE. These reports will thoroughly capture the JUAV JT&E data management and analysis construct, relevant instrumentation architecture, issues, and lessons learned. If unexpected circumstances occur,

multiple activity reports may be required. These reports provide an audit trail for developing and validating the JUAV JT&E project results, conclusions, and recommendations. Procedures will be developed to prevent release of premature conclusions based on anecdotal or incomplete information. On average, the field test reports will be published five to six months after the conclusion of the field test. This amount of time is needed to complete analysis and present it to the JWAG for critical operational review by the warfighter.

6.3.3 Special Reports

The JTD will submit special reports to DD, DT&E when critical problems occur that require immediate attention and are beyond the director's capability to resolve. Special reports will be generated as necessary to satisfy specific requests for data generated prior to completing a test activity or the final report. In case of a mishap (e.g., USN Class A or Class B equivalent) or death or injury to any person participating in the JT&E, the JTD will submit a telephonic report immediately to the DD, DT&E and JT&E Program Manager with a written report submitted within 24 hours. Service-specific reporting elements will also be followed.

6.3.4 Joint Test Final Report

OSD and Services will base their decision to implement the recommendations and institutionalize the legacy products arising from this JT&E project on the credibility and thoroughness of the Joint test final report. The JTD will ensure that the final report and associated briefings are supported by appropriate documentation. This report will detail the background and problem that generated the requirement for a Joint test as well as the scope, scenarios, methodologies, assumptions, limitations, findings, conclusions, and recommendations used in the JUAV JT&E. This report will specifically address instituting the JUAV JT&E legacy products and describe responsibility and funding source(s) required for support in the out-years. The JUAV JT&E project's Joint test final report will be properly coordinated with the OSD, JS, and Services. The report and all associated briefings will conform to formats established by the *JT&E Handbook*. The final draft of the final report is due to the JT&E Program Office for DD, DT&E signature 120 days prior to the JT&E project's closedown date.

6.3.5 JUAV Management Report

A JUAV management report will be prepared and submitted within 30 days of presenting the JUAV Joint test final report to DD, DT&E. The report will assess the accomplishment of the JUAV charter. Lessons learned regarding the establishment, organization, and management of future JT&Es, along with policies and procedures regarding efficiency and effectiveness, will be emphasized. The report will conform to all format and preparation requirements delineated in the *JT&E Handbook*.

6.4 JOINT TEST TRAINING REQUIREMENTS

The only JUAV JT&E training requirement envisioned at this time is the training of data collectors to collect the data and use appropriate forms. Prior to each M&S event and each field test, data collectors will be trained to use communication equipment unique to a particular facility or test. Data collectors will participate in rock drills at the JUAV facility prior to deploying to simulation events or field tests. Data collectors will be trained on all tools required, such as palmtop computers, video, voice, and digital data recordings. They will become familiar with the appearance of normal and abnormal operations at the node where data are to be collected. This training will enable them to annotate data appropriately. This feature is especially important when abnormal conditions occur (e.g., voice communications failure) so data may still be used for analysis. Team members will also be briefed about specific test venue rules and regulations.

6.5 SECURITY

The JUAV Security Manager is responsible for all aspects of security including security of collected data as well as physical access to JUAV JT&E facilities. The JUAV Security Plan is provided as Annex H.

6.6 SAFETY

Accomplishing the mission safely is the primary precedence. The JTF will follow host venue safety operating instructions, regulations, and procedures. Personnel are responsible for mishap prevention. Flight and ground safety is the responsibility of the command exercising operational control over platforms and personnel. Commanders will ensure equipment provided to support testing is used in accordance with applicable service technical manuals. When deployed, the JTD, or designated representative, is responsible for the overall safe conduct of all JT&E activities. DTPs and test readiness reviews address safety issues and hazard-mitigation plans. Any death or injury to a person or mishap of a major weapon system, such as an aircraft, will be immediately reported to the DD, DT&E and JT&E Program Manager with a written summary to follow within 24 hours of the incident. Procedures for government and contractor personnel will be established and published in each DTP.

6.7 ENVIRONMENTAL

The JUAV JT&E will be conducted on established DoD facilities and ranges. The JTF will coordinate with local environmental personnel and comply with all established laws and regulations. For each live test, the JUAV JT&E will comply with environmental-protection sensitivities and restrictions established by each applicable installation commander, approved by the U.S. Environmental Protection Agency, and defined in appropriate military installation documentation. Each test venue has environmental impact statements applicable to the proposed test activity. No adverse environmental impact is anticipated.

ANNEXES

ANNEX A: DEFINITIONS

ANNEX B: ACRONYMS AND ABBREVIATIONS

ANNEX C: JUAV JT&E MEMORANDA OF AGREEMENT

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Appendix F-1: Statistical Analysis Methodology

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ANNEX G: COMMAND AND CONTROL ARCHITECTURES

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ANNEX A DEFINITIONS

To ensure uniformity and a common understanding of terminology, this annex defines terms that are pertinent to the JUAV JT&E. Many entries were extracted from Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 23 March 1994.

AIR INTERDICTION: Air operations conducted to destroy, neutralize, or delay the enemy's military potential before it can be brought to bear effectively against friendly forces at such distance from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required. (JP 1-02)

AIRSPACE INTEGRATION: Actions conducted to ensure that multiple aircraft and/or weapons operate safely in a confined airspace in order to accomplish a common mission or task.

AIRSPACE MANAGEMENT: The coordination, integration, and regulation of the use of airspace of defined dimensions. (JP 1-02)

ALLOCATION: Assigning responsibility for engaging a specific target to a weapons delivery platform by a command and control node.

CLOSE AIR SUPPORT (CAS): Air action by fixed-wing and rotary-wing aircraft against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces. (JP 1-02)

DETECTION: In tactical operations, the perception of an object of possible military interest but unconfirmed by recognition. (JP 1-02)

DYNAMIC SEPARATION: A method of airspace control involving direct communication between air platforms.

ENGAGEMENT: A tactical conflict, usually between opposing lower echelons maneuver forces. (JP 1-02)

FIRE SUPPORT: Air attacks and naval and artillery gunfire that directly supports land, maritime, amphibious, and special operation forces to engage enemy forces, combat formations, and facilities in pursuit of tactical and operational objectives.

IDENTIFICATION: 1. The process of determining the friendly or hostile character of an unknown detected contact. 2. In ground combat operations, discrimination between recognizable objects as being friendly or enemy, or the name that belongs to the object as a member of a class. (JP 1-02)

INTERDICTION: An action to divert, disrupt, delay, or destroy the enemy's surface military potential before it can be used effectively against friendly forces. (JP 1-02)

ISSUE: A question that a nomination poses that a JT&E will resolve. Issues are questions that must be answered relative to concepts, procedures, system interfaces, or systems capabilities to resolve multi-Service problems or address multi-Service needs. (*JFS Handbook*, 1995)

JOINT TACTICS, TECHNIQUES, AND PROCEDURES (JTTP): The actions and methods that implement Joint doctrine and describe how forces will be employed in Joint operations. (JP 1-02)

MEASURES OF EFFECTIVENESS (MOE): Quantifiable values that express the effectiveness of the system or process under test. MOE must be calculated and use data to be collected to compute a quantity called the measure. (*JFS Handbook*, March 2002)

MEASURES OF PERFORMANCE (MOP): Measures that evaluate a capability or characteristic of a system or process under a specified set of conditions at the human-machine task level. (*JFS Handbook*, March 2002)

MISSION-LEVEL MEASURES (MLM): Measures that reflects the effects of a system or process on the overall mission of which the system or process is a part. (*JFS Handbook*, March 2002)

PALMTOP COMPUTER: A small computer that literally fits in your palm. Compared to full-size computers, palmtops are severely limited, but they are practical for certain functions such as phone books and calendars. Palmtops that use a pen rather than a keyboard for input are often called hand-held computers or Personal Data Assistants (PDAs). Palmtops are also called PDAs, hand-held computers and pocket computers. (802.11 Glossary from Planet.com)

PROCEDURAL CONTROL: A method of airspace control that relies on a combination of previously agreed and promulgated orders and procedures. (JP 1-02)

RECOGNITION: 1. The determination by any means of the individuality of persons, or of objects such as aircraft, ships, or tanks, or of phenomena such as communications-electronics patterns. 2. In ground combat operations, the determination that an object is similar within a category of something already known; e.g., tank, truck, man. (JP 1-02)

RECONNAISSANCE: A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. (JP 1-02)

SURVEILLANCE: The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means. (JP 1-02)

TARGET: A geographical area, complex, or installation planned for capture or destruction by military forces. (JP 1-02)

TARGET ACQUISITION: The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. (JP 1-02)

TARGETING: The process of selecting targets and matching the appropriate response to them, taking account of operational requirements and capabilities. (JP 1-02)

TIME-SENSITIVE OPERATIONS: Operations requiring immediate response because of a clear and present danger to friendly forces, the value of the resources involved, or the fleeting nature of the situation.

ANNEX B ACRONYMS AND ABBREVIATIONS

ABCCC	Airborne Battlefield Command and Control Center
ACO	Airspace Control Order
ACR	Armored Cavalry Regiment
ADATD	Air Defense Artillery Test Directorate
ADDS	Advanced Digital Display System
ADP	Automatic Data Processing
ADPE	Automatic Data Processing Equipment
ADSI	Air Defense System Integrator
ADSS	ATEC Decision Support System
AFATDS	Advanced Field Artillery Tactical Data System
AFOTEC	Air Force Operational Test and Evaluation Center
AFSERS	Air Force Synthetic Environment for Reconnaissance and Surveillance
AH	Attack Helicopter
AI	Airspace Integration
ALSA	Air Land Sea Application
ALSP	Aggregate-Level Simulation Protocol
AMC	Airborne Mission Commander
AMCOM	Aviation and Missile Command
AMRDEC	Aviation and Missile Research, Development and Engineering Center
ANG	Air National Guard
ANOVA	Analysis of Variance
APEX	Advanced Prototyping, Engineering, and Experimentation Laboratory
AT&L	Acquisition, Technology, and Logistics
ATEC	Army Test and Evaluation Command
ATO	Air Tasking Order
AV	Air Vehicle
AWACS	Airborne Warning and Control System

BDA	Bomb Damage Assessment
BHIVE	Battlefield Highly Immersive Virtual Environment
BLUFOR	Blue Force
BP	Bravo Papa, Strike Warfare C2 Center at NAS Fallon
BWF	Battle Watch Functions
BWO	Battle Watch Officer
C2	Command and Control
C3	Command, Control, and Communications
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAOC	Combined Air Operations Center
CAS	Close Air Support
CBSC	Combined Battle Simulation Center
CD-R	Compact Disk-Recordable
CD-ROM	Compact Disk-Read Only Memory
CFC	Combined Forces Command
CIB	Controlled Image Base
CIRPAS	Center for Interdisciplinary Remotely-Piloted Aircraft Studies
CJCSM	Chairman of the Joint Chiefs of Staff Memorandum
COE	Common Operating Environment
COMBAT	Combined Media Battle Analysis Tool
COMM	Communications
COMSEC	Communications Security
CONOPS	Concept of Operations
COP	Common Operating Picture
COTS	Commercial-Off-The-Shelf
CPX	Command Post Exercise

CRD	Capstone Requirements Documents
CRE	Consolidated Resource Estimate
CRTC	Combat Readiness Training Center
CSAR	Combat Search and Rescue
CSS	Control Station Surrogate
CVIC	Aircraft Carrier Information Center
D, S&TS	Director, Strategic and Tactical Systems
DCAT	Data Collection and Analysis Tool
DCC	Data Certification Committee
DCI	Deputy for Customer Interactions
DCW	Digital Chart of the World
DD, DT&E	Deputy Director, Developmental Test and Evaluation
DE	Data Element
DIA	Defense Intelligence Agency
DII	Defense Information Infrastructure
DII-COE	Defense Information Infrastructure—Common Operating Environment
DIIS	Deputy for Intel/Info Systems (JT&E Staff position)
DIR	Director
DIS	Distributed Interactive Simulation
DLNIF	Data-Link Network Integration Facility
DLS	Data Library System
DMAP	Data Management and Analysis Plan
DoD	Department of Defense
DOF	Degrees of Freedom
DOT&E	Director, Operational Test and Evaluation
DOTMLPF	Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities
DQRT	Data Quality Review Team
DR	Desert Rescue
DREN	Defense Research Engineering Network

DSR	Deputy for Supply Resources
DTED	Digital Terrain Elevation Data
DTODM	Deputy for Test Operations and Data Management
DTP	Deputy for Test Plans; Detailed Test Plan
EEFI	Essential Elements of Friendly Information
EO	Electro-Optic
FAA	Federal Aviation Administration
FAC	Forward Air Controller
FAC-A	Forward Air Controller, Airborne
FFRDC	Federally Funded Research and Development Center
FLIR	Forward-Looking Infrared
FM	Field Manual
FOIA	Freedom of Information Act
FOR	Field of Regard
FOUO	For Official Use Only
FOV	Field of View
FRTC	Fallon Range Training Complex
FS	Air Force Fighter Squadron
FSO	Facility Security Officer
FSTD	Fire Support Test Directorate
FT	Field Test (FT-1 and FT-2)
GCCS	Global Command and Control System
GCS	Ground Control Station
GOSC	General Officer Steering Committee
GPS	Global Positioning System
GSA	General Services Administration
GUI	Graphical User Interface
HLA	High-Level Architecture
HMLA	Marine Corps Light Attack Helicopter Squadron

HMMWV	High Mobility Multipurpose Wheeled Vehicle
HPC	High Performance Computing
HPCDC	High Performance Computing Distributed Center
HPCMP	High Performance Computing Modernization Programs
HQ	Headquarters
HS	Navy Helicopter Squadron
HUD	Heads Up Display
I&W	Indications and Warning
IBAR	Integrated Battlespace Arena
ID	Identification; Infantry Division
IDEFM	Integration Definition for Function Modeling
IDRL	Integrated Data Requirements List
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IR	Infrared
IRIG	Inter-Range Instrumentation Group
IRST	Infrared Surveillance Targeting
ISR	Intelligence, Surveillance, and Reconnaissance
IZLID	Infrared Zoom Laser Illuminator Designator
JAOC	Joint Air Operations Center
JC2	Joint Command and Control
JCAS	Joint Close Air Support JT&E
JCIET	Joint Combat Identification Evaluation Team
JCS	Joint Chiefs of Staff
JFC	Joint Force Commander
JFCOM	Joint Forces Command
JFS	Joint Feasibility Study
JFSR	Joint Feasibility Study Report
JMTK	Joint Mapping Toolkit
JOTBS	Joint Operational Test Bed System

JP	Joint Publication
JS	Joint Staff
JSF	Joint Strike Fighter
JSTARS	Joint Surveillance Target Attack Radar System
JT&E	Joint Test and Evaluation
JTC/SIL	Joint Technology Center/Systems Integration Laboratory
JTD	Joint Test Director
JTF	Joint Test Force
JTFEX	Joint Task Force Exercise
JTTP	Joint Tactics, Techniques, and Procedures
JUAV	Joint Unmanned Aerial Vehicle
JUAV-TSO	Joint Unmanned Aerial Vehicle in Time-Sensitive Operations
JVTE	Joint Validation Test Event
JWAG	JUAV Warfighter Advisory Group
JWFC	Joint Warfighting Center
LAN	Local Area Network
LCD	Liquid Crystal Display
LGB	Laser-Guided Bomb
LOA	Letters of Agreement
M&S	Modeling and Simulation
M&S WG	Modeling and Simulation Working Group
MANPADS	Man Portable Air Defense Systems
MIPR	Military Interdepartmental Purchase Request
MLM	Mission-Level Measures
MOA	Memoranda of Agreement
MOE	Measures of Effectiveness
MOP	Measures of Performance
MOU	Memorandum of Understanding
MOUT	Military Operations in Urban Terrain

MPO	Mission Payload Operator
MS	Microsoft
MSN	Mission
MSEL	Master Scenario Events List
MUSE	Multiple Unified Simulation Environment
NAS	Naval Air Station
NASF	Naval Air Station Fallon (NV)
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NAWCWD	Naval Air Warfare Center, Weapons Division
NAWS	Naval Air Weapons Station
NEO	Non-combatant Evacuation Operation
NIMA	National Imagery and Mapping Agency
NISPOM	National Industrial Security Program Operating Manual
NMCI	Navy/Marine Corps Intranet
NSA	National Security Agency
NSAWC	Naval Strike and Air Warfare Center
NSW	Naval Special Warfare
NTC	National Training Center
NTFS	Microsoft Windows NT File System
O&M	Operations and Maintenance
OPFOR	Opposing Force
OPNAV	Office of Naval Operations
OPS	Operations
OPSEC	Operations Security
ORD	Operational Requirements Documents
OSD	Office of the Secretary of Defense
OSS	Operations Support Squadron
OTC	Operational Test Command

OTP	Operational Test Plan; Outline Test Plan
OUSD for AT&L	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
PDA	Personal Data Assistant
PEC	Precision Engagement Center
PID/SOC	Program Introduction Documents and Statements of Capability
POC	Point of Contact
PTP	Program Test Plan
PTW	Precision Targeting Workstation
QA	Quality Assurance
QC	Quality Control
RAID	Redundant Array of Independent Disks
RESCAP	Rescue Combat Air Patrol
RESCORT	Rescue Escort
RMC	Rescue Mission Commander
ROC	Range Operations Center
ROE	Rules of Engagement
ROZ	Restricted Operating Zone
RP	Rescue Platform
S&T	Science and Technology
S&TS	Strategic and Tactical Systems
SACC	Supporting Arms Coordination Center
SADL	Situation Awareness Data Link
SAR	Synthetic Aperture Radar
SATCOM	Satellite Communications
SCG	Security Classification Guide
SCI	Sensitive Compartmented Information
SDREN	Secret Defense Research and Engineering Network
SEAD	Suppression of Enemy Air Defenses

SF	Special Forces
SIAP	Single Integrated Air Picture
SIM	Simulation
SIPRNET	Secret Internet Protocol Router Network
SM	Security Manager
SMA	Subject Matter Analyst
SME	Subject Matter Expert
SOF	Special Operations Forces
SPECOPS	Special Operations
SPINS	Special Instructions
SPSS	Statistical Package for the Social Sciences
SRU	Search and Rescue Unit
SSO	Special Security Office
STU	Secure Telephone Unit
T&E	Test and Evaluation
TAB	Technical Advisory Board
TACAIR	Tactical Aircraft
TACP	Tactical Air Control Party
TACTS	Tactical Air Combat Training System
TCT	Time-Critical Target
TD	Target Designation; Technical Director
TDY	Temporary Duty
TEIN	Test and Evaluation Identification Number
TESA	Test and Evaluation Support Activity
TOC	Tactical Operations Center
TRP	Test Resource Plan
TSARC	Test Schedule and Review Committee
TSO	Time-Sensitive Operations
TSPI	Time-Space-Position Information

TTP	Tactics, Techniques, and Procedures
UAV	Unmanned Aerial Vehicle
UAV BL	Unmanned Aerial Vehicle Battlelab
UGV	Unmanned Ground Vehicle
UHF	Ultra High Frequency
UJTL	Universal Joint Task List
UPD	Unmanned Aerial Vehicle (UAV) Product Distribution
UK	United Kingdom
USFK	United States Forces Korea
USMTF	United States Message Text Format
VAQ	Navy Electronic Warfare Squadron
VAW	Navy Early Warning Squadron
VC	Navy Composite Squadron
VF	Navy Fighter Squadron
VFA	Navy Fighter Attack Squadron
VISLAB	Visual Presentation Lab
VPF	Virtual Prototype Facility
VR	Virtual Rehearsal
VRSG	Virtual Reality Scene Generator
VSAT	Video Satellite
VTC	Video Teleconference
VV&A	Verification, Validation, and Accreditation
VV&C	Verification, Validation, and Certification
WAM	Warfare Assessment Model
WDP	Weapon Delivery Platform
WPN	Weapon

ANNEX C JUAV JT&E MEMORANDA OF AGREEMENT

The JUAV JT&E has concluded or is negotiating memoranda of agreement (MOA) with various agencies to support the JT&E. The following is a list of the MOA:

- US Joint Forces Command, Norfolk, VA (signature on file, page C-5)
- Naval Strike and Air Warfare Center, NAS Fallon, NV (signature pending, page C-9)
- JCAS JT&E, Eglin AFB, FL (signature pending, page C-12)
- Integrated Battlefield Arena (IBAR), Naval Air Weapons Center, Weapons Division, China Lake, CA (signature pending, page C-15)
- US Forces Korea (signature pending, page C-20)
- Advanced Prototyping, Engineering, and Experimentation (APEX) Lab, U.S. Army's Aviation and Missile Command, Redstone Arsenal, AL (signature pending, page C-23)
- OTP submissions to Army TSARC process (description, page C-25)

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MEMORANDUM OF UNDERSTANDING
BETWEEN
UNITED STATES JOINT FORCES COMMAND
NORFOLK, VIRGINIA
AND
DIRECTOR, JOINT UNMANNED AERIAL VEHICLE IN TIME-SENSITIVE OPERATIONS JOINT TEST AND EVALUATION,
NAS FALLON, NEVADA

1. PURPOSE: To outline and identify responsibilities between the United States Joint Forces Command (USJFCOM) and Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E). This Memorandum of Understanding (MOU) allows the personnel from each organization to collaborate with each other to ensure sufficient planning and coordination are accomplished to meet the mission and objectives of both organizations.

AUTHORITY: Department of Defense (DoD) Directive 5010.41, Joint Test and Evaluation (JT&E) Program.

2. GENERAL: The JUAV-TSO JT&E is an Office of the Secretary of Defense (OSD)-managed program. It reports to the Deputy Director, Developmental Test and Evaluation (DD, DT&E), under the Director, Strategic and Tactical Systems (S&TS), Office of the Under-Secretary of Defense for Acquisition, Technology, and Logistics (OUSD for AT&L). Per DoD Directive, the purpose of the OSD-managed JT&E program is to bring two or more Military Departments together to assess the interoperability of Service systems in Joint operations and to explore potential solutions to identified problems. Specifically, the JUAV-TSO JT&E is chartered by OSD to employ multi-Service and other DoD agency support personnel and equipment to test, evaluate, and make recommendations to improve the integration of unmanned aerial vehicles (UAVs) into time-sensitive combat operations at the tactical level of warfare. In contrast to today's platform-dependent, Service-centric UAV tactics, techniques, and procedures (TTP), the JUAV-TSO JT&E will assist with the development of platform-independent, Joint UAV TTP.

3. SCOPE: USJFCOM Directors and the Director of the JUAV-TSO JT&E recognize that both organizations will benefit from observation, data collection, coordination, collaboration, and participation in meetings, events, exercises, and tests. The JUAV-TSO JT&E planned test venues (e.g., Desert Rescue, MAWTS-1 WTI, etc.) are defined in the JUAV-TSO JT&E Program Test Plan (PTP). Specific coordination requirements are described in the following paragraphs:

a. USJFCOM:

- Notify and invite JUAV-TSO JT&E to participate at applicable planning conferences and meetings.
- Allow representatives to coordinate with appropriate JUAV-TSO JT&E Joint Test Force (JTF) staff members on test venues and UAV TTP development.
- Participate in the JUAV-TSO JT&E planning process and support the development of measures of effectiveness and measures of performance.
- Director of Joint Experimentation (J9) will participate as the chairman of the JUAV-TSO General Officer Steering Group.
- Provide access to USJFCOM tasked UAV assets including the Joint Operational Test Bed System (JOTBS) through the JOTBS scheduling and prioritization process.

b. JUAV-TSO JT&E:

- Plan for and fund costs for any JUAV-TSO JT&E participation in USJFCOM events, exercises, additional targets (if uniquely required for JUAV-TSO), participants, and instrumentation needed to satisfy JT&E unique objectives.
- Invite USJFCOM to participate at the JUAV-TSO JT&E Warfighter Advisory Group (JWAG) meetings and JT&E tests.

4. RESPONSIBILITIES:

a. Financial Management: USJFCOM and JUAV-TSO JT&E will separately fund their respective activities and personnel, including salary and travel expenses.

b. Planning: USJFCOM and JUAV-TSO JT&E will invite each other to planning conferences and other significant planning events. JUAV-TSO JT&E will use the existing USJFCOM planning process to plan for participation in events such as Millennium/Olympic Challenge and Roving Sands to include schedules, operations, logistics, and data collection.

c. Analysis and Reporting: JUAV-TSO JT&E will coordinate their observation and data collection activities with USJFCOM during events and exercises to avoid duplication of effort. USJFCOM and JUAV-TSO JT&E will share data from events where JUAV-TSO JT&E participates. This will be accomplished on a non-interference basis with the exercises.

d. Liaison: USJFCOM and JUAV-TSO JT&E will assign points of contact to coordinate activities and attend applicable planning meetings.

5. AGREEMENT AND ADMINISTRATION:

a. Effective Date: This MOU is effective when signed by both parties.

b. Changes: Both parties will review this agreement annually. This MOU may be amended in writing by mutual agreement of both parties. Either party may formally terminate this agreement by providing written notification.

c. Expiration Date: This MOU will remain in effect until superseded or rescinded.

d. The provisions of this MOU apply to USJFCOM staff, JUAV-TSO JT&E staff, and their contractors.

Signed Copy on File	Signed Copy on File
_____	_____
David A. Rogers	Jack R. Holbein
Captain, U. S. Navy	Major General, U. S. Air Force
Director, JUAV-TSO JT&E Joint Test Force	Chief of Staff, U. S. Joint Forces Command
_____	_____
DATE	DATE

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MEMORANDUM OF AGREEMENT
BETWEEN
COMMANDER, NAVAL STRIKE AND AIR WARFARE CENTER
NAVAL AIR STATION FALLON, NEVADA
AND
THE OFFICE OF THE SECRETARY OF DEFENSE
JOINT UNMANNED AERIAL VEHICLES
JOINT TEST AND EVALUATION JOINT TEST FORCE
NAVAL AIR STATION FALLON, NEVADA

1. Purpose. This memorandum establishes an agreement between the Naval Strike and Air Warfare Center (NSAWC) and the Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E) to collect and analyze data from NSAWC hosted training exercises at Naval Air Station Fallon, NV, in order to develop Joint tactics, techniques and procedures (JTTP) for Unmanned Aerial Vehicles (UAVs).

2. Authorization. This memorandum of agreement is authorized and executed by the Commander, NSAWC, and the Director, JUAV-TSO JT&E.

3. Agreement. NSAWC and JUAV-TSO JT&E agree to a two-year (2002-2003) cooperative effort for collecting data during periodic carrier air wing rotational training and the annual Desert Rescue (DR) exercise. JUAV-TSO JT&E agrees to analyze the data and provide recommendations to DR participants regarding integration of UAVs.

4. Responsibilities.

a. NSAWC will:

(1) Advocate DR exercise scenarios that utilize UAVs.

(2) Request written JUAV-TSO JT&E funding commitment prior to obligation of funds to cover the implementation of these memorandum of agreement provisions, which are beyond the scope of normal exercise or operational commitments.

(3) Assist JUAV-TSO JT&E in gaining access to the Fallon Range Training Complex and information for collecting necessary data to meet the terms of this Agreement. Specifically this includes:

(a) Access to DR mission planning cells, briefing/de-briefing rooms and the Range Operations Center (ROC).

(b) Access to exercise scripting, TTP and standard operating procedures (SOPs).

(c) Access to VTC equipment and meetings where UAV TTP are discussed.

(4) Advise JUAV-TSO JT&E on:

(a) Issues, goals, and objectives that will impact UAV integration before and during DR.

(b) Local safety, environmental, uniform, force protection, and communication and security requirements for JUAV-TSO JT&E personnel.

(c) Recommended data collection procedures specific to the Fallon Range Training Complex (FRTC).

b. JUAV-TSO JT&E, in conducting a JT&E as chartered by the Office of the Secretary of Defense, will use NSAWC's DR exercise to develop UAV JTTP to enhance the effectiveness of UAV integration in Combat Search and Rescue (CSAR) missions. Specifically, JUAV-TSO JT&E will:

(1) Provide NSAWC with the final project report, which will include a detailed written analysis of UAV command and control procedures used during DR and recommended changes to existing TTP, SOPs, and other warfighting documents that will enhance the integration of UAVs.

(2) Work with DR exercise staff to obtain appropriate representations of trackable UAV events within exercise play.

(3) Appoint a JUAV-TSO JT&E representative to coordinate participation in DR through the designated NSAWC representative for this memorandum of agreement.

(4) Design a minimally intrusive but comprehensive data collection plan that captures information on the effectiveness of UAV integration. The plan should include the number of observers, location of data collection nodes, access needed to components and facilities, collection tools, communication requirements, automated information systems equipment, administrative support, and any other essential elements. The plan must be prepared and submitted prior to the DR Final Planning Conference (FPC) for NSAWC review and approval.

(5) Provide NSAWC reimbursement for any unfunded obligations as agreed in paragraph 4.a. (2) above.

(6) Coordinate all transportation, billeting, administrative, and logistical support for the JUAV JTF while at NAS Fallon. JUAV-TSO JT&E is responsible for funding its own expenses.

(7) Coordinate security clearances and handling of classified information with the NSAWC security office.

(8) Participate in initial, mid, and final planning conferences and comply with suspense dates as appropriate.

5. Administration.

a. This memorandum of agreement and its provisions are the responsibility of the Commander, NSAWC and the Director, JUAV-TSO JT&E. It becomes effective with the signatures of the Deputy Commander and the Director, JUAV-TSO JT&E. JUAV-TSO JT&E is appointed the coordinating authority for this memorandum of agreement, and as such, is responsible for initiating its annual review. Each organization will appoint a representative to administer this memorandum of agreement and will advise the other signatory of any necessary changes.

b. Direct coordination and liaison are authorized between representatives of NSAWC and JUAV-TSO JT&E.

c. This memorandum of agreement can be modified at any time by written agreement of the signatories. Review of this agreement will be conducted each year on the anniversary of its approval and as necessary to ensure currency and accuracy. JUAV-TSO JT&E is the lead organization for this annual review. Changes must be in writing, mutually agreed upon by all parties, and signed as amendments to the memorandum of agreement.

d. This memorandum of agreement will terminate 31 December 2003, or upon completion of the JUAV-TSO JT&E. This memorandum of agreement can also be terminated earlier by either party upon 60 days written notification.

(Signature Pending)	(Signature Pending)
_____	_____
David A. Rogers	John M. Sherman
Captain, U. S. Navy	Captain, U. S. Navy
Director, JUAV-TSO JT&E Joint Test Force	Naval Strike and Air Warfare Center
_____	_____
DATE	DATE

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MEMORANDUM OF AGREEMENT
BETWEEN
JOINT UNMANNED AERIAL VEHICLES (JUAV)
JOINT TEST FORCE (JTF),
AND
JOINT CLOSE AIR SUPPORT (JCAS) JTF

PURPOSE: The purpose of this memorandum of agreement is to establish a working relationship and define roles and responsibilities between the JUAV-TSO JT&E JTF, and the JCAS JTF in support of the JUAV Risk Reduction Mini-Test, which is tentatively scheduled for January 2003, in conjunction with NTC Rotation 03-04.

BACKGROUND: On 02 October 2001, the Office of the Undersecretary of Defense; Director, Strategic and Tactical Systems (OUSD; S&TS), in coordination with general officer representatives of each of the Services, the Unified Commands and the Joint Staff, chartered the JUAV-TSO JT&E to "investigate, evaluate and make recommendations to improve the effectiveness of Unmanned Aerial Vehicles (UAVs)." JUAV-TSO JT&E will measure and compare today's "platform-dependent, Service-centric UAV TTP" against an alternative set of platform-independent, Joint Tactics, Techniques, and Procedures (TTP). To address these issues, the JUAV-TSO JT&E JTF will conduct field tests to quantitatively and qualitatively evaluate the proposed TTP. These tests will be designed to collect data necessary to answer the JT&E's charter objectives and will be structured around real-world operational scenarios using representative warfighting forces and systems.

TERMS OF AGREEMENT:

a. JCAS responsibilities:

(1) Act as the lead host organization for the JUAV-TSO JT&E Risk Reduction Mini-Test.

(2) Interface with the NTC staff and all supporting organizations at Ft. Irwin for the planning and execution of JUAV-TSO JT&E Risk Reduction Mini-Test.

(3) When possible, participate in planning conferences.

(4) Review and comment on the JUAV-TSO JT&E Risk Reduction Mini-Test Detailed Test Plan (DTP) within 30 days of receipt.

(5) Schedule use of Ft. Irwin training ranges and associated instrumentation to support test execution during normal (agreed upon) operating hours.

(6) Provide observations and lessons learned on test planning and execution upon completion of the test.

(7) Each organization will fund travel for their respective personnel.

b. JUAV-TSO JT&E JTF responsibilities:

(1) Provide JCAS with facility and instrumentation requirements.

(2) Provide JCAS with a detailed list of logistical requirements to support the Risk Reduction Mini-Test.

(3) Provide JCAS with a JUAV-TSO JT&E Risk Reduction Mini-Test DTP at least 60 days prior to the commencement of the exercise.

(4) Review and approve support concepts, plans, and developments.

(5) Coordinate with JCAS JTF for recommendations and consultation before making decisions regarding JTF test event support.

(6) Based on an agreed Statement of Charges (SOC), provide funding for NTC activities to JCAS via Military Interdepartmental Purchase Request (MIPR) to accomplish required JTF support.

(7) Each organization will fund travel for their respective personnel.

IMPLEMENTATION, MANAGEMENT, AND TERMINATION OF THE MEMORANDUM OF AGREEMENT:

a. This agreement will be effective upon signature by both parties and will remain effective through 28 June 2003 (this will allow for data reduction, validation, and reporting) or upon a future date mutually acceptable to all parties.

b. Either party may terminate the memorandum of agreement with 90-day's notice in writing. In the event of such termination, all unexecuted funds previously provided to the JCAS by the JUAV-TSO JT&E will be returned.

c. This memorandum of agreement may be amended by mutual consent of all parties, in writing.

(Signature Pending)	(Signature Pending)
_____	_____
David A. Rogers Captain, U. S. Navy Director, JUAV-TSO JT&E Joint Test Force	David Brown Colonel, U. S. Air Force Director, JCAS JTF
_____	_____
DATE	DATE

MEMORANDUM OF UNDERSTANDING
BETWEEN
INTEGRATED BATTLESPACE ARENA
NAVAL AIR WEAPONS STATION CHINA LAKE CALIFORNIA,
AND
DIRECTOR, JOINT UNMANNED AERIAL VEHICLE in TIME-SENSITIVE OPERATIONS (JUAV-TSO) JOINT TEST AND EVALUATION,
NAS FALLON, NEVADA

1. PURPOSE: To outline and identify responsibilities between the Integrated Battlespace Arena (IBAR) and Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E). This Memorandum of Understanding (MOU) allows the personnel from each organization to collaborate with each other to ensure sufficient planning and coordination are accomplished to meet the mission and objectives of both organizations.

AUTHORITY: Department of Defense (DoD) Directive 5010.41, Joint Test and Evaluation (JT&E) Program.

2. GENERAL: The JUAV-TSO JT&E is an Office of the Secretary of Defense (OSD)-managed program. It reports to the Deputy Director, Developmental Test and Evaluation (DD, DT&E), under the Director, Strategic and Tactical Systems (S&TS), Office of the Under-Secretary of Defense for Acquisition, Technology, and Logistics (OUSD for AT&L). Per DoD Directive, the purpose of the OSD-managed JT&E program is to bring two or more Military Departments together to assess the interoperability of Service systems in Joint operations and to explore potential solutions to identified problems. Specifically, the JUAV-TSO JT&E is chartered by OSD to employ multi-Service and other DoD agency support personnel and equipment to test, evaluate, and make recommendations to improve the integration of unmanned aerial vehicles (UAVs) into time-sensitive combat operations at the tactical level of warfare. In contrast to today's platform specific, Service-centric UAV tactics, techniques and procedures (TTP), JUAV-TSO JT&E will assist with development of platform-independent, Joint UAV TTP.

3. SCOPE: IBAR Directors and the Director of the JUAV-TSO JT&E recognize that both organizations will benefit from collaboration and participation in meetings, events, and modeling and simulation (M&S) exercises to take place at the IBAR. JUAV-TSO JT&E plans M&S federations with various models (e.g., JANUS, UFL, APEX, etc.) are defined in the JUAV-TSO JT&E Program Test Plan (PTP). Specific coordination requirements are described in the following paragraphs:

a. IBAR:

- Notify and invite JUAV-TSO JT&E to participate at applicable planning conferences and meetings.
- Allow representatives to coordinate with appropriate JUAV-TSO JT&E Joint Test Force (JTF) staff members on M&S events and federations.
- Participate in the JUAV-TSO JT&E planning process and support the development of measures of effectiveness and measures of performance.
- Provide access to UAV M&S assets including the IBAR MUSE through a scheduling and prioritization process.
- Provide JUAV-TSO JT&E with a financial breakdown for each M&S event.

b. JUAV-TSO JT&E:

- Plan for and fund costs for any JUAV-TSO JT&E participation in IBAR events, participants, and instrumentation needed to satisfy JT&E-unique objectives.
- Invite IBAR to participate at JUAV-TSO JT&E Warfighter Advisory Group (JWAG) meetings and JUAV-TSO JT&E tests.
- JUAV-TSO JT&E will fund IBAR for the M&S events within the allowable scope of a JT&E.

4. RESPONSIBILITIES:

a. Financial Management: IBAR and JUAV-TSO JT&E will separately manage their respective activities and personnel, including salary and travel expenses.

b. Planning: IBAR and JUAV-TSO JT&E will invite each other to planning conferences and other significant planning events. JUAV-TSO JT&E will use the existing IBAR planning process.

c. Analysis and Reporting: JUAV-TSO JT&E will coordinate their observation and data collection activities with IBAR during events and exercises to avoid duplication of effort. IBAR and JUAV-TSO JT&E will share data from events where JUAV-TSO JT&E participates. This will be accomplished on a non-interference basis with the exercises.

d. Liaison: IBAR and JUAV-TSO JT&E will assign points of contact to coordinate activities and attend applicable planning meetings.

5. AGREEMENT AND ADMINISTRATION:

a. Effective Date: This MOU is effective when signed by both parties.

b. Changes: Both parties will review this agreement annually. This MOU may be amended in writing by mutual agreement of both parties. Either party may formally terminate this agreement by providing written notification.

c. Expiration Date: This MOU will remain in effect until superseded or rescinded.

d. The provisions of this MOU apply to IBAR staff, JUAV-TSO JT&E staff, and their contractors.

(Signature Pending)	(Signature Pending)
_____	_____
David A. Rogers Captain, U. S. Navy Director, JUAV-TSO JT&E Joint Test Force	NAVAIR-Weapons Division
_____	_____
DATE	DATE

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MEMORANDUM OF AGREEMENT
BETWEEN
HEADQUARTERS UNITED STATES FORCES KOREA
YONGSAN ARMY GARRISON, SEOUL, REPUBLIC OF KOREA
AND
THE OFFICE OF THE SECRETARY OF DEFENSE
JOINT UNMANNED AERIAL VEHICLES
JOINT TEST AND EVALUATION JOINT TEST FORCE
FALLON, NV

1. PURPOSE: This memorandum establishes an agreement between United States Forces Korea (USFK) and the Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E) Joint Test Force (JTF) to utilize select data collected from the annual Ulchi Focus Lens (UFL) exercise to:

a. Improve Combined Forces Command (CFC) ability to integrate unmanned aerial vehicles (UAVs) in support of Joint and combined operations.

b. Help evaluate and improve the operational effectiveness of Joint Force UAV Tactics, Techniques, and Procedures (TTP).

2. AUTHORIZATION: This memorandum of agreement is authorized and executed by the Assistant Chief of Staff for Intelligence, USFK, and the Director, JUAV-TSO JT&E.

3. AGREEMENT: USFK and JUAV-TSO JT&E agree to a three-year (2002-2004) cooperative planning effort for the purpose of collecting data during annual UFL exercises on CFC's UAV command and control processes and procedures, analyzing this data and recommending enhancements to CFC.

4. RESPONSIBILITIES:

a. USFK represents JUAV-TSO JT&E within CFC to obtain the support needed to perform the data collection that the JT&E requires to meet the terms of this Agreement. Specifically, USFK will:

(1) Advocate UFL exercise scenarios containing a representative sample of realistic, trackable UAV events appropriate for the particular phase of hostilities being replicated in the exercise.

(2) Request and obtain written JUAV-TSO JT&E funding commitment prior to obligation of funds to cover the implementation of the memorandum of agreement provisions, which are beyond the scope of normal exercise or operational commitments.

(3) Assist JUAV-TSO JT&E in gaining access to CFC locations and information for collecting necessary data to meet the terms of this Agreement. Specifically, this includes:

(a) Access to and coordination with USFK components. This includes assistance in disseminating JUAV JTF personnel clearances to security offices and component/player sites.

(b) Access to Joint and component levels of UFL exercise play at player locations, simulation sites, and controller cells (to include White Cell access (Trusted Agent status) for selected JUAV JTF personnel at the Combined Battle Simulation Center (CBSC)).

(c) Access to exercise scripting; Tactics, Techniques, and Procedures (TTP); and standard operating procedures (SOPs).

(d) Access to VTC equipment and meetings where UAV TTP are discussed.

(e) Access to the Master Scenario Events List (MSEL) for UFL exercises.

(f) Access to information regarding the models, simulation, exercise directives, and the scenario plan.

(4) Advise JUAV-TSO JT&E on:

(a) Issues, goals, and objectives that will impact UAV TTP before and during UFL.

(b) Current and programmed upgrades to theater UAV systems, architectures, and TTP.

(c) Safety, environmental, uniform, force protection, communication, automatic data processing (ADP), and security requirements for JUAV-TSO JT&E to be in compliance with in-country policies.

(d) How best to collect data on the command's UAV TTP.

b. JUAV-TSO JT&E, in conducting a JT&E as chartered by the Office of the Secretary of Defense, will use CFC's UFL series of exercises to evaluate the effectiveness of UAV TTP in support of Joint and combined operations. Specifically, JUAV-TSO JT&E will:

(1) Provide the USFK/J3 the final project report, which will include a detailed written analysis of UAV TTP used during UFL; recommendations of potential equipment, hardware, or software enhancements to the processes; and

recommended changes to existing TTP, SOPs, and other warfighting documents that will enhance the UAV integration of the command

(2) Recommend improvements to CFC's UAV TTP.

(3) Work with UFL exercise staff to obtain appropriate representations of trackable UAV events within exercise play.

(4) Appoint a JUAV JTF representative to coordinate participation in UFL through the designated USFK representative for this memorandum of agreement.

(5) Design a minimally intrusive but comprehensive data collection plan that captures information on the effectiveness of UAV TTP. The plan should include the number of observers, location of data collection nodes, access needed to components and facilities, collection tools, communication requirements, automatic data processing equipment (ADPE), administrative support, and any other essential elements. The plan must be prepared and submitted annually by the UFL Final Planning Conference (FPC) for USFK review and approval.

(6) Recommend prospective enhancements and assess the value-added of induced enhancements.

(7) Provide USFK or its components reimbursement for any unfunded obligations as agreed in paragraph 4.a. (2) above.

(8) Coordinate all transportation, billeting, administrative, and logistical support for the JUAV JTF while in theater. JUAV-TSO JT&E is responsible for funding its own expenses.

(9) Coordinate security clearances and handling of classified information with the USFK security office.

(10) Participate in initial, mid, and final planning conferences and comply with standard suspenses as appropriate.

5. ADMINISTRATION:

a. This memorandum of agreement and its provisions are the responsibility of the Assistant Chief of Staff for Intelligence, US Forces Korea and the Director, JUAV-TSO JT&E. It becomes effective with the signatures of the Assistant Chief of Staff for Operations, and the Director, JUAV-TSO JT&E. JUAV-TSO JT&E is appointed the coordinating authority for this memorandum of agreement, and as such, is responsible for initiating its annual review. Each organization will appoint a representative to administer this memorandum of agreement and will advise the other signatory of any necessary changes.

b. Direct coordination and liaison are authorized between representatives of USFK and JUAV-TSO JT&E.

c. This memorandum of agreement can be modified at any time by written agreement of the signatories. Review of this agreement will be conducted each year on the anniversary of its approval and as necessary to ensure currency and accuracy. JUAV-TSO JT&E is the lead organization for this annual review. Changes must be in writing, mutually agreed upon by all parties, and signed as amendments to the memorandum of agreement.

d. This memorandum of agreement will terminate 31 December 2004, or upon completion of the JUAV-TSO JT&E. This memorandum of agreement can also be terminated earlier by either party upon 60 days written notification.

(Signature Pending)	(Signature Pending)
_____	_____
David A. Rogers	Major General, U. S. Army
Captain, U. S. Navy	Assistant Chief of Staff, J3
Director, JUAV-TSO JT&E Joint Test Force	United States Forces Korea
_____	_____
DATE	DATE

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE ADVANCED PROTOTYPING, ENGINEERING, AND EXPERIMENTATION (APEX) LAB,
US ARMY'S AVIATION AND MISSILE COMMAND, SYSTEMS SIMULATION AND DEVELOPMENT DIRECTORATE, REDSTONE ARSENAL, ALABAMA
AND
DIRECTOR, JOINT UNMANNED AERIAL VEHICLE in TIME-SENSITIVE OPERATIONS JOINT TEST AND EVALUATION,
NAS FALLON, NEVADA

1. PURPOSE: To outline and identify responsibilities between APEX and Joint Unmanned Aerial Vehicle in Time-Sensitive Operations (JUAV-TSO) Joint Test and Evaluation (JT&E). This Memorandum of Understanding (MOU) allows the personnel from each organization to collaborate with each other to ensure sufficient planning and coordination are accomplished to meet the mission and objectives of both organizations.

2. AUTHORITY: Department of Defense (DoD) Directive 5010.41, Joint Test and Evaluation (JT&E) Program.

3. GENERAL: The JUAV-TSO JT&E is an Office of the Secretary of Defense (OSD)-managed program. It reports to the Deputy Director, Developmental Test and Evaluation (DD, DT&E), under the Director, Strategic and Tactical Systems (S&TS), Office of the Under-Secretary of Defense for Acquisition, Technology, and Logistics (OUSD for AT&L). Per DoD Directive, the purpose of the OSD-managed JT&E program is to bring two or more Military Departments together to assess the interoperability of Service systems in Joint operations and to explore potential solutions to identified problems. Specifically, the JUAV-TSO JT&E is chartered by OSD to employ multi-Service and other DoD agency support, personnel, and equipment to test, evaluate, and make recommendations to improve the integration of unmanned aerial vehicles (UAVs) into time-sensitive combat operations at the tactical level of warfare. In contrast to today's platform specific, Service-centric UAV tactics, techniques, and procedures (TTP), JUAV-TSO JT&E will assist with development of platform-independent, Joint UAV TTP.

4. SCOPE: APEX Directors and the Director of the JUAV-TSO JT&E recognize that both organizations will benefit from collaboration and participation in meetings, events, and modeling and simulation (M&S) exercises to take place at the APEX. JUAV-TSO JT&E plans M&S federations with various models (e.g., IBAR, UFL, APEX, etc.) are defined in the JUAV-TSO JT&E Program Test Plan (PTP). Specific coordination requirements are described in the following paragraphs:

a. APEX:

- Notify and invite JUAV-TSO JT&E to participate at applicable planning conferences and meetings.
- Allow representatives to coordinate with appropriate JUAV-TSO JT&E Joint Test Force (JTF) staff members on M&S events and federations.
- Participate in the JUAV-TSO JT&E planning process and support the development of measures of effectiveness and measures of performance.
- Provide access to M&S assets including the APEX MUSE and BHIVE through a scheduling and prioritization process.
- Provide JUAV-TSO JT&E with a financial breakdown for each M&S event.

b. JUAV-TSO JT&E:

- Plan for and fund costs for any JUAV-TSO JT&E participation in APEX events, participants, and instrumentation needed to satisfy JT&E-unique objectives.
- Invite APEX to participate at JUAV-TSO JT&E Warfighter Advisory Group (JWAG) meetings and JUAV-TSO JT&E tests.
- JUAV-TSO JT&E will fund APEX for the M&S events within the allowable scope of a JT&E.

5. RESPONSIBILITIES:

a. Financial Management: APEX and JUAV-TSO JT&E will separately manage their respective activities and personnel, including salary and travel expenses.

b. Planning: APEX and JUAV-TSO JT&E will invite each other to planning conferences and other significant planning events. JUAV-TSO JT&E will use the existing APEX planning process.

c. Analysis and Reporting: JUAV-TSO JT&E will coordinate their observation and data collection activities with APEX during events and exercises to avoid duplication of effort. APEX and JUAV-TSO JT&E will share data from events where JUAV-TSO JT&E participates. This will be accomplished on a non-interference basis with the exercises.

d. Liaison: APEX and JUAV-TSO JT&E will assign points of contact to coordinate activities and attend applicable planning meetings.

6. AGREEMENT AND ADMINISTRATION:

a. Effective Date: This MOU is effective when signed by both parties.

b. Changes: Both parties will review this agreement annually. This MOU may be amended in writing by mutual agreement of both parties. Either party may formally terminate this agreement by providing written notification.

c. Expiration Date: This MOU will remain in effect until superseded or rescinded.

d. The provisions of this MOU apply to APEX staff, JUAV-TSO JT&E staff, and their contractors.

(Signature Pending)	(Signature Pending)
_____	_____
David A. Rogers	Dr. Richard Amos, SES Director
Captain, U. S. Navy	Systems Simulation & Development
Director, JUAV-TSO JT&E Joint Test Force	Directorate
_____	_____
DATE	DATE

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ARMY TEST AND EVALUATION COMMAND

Submission of Operational Test Plans to the Test Support and Review Committee

1. PURPOSE: In lieu of a formal memorandum, the Army Test and Evaluation Command (ATEC) has accepted the request for operational testing support by enrolling personnel from the JUAV Program Office into the ATEC Decision Support System (ADSS). The ADSS is the Army's automated online system that allows users to request operational test assets to support Service requirements for operational testing and evaluation. The authorized users are required to provide a detailed list of test requirements including hardware, personnel, supplies, and test dates in the form of an Operational Test Plan (OTP). The user will have to create an OTP for each test exercise support request. The OTPs are reviewed semi-annually by the Test Support and Review Committee (TSARC), which allocates resources if available to support the user's requests.

2. The JUAV Program Office has submitted three (3) OTPs into the Advanced Digital Display System (ADDS). These OTPs are for FY02, FY03, and FY04 respectively.

3. The JUAV Program Office participated in the TSARC meeting conducted at Ft. Hood, TX in Feb 2002.

4. The formal review committee of the TSARC met in April 2002 and has accepted the JUAV OTP for FY02. The committee is reviewing the remaining OTPs, which are listed in the ADSS system as "for planning purposes only" as of this time.

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ANNEX D TEST DESIGN OPTIONS

D.1 INTRODUCTION

The JUAV JT&E test design options were developed to support the field tests and the JVTE as described in Chapters 2 and 3. The design options were developed into notional test cell options, which incorporated three alternative C2 architectures, as described in Annex G. Under each alternative C2 architecture, three time-sensitive missions have been selected: Air Interdiction (fixed-wing and rotary-wing) (M_1), Fire Support (Artillery and CAS) (M_2), and Personnel Recovery (CSAR and NEO) (M_3). Each has multiple test conditions to reflect a combination of weapons, Weapon Delivery Platform (WDP), and weapon-delivery methodology.

D.2 OVERVIEW OF DESIGN OPTIONS

Test design options were developed to support the three primary mission areas with a mix of fixed-wing and rotary-wing aircraft as well as conventional and laser-guided munitions. Table D-1 lists the overall JUAV JT&E test design missions, sub-missions, and scenarios.

Table D-1 Test Design Matrix

Mission		Architecture A	Architecture B	Architecture C
Air Interdiction: Armed Reconnaissance:				
Sub-Mission 1	Fixed-Wing ACFT with no UAV Laser Designation	M_1A_1	M_1B_1	M_1C_1
Sub-Mission 2	Fixed-Wing ACFT with UAV Laser Designation	M_1A_2	M_1B_2	M_1C_2
Sub-Mission 3	Rotary-Wing ACFT with no UAV Laser Designation	M_1A_3	M_1B_3	M_1C_3
Sub-Mission 4	Rotary-Wing ACFT with UAV Laser Designation	M_1A_4	M_1B_4	M_1C_4
Fire Support:				
Artillery		M_2A_1	M_2B_1	M_2C_1
CAS		M_2A_2	M_2B_2	M_2C_2
Personnel Recovery:				
CSAR, NEO		M_3A_1	M_3B_1	M_3C_1

D.3 LIVE TESTS

The JUAV JT&E will include live tests designed to investigate aspects of the issues described in Chapter 2. The live tests consist of a risk reduction mini-test, two field tests, and a JVTE (See Table D-2 for a list of associated venues). At each of these test venues, a minimum of two WDPs, one tactical C2 platform, and one UAV will be used.

Test venues for the JT&E were designed to address the three mission areas (Air Interdiction: Armed Reconnaissance, Fire Support, and Personnel Recovery) with scenarios that supported the three alternative C2 architectures. Table D-2 is a summary of the number of iterations planned for each mission area during the live test events.

Table D-2 Test Venues and Mission Area Events

Test Venues	Mission Areas				
	Air Interdiction	Fire Support		Personnel Recovery	
		Artillery	CAS	CSAR	NEO
Risk Reduction Mini-Test (Ft. Irwin, CA)	36	30	26		
Field Test 1 (DR XI)	108		54	54	3
Field Test 2 (Ft. Hood)	108	54	54		6
JVTE (JCIET04/JTFEX)	36	12	9	9	

D.4 RISK REDUCTION MINI-TEST

The Risk Reduction Mini-Test will serve as a rehearsal for the larger-scale field tests and the JVTE. Data collected at the mini-test will be used to refine data analysis procedures and will not be integrated with data from other field tests. The mini-test will focus on Air Interdiction missions, UAV laser designation operations, and Fire Support/Artillery and CAS. Table D-3 represents a proposed list of mission scenarios to be conducted depending on the training exercise constraints. The JTF will not conduct testing that would adversely affect BLUFOR training. Only Alternative C2 Architecture A data will be collected on BLUFOR. This requirement will prevent the JTF from using non-standard C2 architectures (i.e., alternatives B and C) on the BLUFOR. Non-standard alternative B and C data will be collected on the OPFOR. During operations, the WDP will consist of two F-16s. A Predator will support UAV operations, and the Tactical C2 node will consist of a BLUFOR-manned ground TOC.

The participants identified for the mini-test include these BLUFOR units: 3rd Brigade, 1st Armored Division, including the 1st Battalion, 13th Armored Regiment, the 1st Battalion, 41st Infantry Regiment, and the 1st Battalion, 87th Infantry Regiment. Blufor units also include the 5th Special Forces Group (5th SF); 18th Aviation Regiment from 10th Mountain Division; 7th Company, 158th Aviation Battalion; and 12th ACCS JSTARS. The OPFOR units include: The 11 Armored Cavalry Regiment (ACR) augmented by the 2nd Battalion, 8th Infantry; Company A, 1st Battalion, 125th Infantry; the 478th Engineer Battalion; the 1st Battalion, 119th Field Artillery; and a mortar platoon from the 36th Brigade, 49th

Armored Division. The 421st Fighter Squadron from Hill AFB and the 310th Fighter Squadron from Luke AFB will provide F-16 air support. The Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) is expected to provide a UAV or UAV surrogate.

Table D-3 Risk Reduction Mini-Test Scenarios

Mission		Architecture A	Architecture B	Architecture C
Air Interdiction: Armed Reconnaissance:				
Sub-Mission 1	Fixed-Wing ACFT with no UAV Laser Designation	M_1A_1	M_1B_1	M_1C_1
Sub-Mission 2	Fixed-Wing ACFT with UAV Laser Designation	M_1A_2	M_1B_2	M_1C_2
Fire Support:				
Artillery		M_2A_1	M_2B_1	M_2C_1
CAS		M_2A_2	M_2B_2	M_2C_2

D.5 FIELD TEST 1, DESERT RESCUE XI

Field Test 1 (FT-1) focuses primarily on CSAR operations with Air Interdiction and Fire Support. JTF test objectives are to focus on CSAR and collect data from the other mission areas. FT-1 will be integrated into the DR XI exercise conducted at Naval Air Station Fallon (NASF) on the Fallon Range Training Complex (FRTC). During operations, the WDP will consist of two F-14s, and A-10s, AH-1Ws, UH-1Ns, HH-60Hs, F-15s, F/A-18s, or F-16s. UAVs will be a Pioneer and a Predator. An E-2C will fulfill the Tactical C2 node needs. Table D-4 lists the scenarios to be conducted at FT-1.

D.5.1 Field Test 1, Desert Rescue XI Participants

DR XI is a multi-Service exercise with participants from the USA, USAF, ANG, USMC, and USN. Platforms attending include C-130s, F-14s, A-10s, AH-1Ws, UH-1Ns, HH-60Hs, F-15s, F/A-18s, and F-16s. The units participating in FT-1 have not been identified at this time but will be at the Initial Planning Conference in November 2002. It is anticipated that a JFCOM JOTBS Predator and a USN VC-6 Pioneer will be the participating UAVs.

Table D-4 Field Test 1 Scenarios

Mission		Architecture A	Architecture B	Architecture C
Air Interdiction: Armed Reconnaissance:				
Sub-Mission 1	Fixed-Wing ACFT with no UAV Laser Designation	M_1A_1	M_1B_1	M_1C_1
Sub-Mission 2	Fixed-Wing ACFT with UAV Laser Designation	M_1A_2	M_1B_2	M_1C_2
Fire Support:				
CAS		M_2A_2	M_2B_2	M_2C_2
Personnel Recovery:				
CSAR, NEO		M_3A_1	M_3B_1	M_3C_1

D.6 FIELD TEST 2, FT. HOOD

Field Test 2 (FT-2) focuses on NEO scenarios, rotary-wing Air Interdiction, and Fire Support missions. The JUAV JTF may incorporate CSAR scenarios to validate data and JTTP that are developed during DR XI. FT-2 will be conducted at Ft. Hood, TX. Unlike the other live tests, FT-2 will not be integrated into an existing exercise. Instead, the JTF will develop its own JT&E-specific scenarios for the test. The concept of operations is based upon a NEO mission and a shaping and isolation mission. During operations, the WDPs will consist of two F/A-18s or two AH-64s. A Shadow or Hunter will support UAV operations, and the Tactical C2 node will consist of a BLUFOR manned ground TOC. Table D-5 lists the scenarios to be conducted at FT-2.

The military units that will participate in FT-2 have not yet been identified. It is anticipated that a Shadow or Hunter coordinated through the ATEC will be available for the test. Coordination with OTC and III Corps has identified several potential units, including a mechanized infantry brigade and its associated direct support artillery battalion from Ft. Riley, KS. WDPs planned to attend are Shadow, Hunter, F/A-18s, E-2s, C-130s, UH-60s, AH-64s, 105mms, 155mms, M2A2s, M113As, M998s, and HMMWVs and numerous other ground support vehicles. An Army light division HQ may be used as the Central C2 node.

Table D-5 Field Test 2 Scenarios

Mission		Architecture A	Architecture B	Architecture C
Air Interdiction: Armed Reconnaissance:				
Sub-Mission 3	Rotary-Wing ACFT with no UAV Laser Designation	M_1A_3	M_1B_3	M_1C_3
Sub-Mission 4	Rotary-Wing ACFT with UAV Laser Designation	M_1A_4	M_1B_4	M_1C_4
Fire Support:				
Artillery		M_2A_1	M_2B_1	M_2C_1
CAS		M_2A_2	M_2B_2	M_2C_2
Personnel Recovery:				
CSAR, NEO		M_3A_1	M_3B_1	M_3C_1

D.7 JOINT VALIDATION TEST EVENT AT JCIET04/JTFEX

The objectives of the JVTE are to test C2 architectures and validate modifications to the JTTP developed and tested during the previous field tests. A dedicated training packet developed for BWF performed by selected BWOs will be incorporated as a baseline for comparison. The venue for the JVTE is the JTFEX. The event will leverage a Navy JTFEX but is expected to have all of the customary Joint (and UK) players JCIET usually has and will be located either at Savannah Combat Readiness Training Center (CRTC)/Ft. Stewart, GA or at Ft. Bragg/Camp Lejeune, NC. The JTF is working closely with JFCOM to finalize the venue. Table D-6 lists the scenarios to be conducted at the JVTE.

The units that will participate in the JCIET04/JTFEX have not yet been identified. It is anticipated that a Pioneer and a Shadow will be available for the test.

Table D-6 Joint Validation Test Event Test Scenarios

Mission		Architecture A	Architecture B	Architecture C
Air Interdiction: Armed Reconnaissance:				
Sub-Mission 1	Fixed-Wing ACFT with no UAV Laser Designation	M_1A_1	M_1B_1	M_1C_1
Sub-Mission 2	Fixed-Wing ACFT with UAV Laser Designation	M_1A_2	M_1B_2	M_1C_2
Sub-Mission 3	Rotary-Wing ACFT with no UAV Laser Designation	M_1A_3	M_1B_3	M_1C_3
Sub-Mission 4	Rotary-Wing ACFT with UAV Laser Designation	M_1A_4	M_1B_4	M_1C_4
Fire Support:				
Artillery		M_2A_1	M_2B_1	M_2C_1
CAS		M_2A_2	M_2B_2	M_2C_2
Personnel Recovery:				
CSAR, NEO		M_3A_1	M_3B_1	M_3C_1

D.8 DETAILED TEST SCENARIOS/OPTIONS

Alternative C2 architecture requirements will have specific data-flow patterns, which will produce products that help enable decisions based on the commander's intent, target nature, and time constraints associated with tactical considerations. The following series of pictorial representations provides an outline of mission scenarios to be executed during the tests. The platforms depicted in the figures are generic. Actual platforms will be dependent on test venue and participants. These pictorials show a minimum representation of air and ground participants. The exact number of participants in each node of the C2 architecture may fluctuate depending on the current training exercise at each test venue. A DTP, describing the specific details for each test, will be generated prior to each live test. The communications nodes and connectivity are displayed for each scenario as well as the functions associated with each specific location. The scenarios are displayed in a series of pictorial representations of the primary mission areas configured in the alternative C2 architectures.

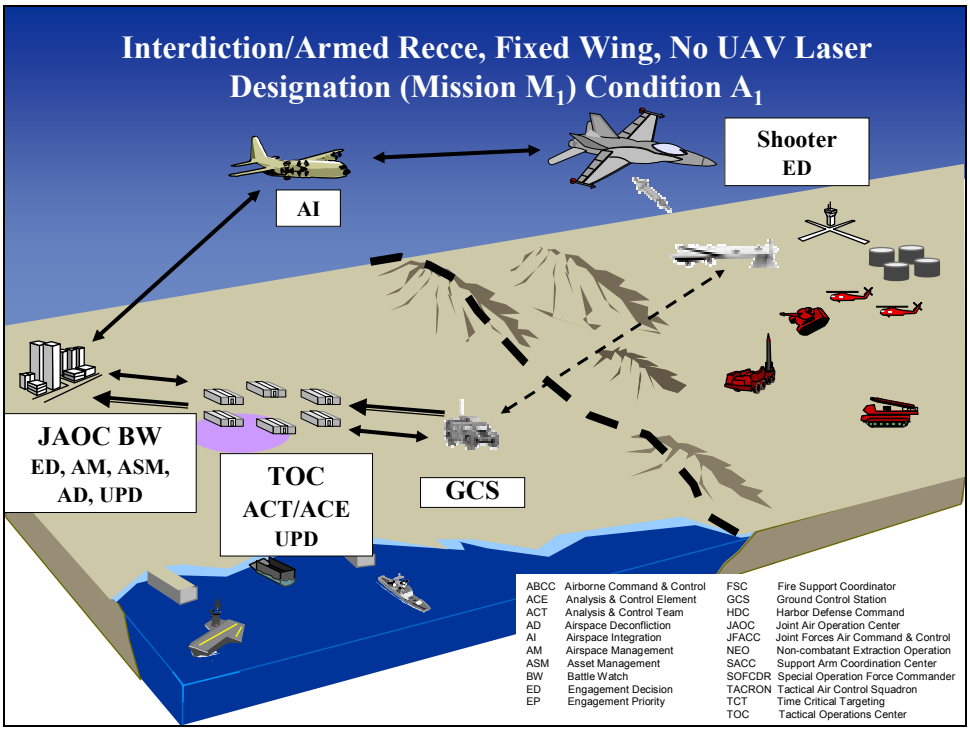

Figure D-1 Scenario M_1A_1: Fixed-Wing Aircraft with no UAV Laser Designation

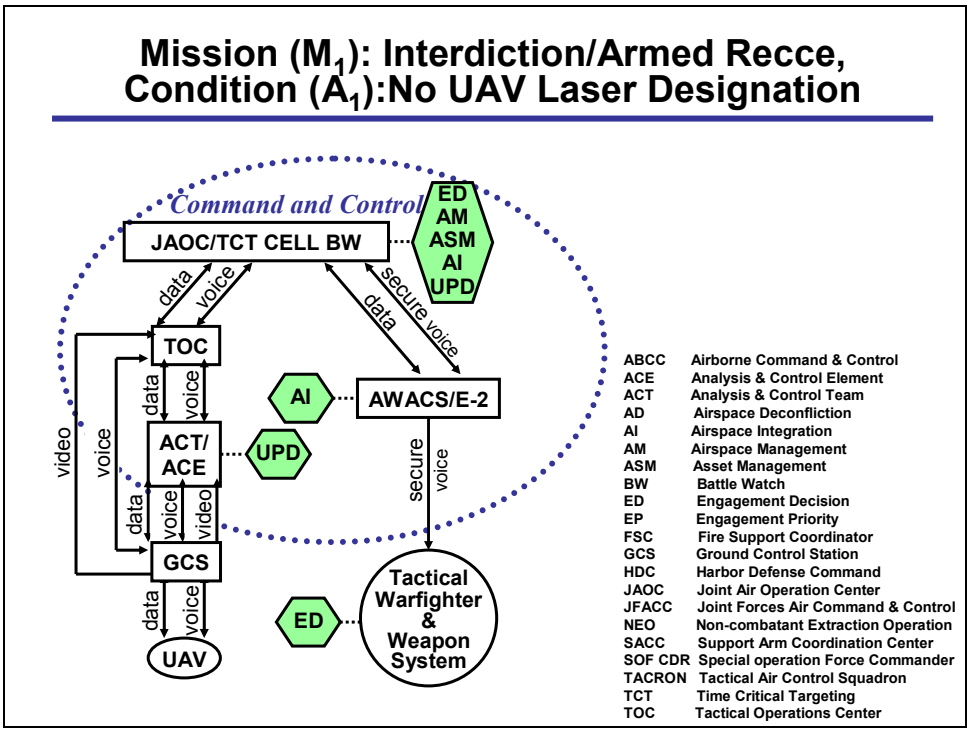

Figure D-2 Scenario M_1A_1: Fixed-Wing Aircraft with no UAV Laser Designation Communications Block Diagram

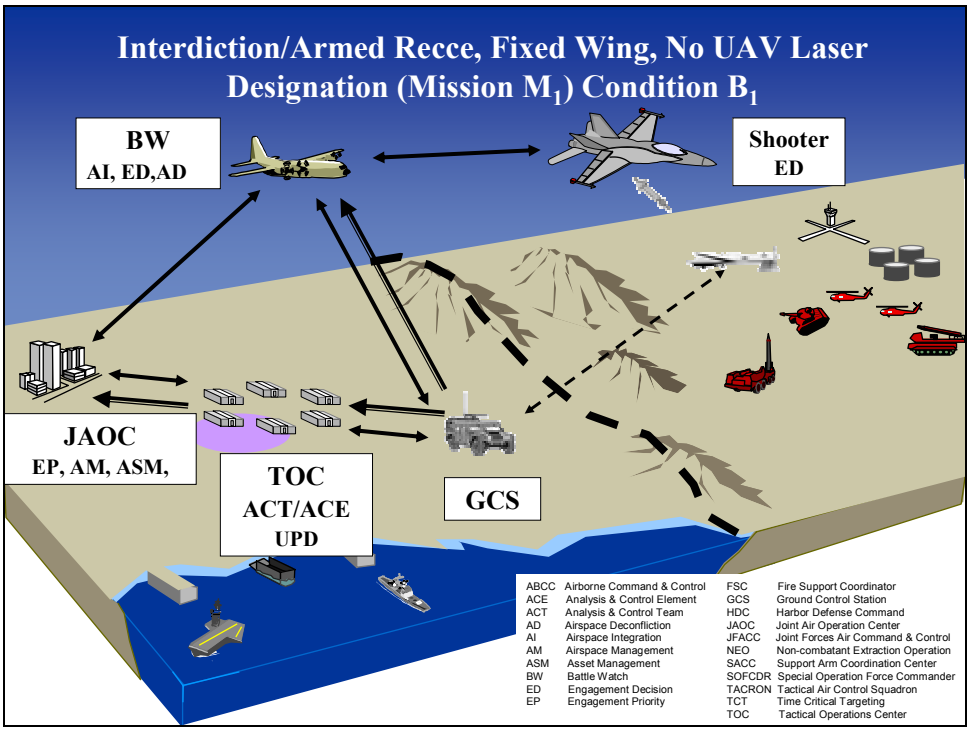

Figure D-3 Scenario M_1B_1: Fixed-Wing Aircraft with no UAV Laser Designation

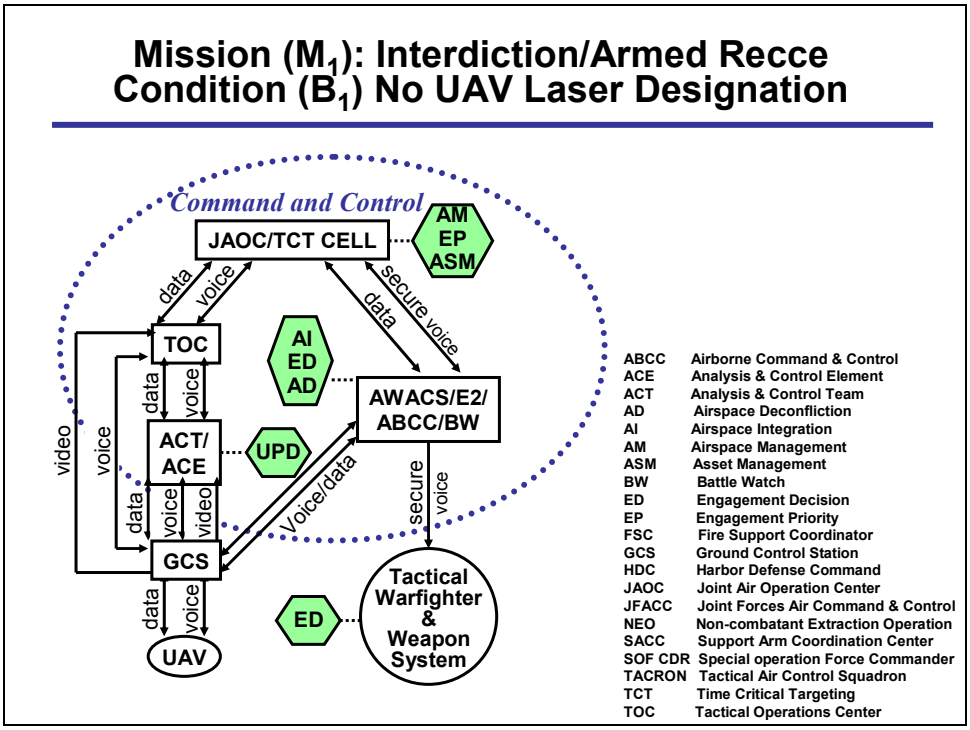

Figure D-4 Scenario M_1B_1: Fixed-Wing Aircraft with no UAV Laser Designation Communications Block Diagram

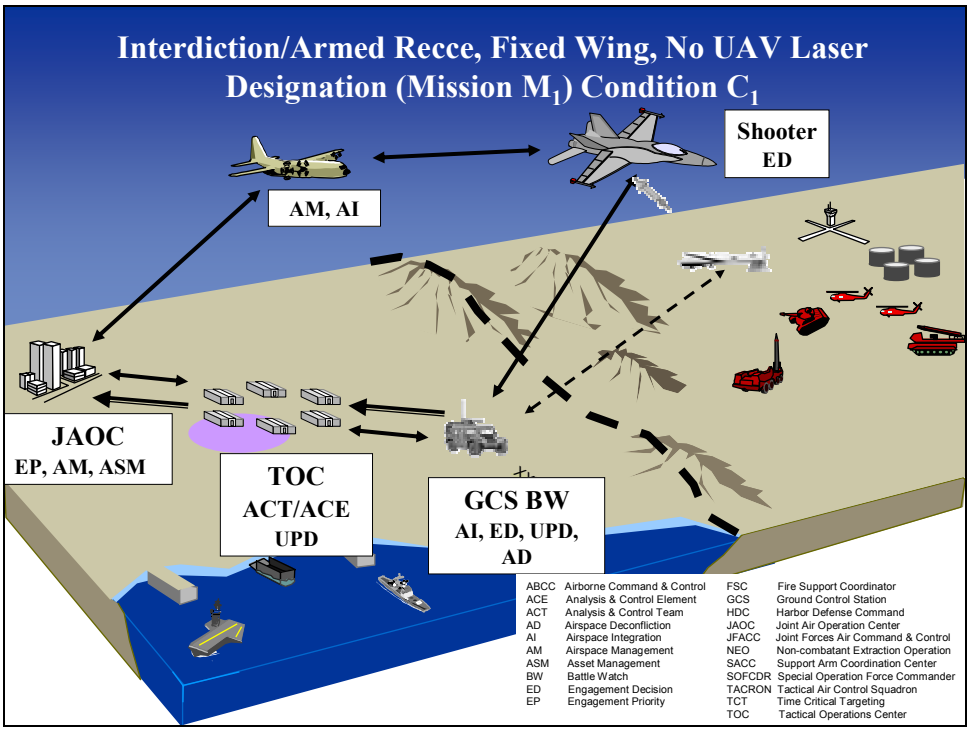

Figure D-5 Scenario M_1C_1: Fixed-Wing Aircraft with no UAV Laser Designation

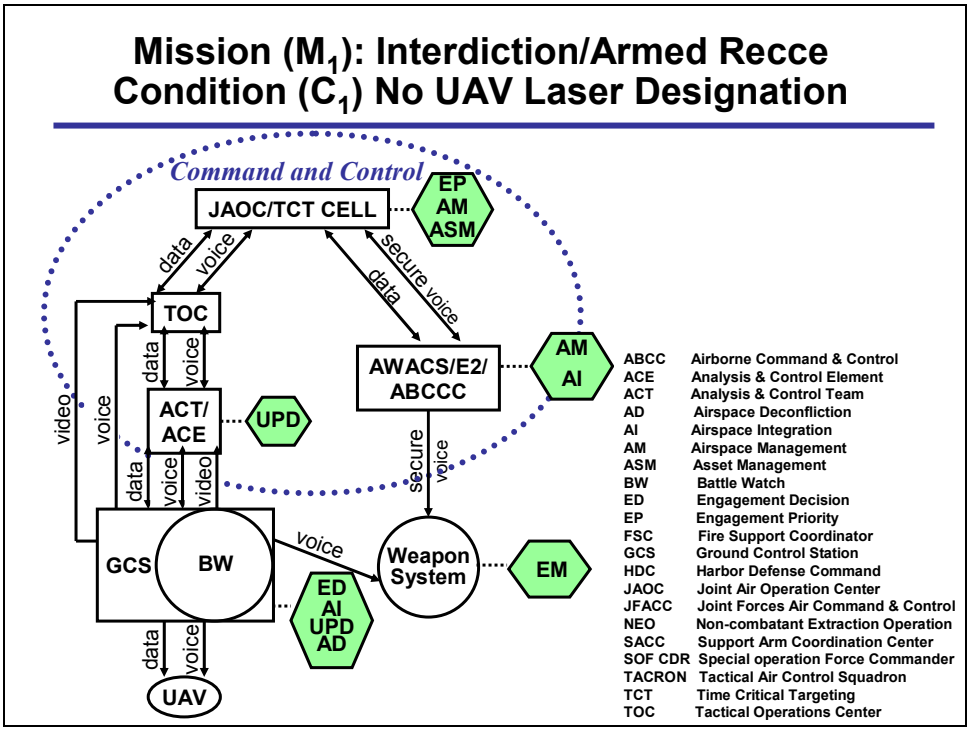

Figure D-6 Scenario M_1C_1: Fixed-Wing Aircraft with no UAV Laser Designation Communications Block Diagram

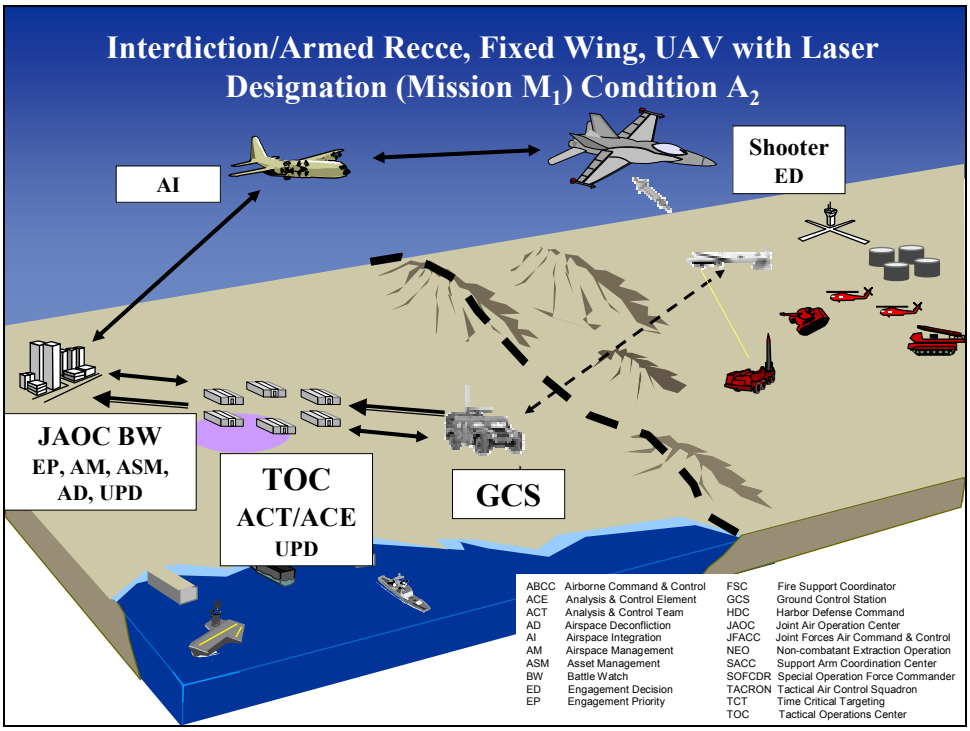

Figure D-7 Scenario M_1A_2: Fixed-Wing Aircraft with UAV Laser Designation

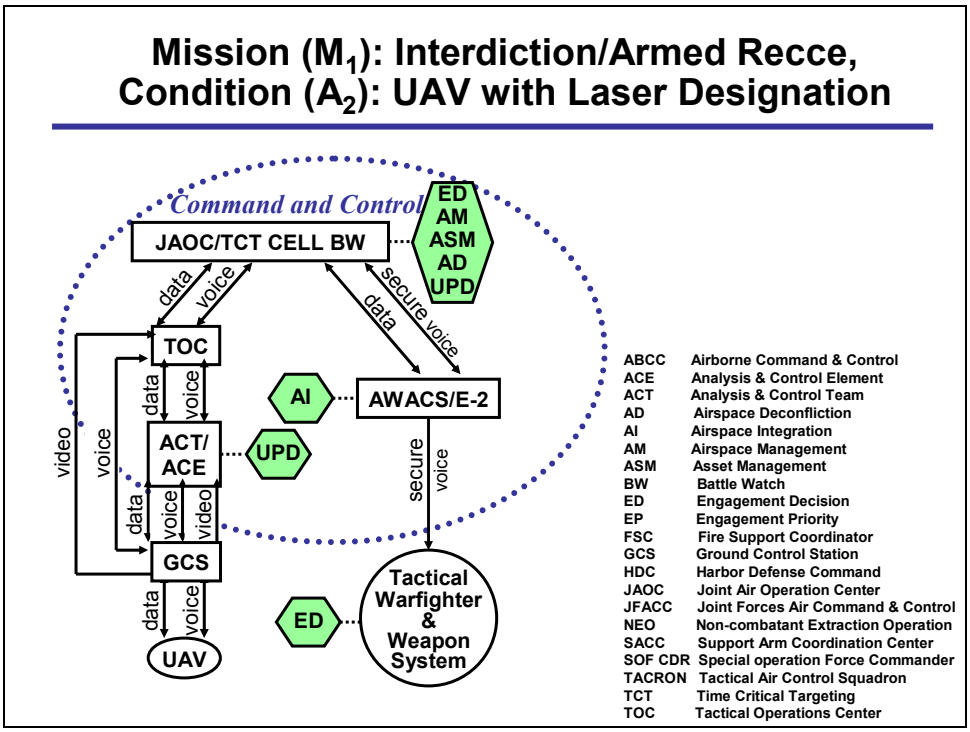

Figure D-8 Scenario M_1A_2: Fixed-Wing Aircraft with UAV Laser Designation Communications Block Diagram

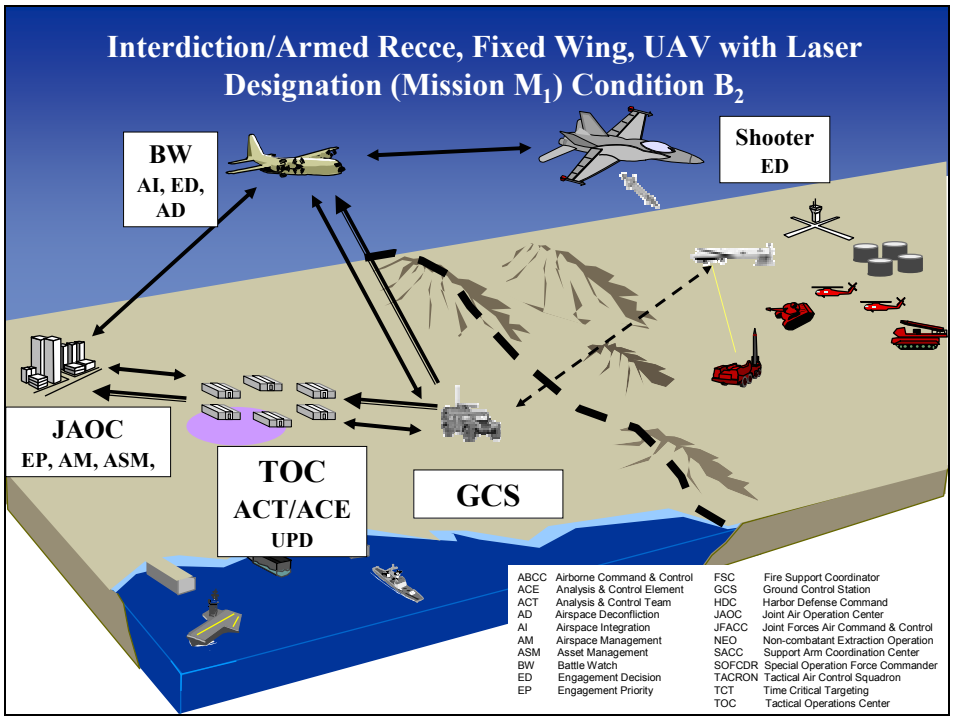

Figure D-9 Scenario M_1B_2: Fixed-Wing Aircraft with UAV Laser Designation

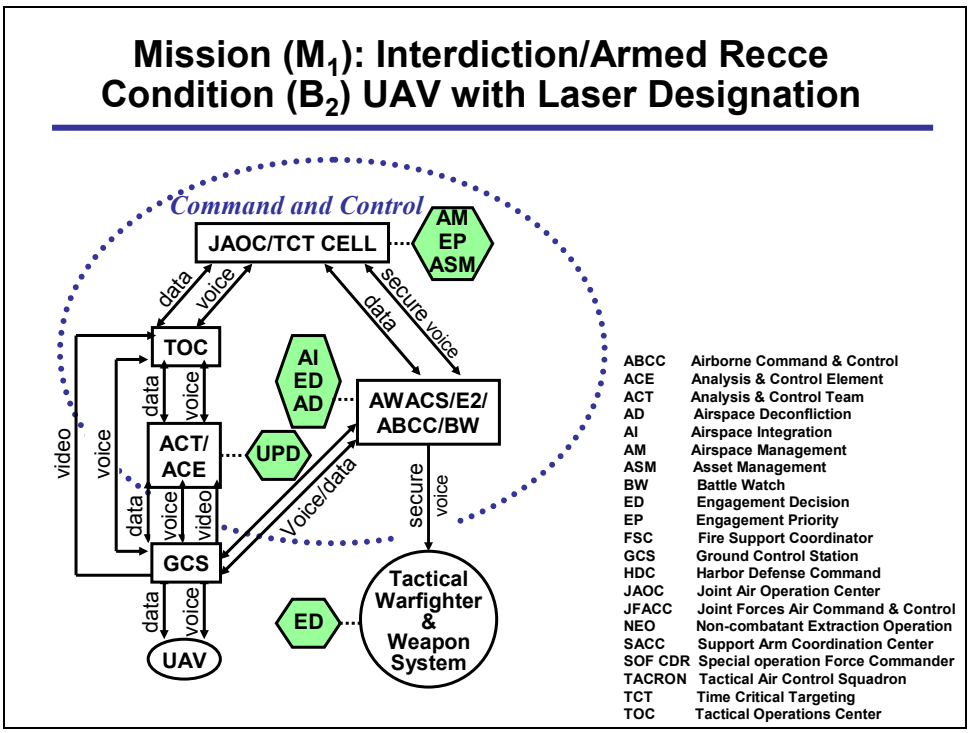

Figure D-10 Scenario M_1B_2: Fixed-Wing Aircraft with UAV Laser Designation Communications Block Diagram

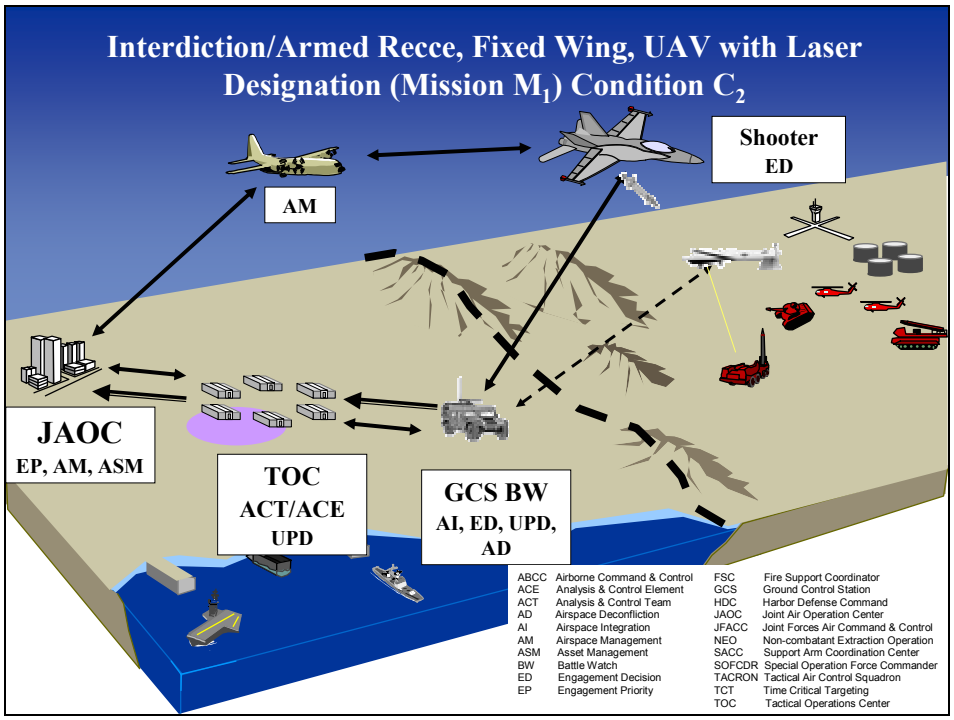

Figure D-11 Scenario M_1C_2: Fixed-Wing Aircraft with UAV Laser Designation

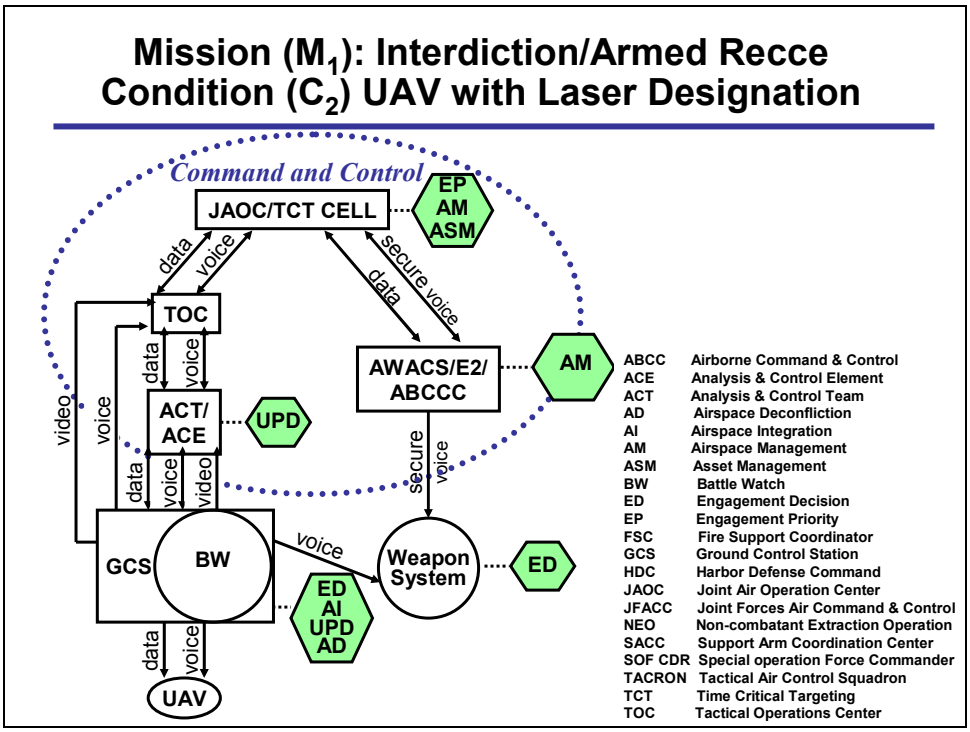

Figure D-12 Scenario M_1C_2: Fixed-Wing Aircraft with UAV Laser Designation Communications Block Diagram

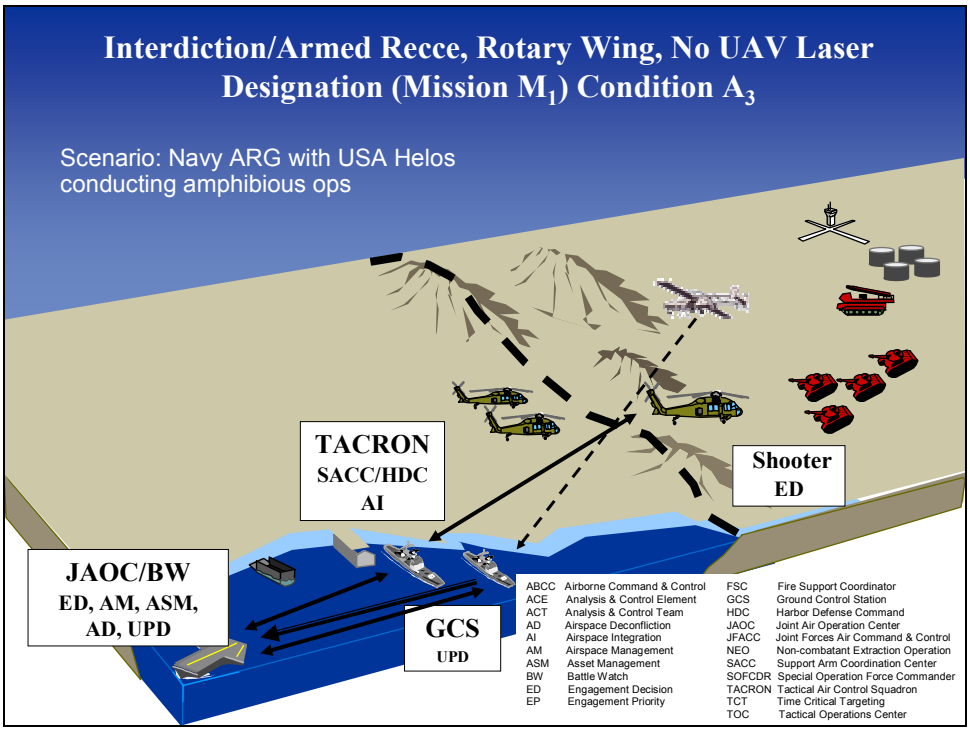

Figure D-13 Scenario M_1A_3: Rotary-Wing Aircraft with no UAV Laser Designation

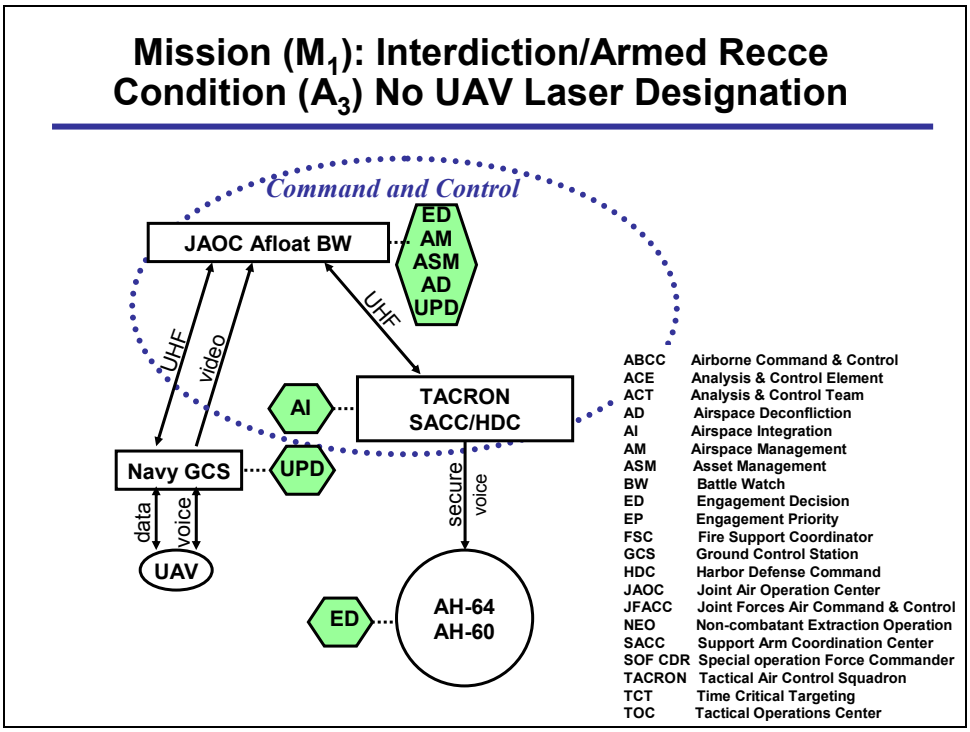

Figure D-14 Scenario M_1A_3: Rotary-Wing Aircraft with no UAV Laser Designation Communications Block Diagram

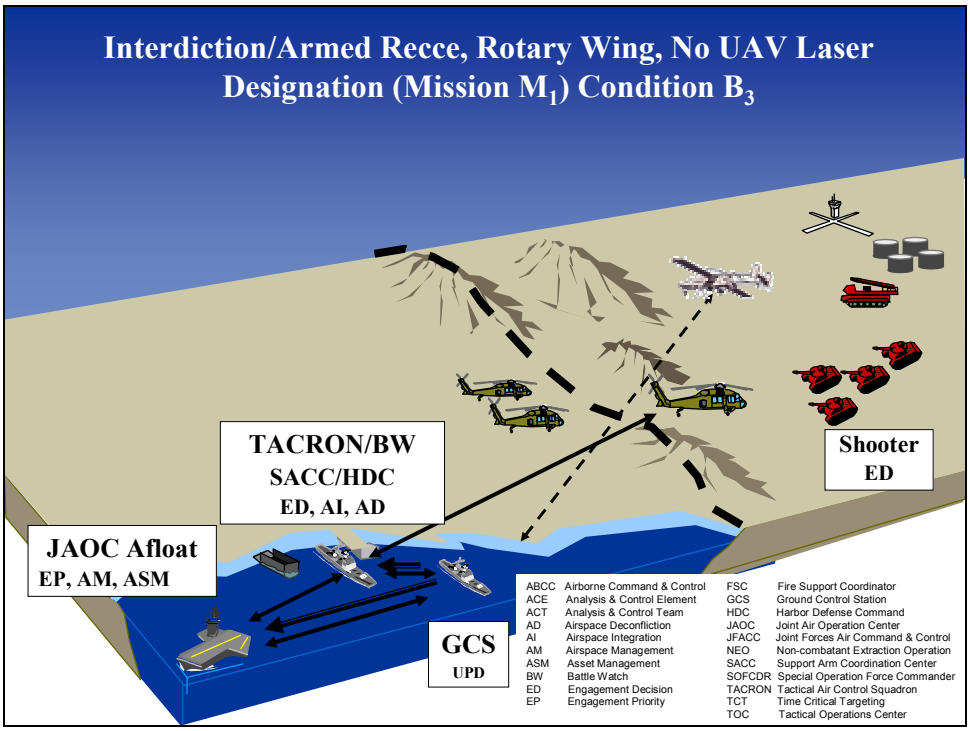

Figure D-15 Scenario M_1B_3: Rotary-Wing Aircraft with no UAV Laser Designation

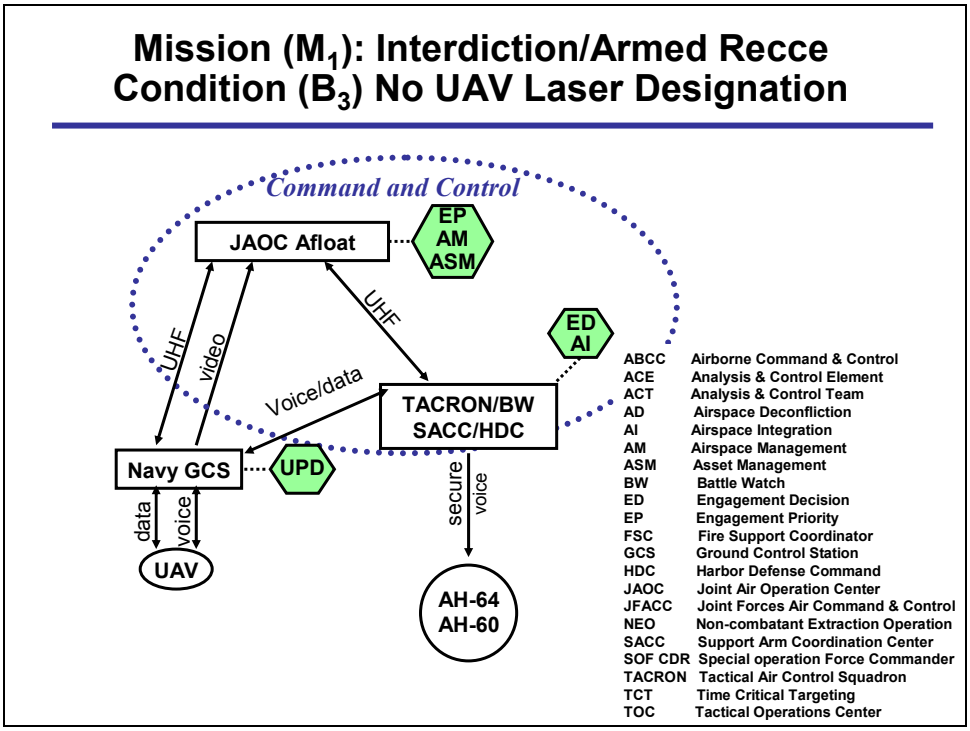

Figure D-16 Scenario M_1B_3: Rotary-Wing Aircraft with no UAV Laser Designation Communications Block Diagram

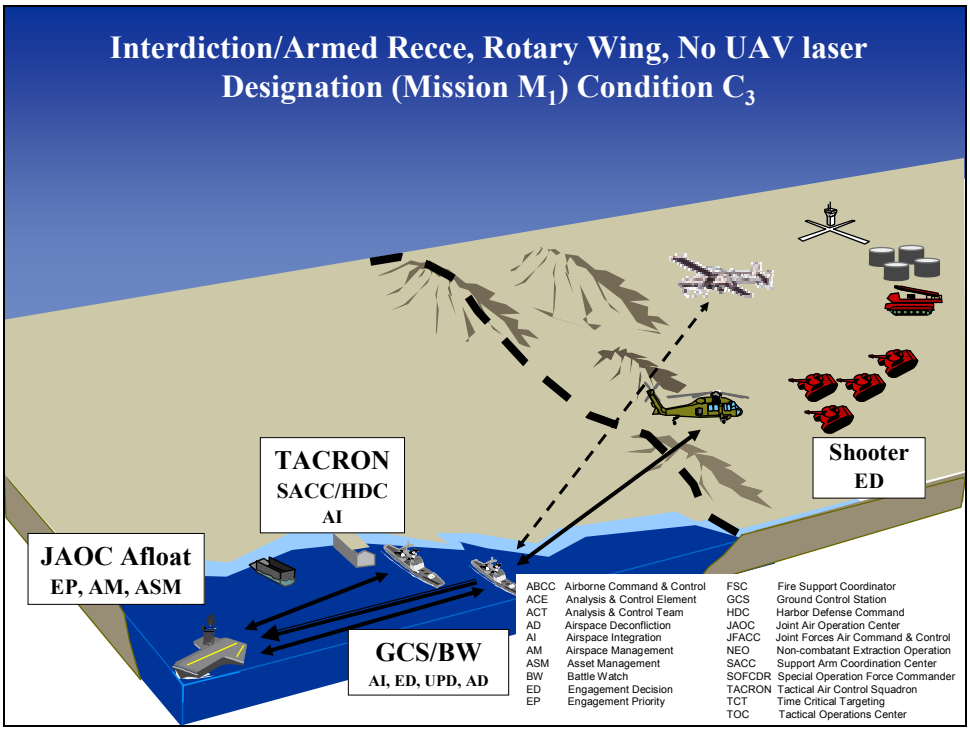

Figure D-17 Scenario M_1C_3: Rotary-Wing Aircraft with no UAV Laser Designation

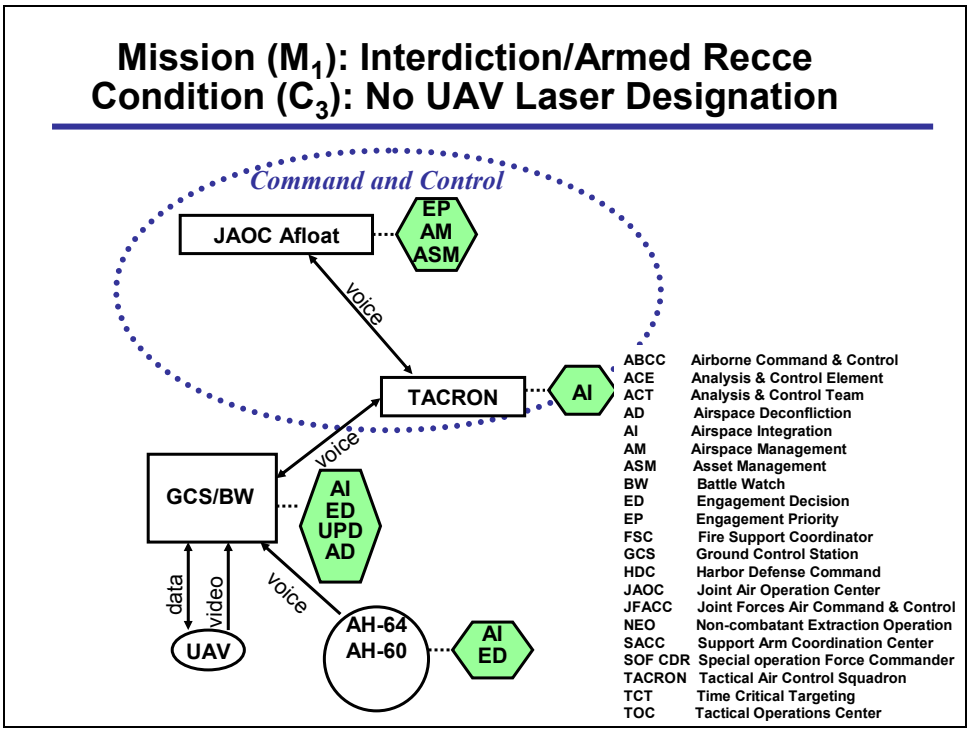

Figure D-18 Scenario M_1C_3: Rotary-Wing Aircraft with no UAV Laser Designation Communications Block Diagram

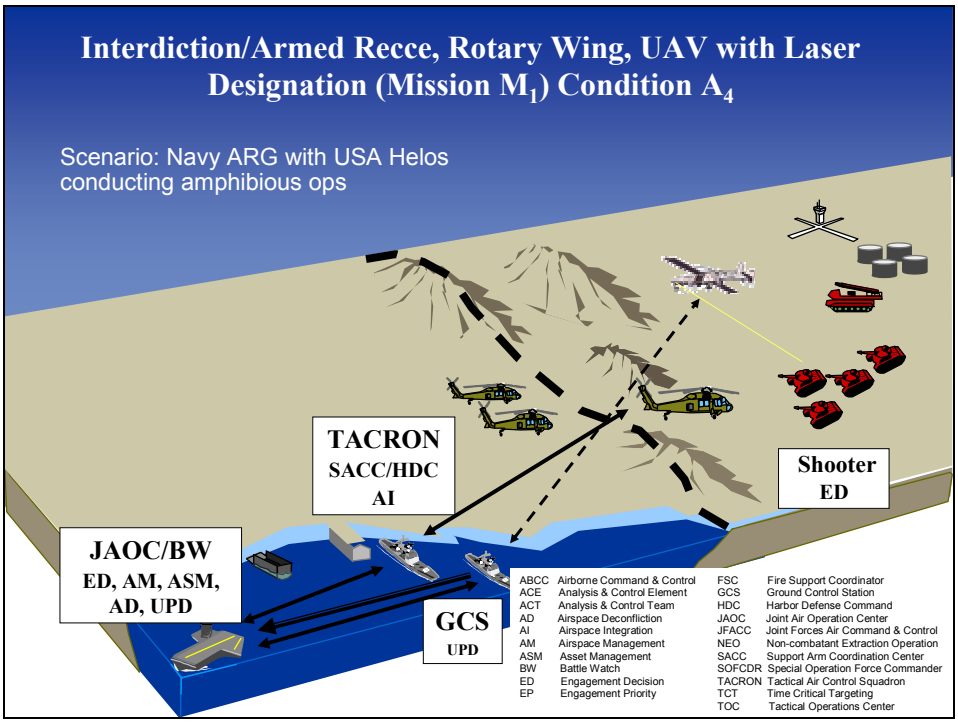

Figure D-19 Scenario M_1A_4: Rotary-Wing Aircraft with UAV Laser Designation

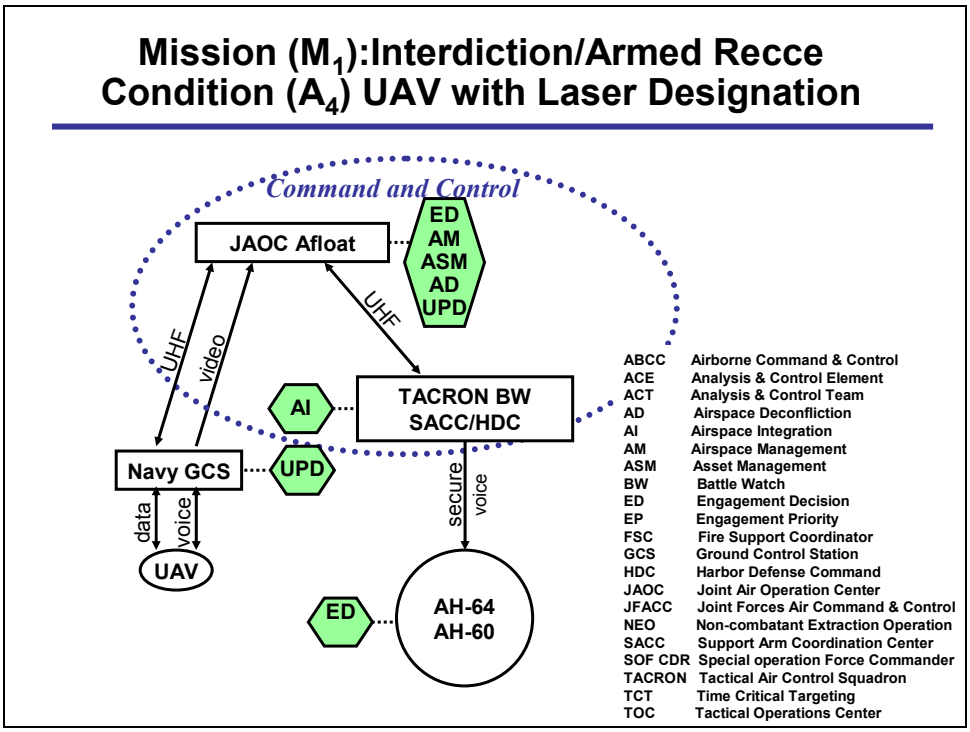

Figure D-20 Scenario M_1A_4: Rotary-Wing Aircraft with UAV Laser Designation Communications Block Diagram

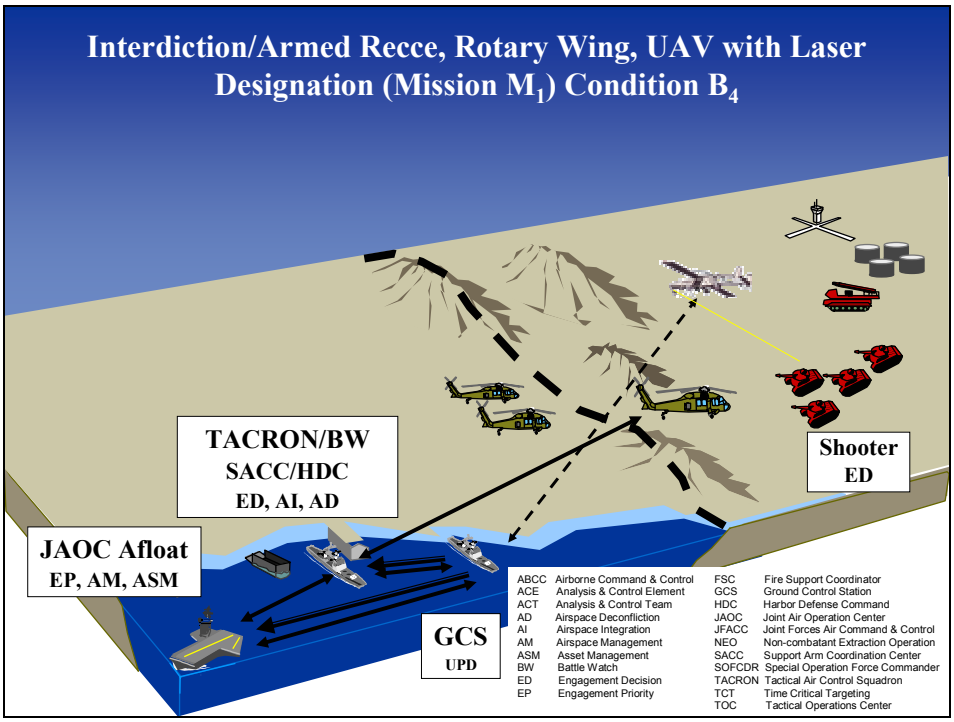

Figure D-21 Scenario M_1B_4: Rotary-Wing Aircraft with UAV Laser Designation

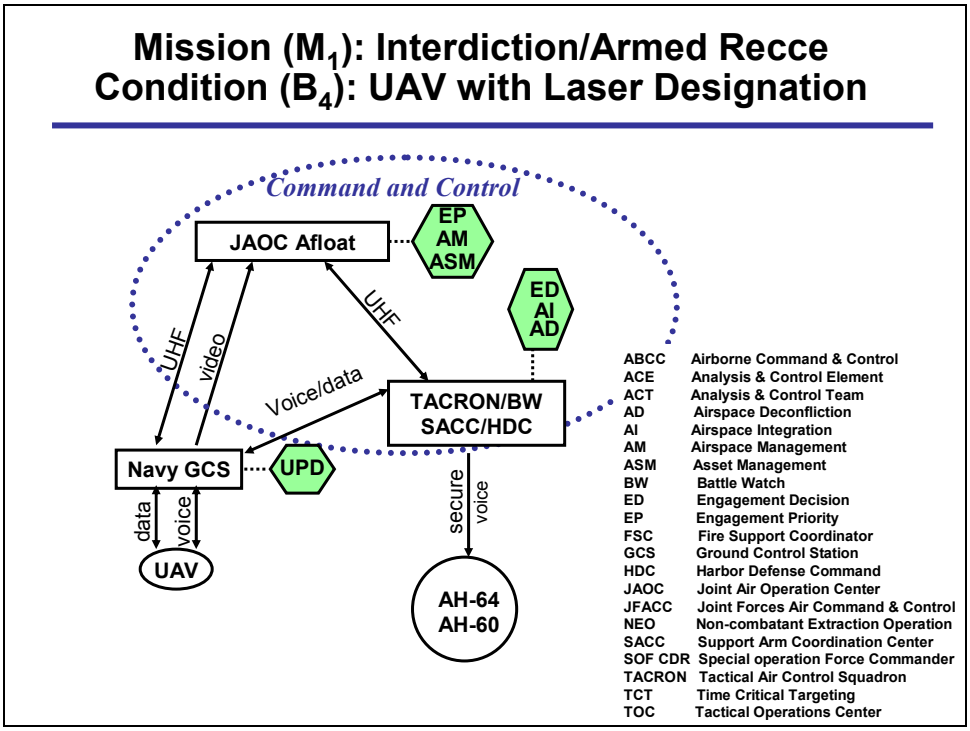

Figure D-22 Scenario M_1B_4: Rotary-Wing Aircraft with UAV Laser Designation Communications Block Diagram

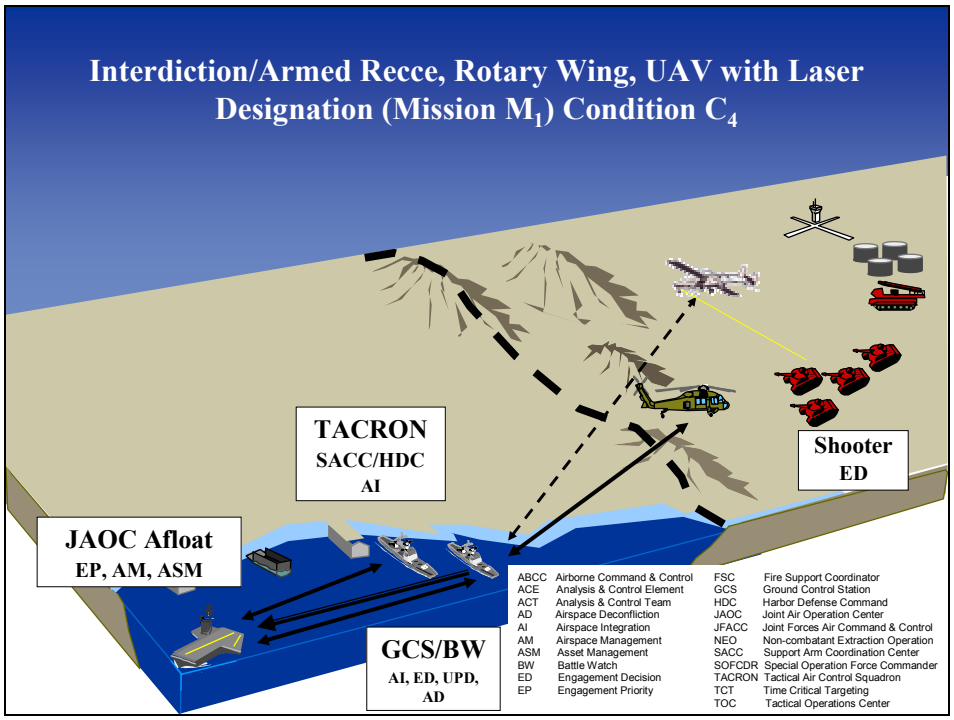

Figure D-23 Scenario M_1C_4: Rotary-Wing Aircraft with UAV Laser Designation

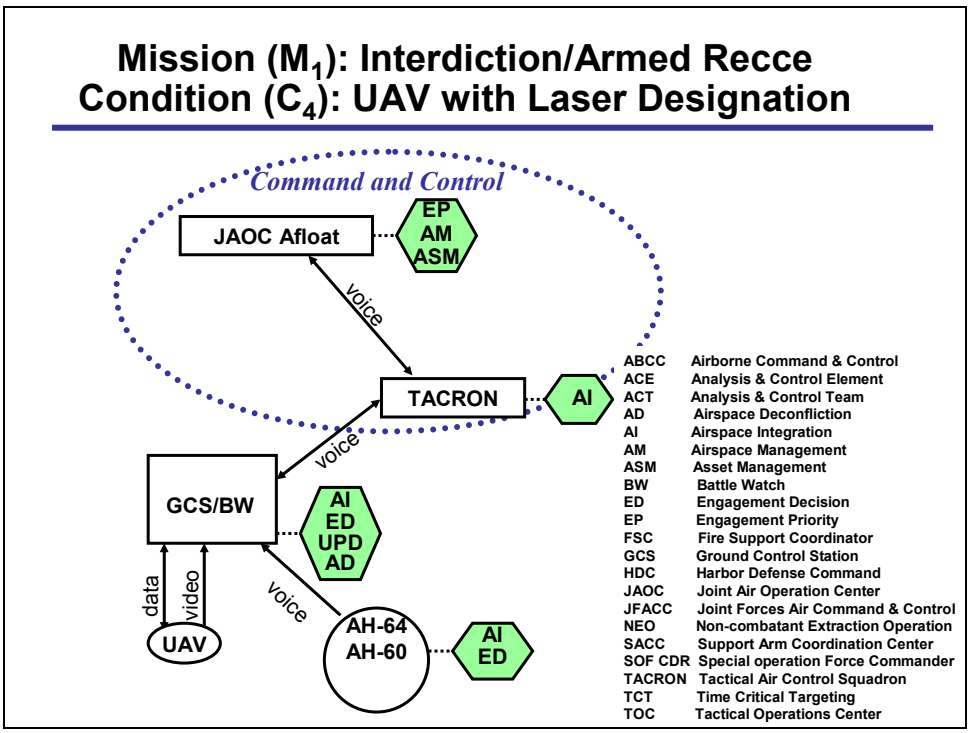

Figure D-24 Scenario M_1C_4: Rotary-Wing Aircraft with UAV Laser Designation Communications Block Diagram

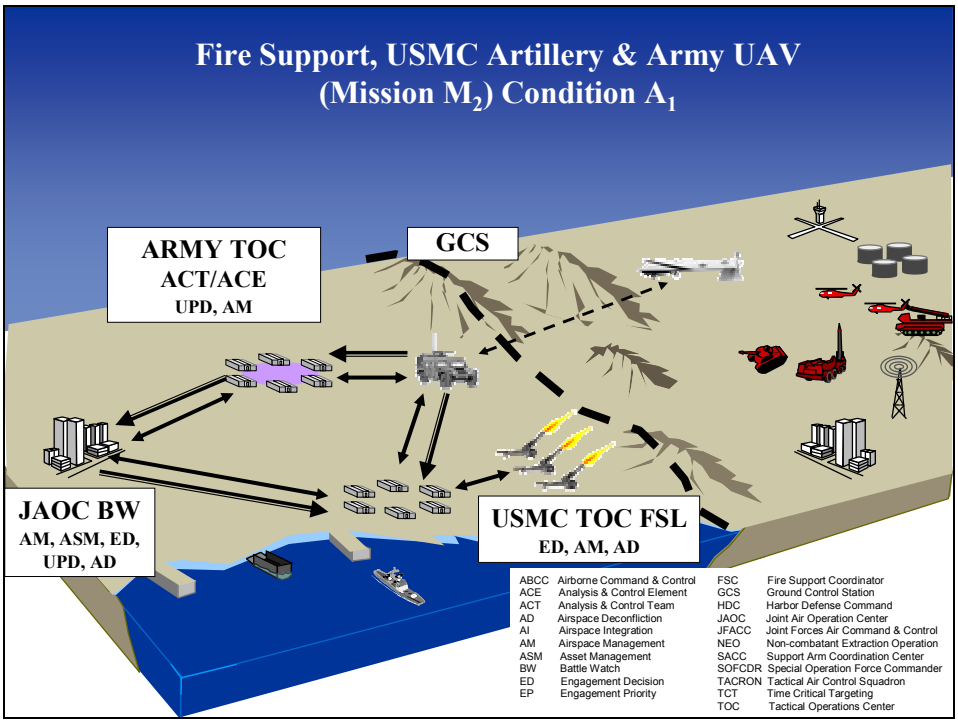

Figure D-25 Scenario M_2A_1: Artillery Fire Support

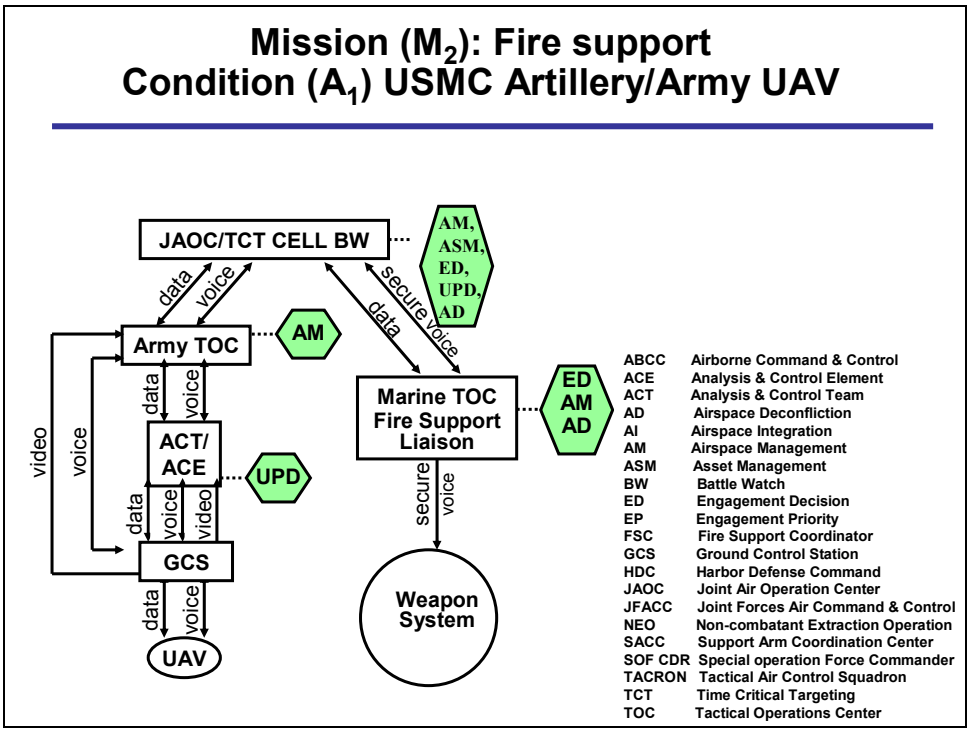

Figure D-26 Scenario M_2A_1: Artillery Fire Support Communications Block Diagram

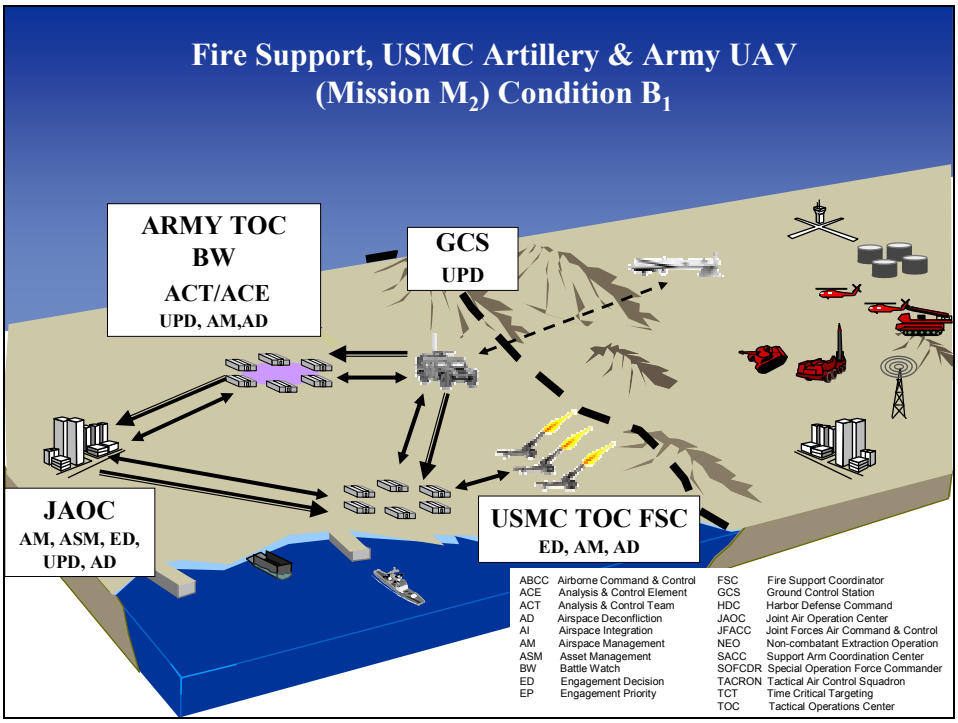

Figure D-27 Scenario M_2B_1: Artillery Fire Support

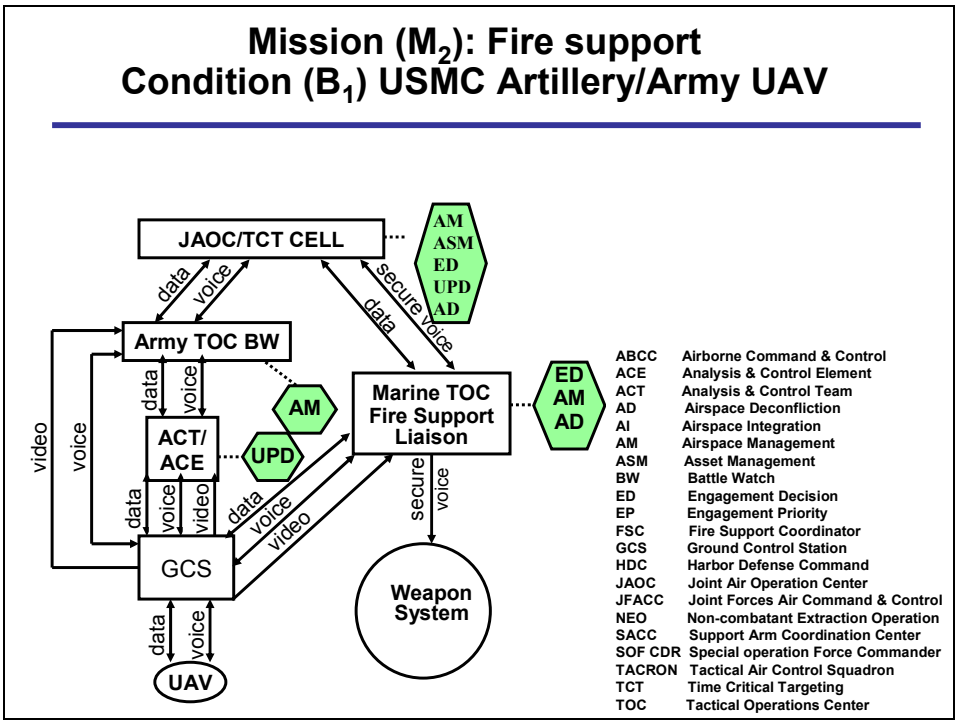

Figure D-28 Scenario M_2B_1: Artillery Fire Support Communications Block Diagram

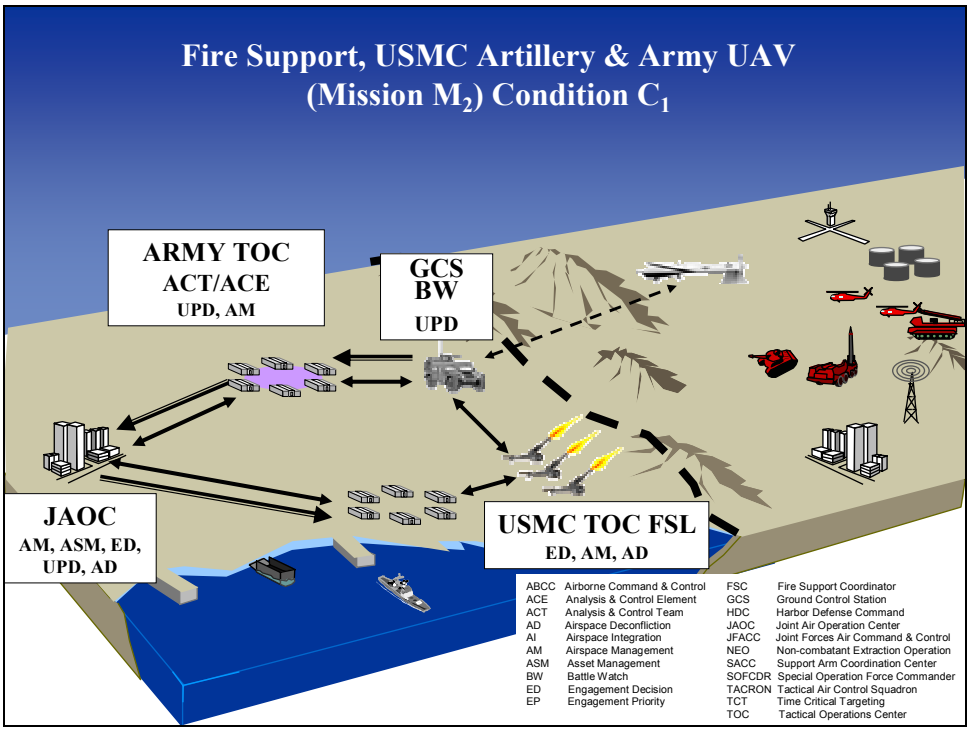

Figure D-29 Scenario M_2C_1: Artillery Fire Support

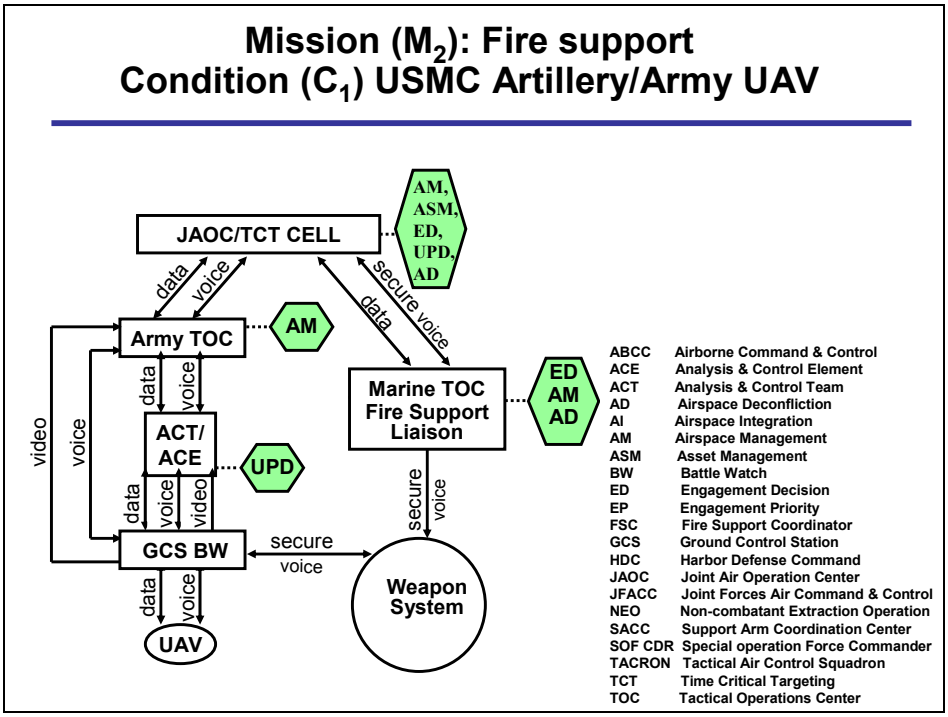

Figure D-30 Scenario M_2C_1: Artillery Fire Support Communications Block Diagram

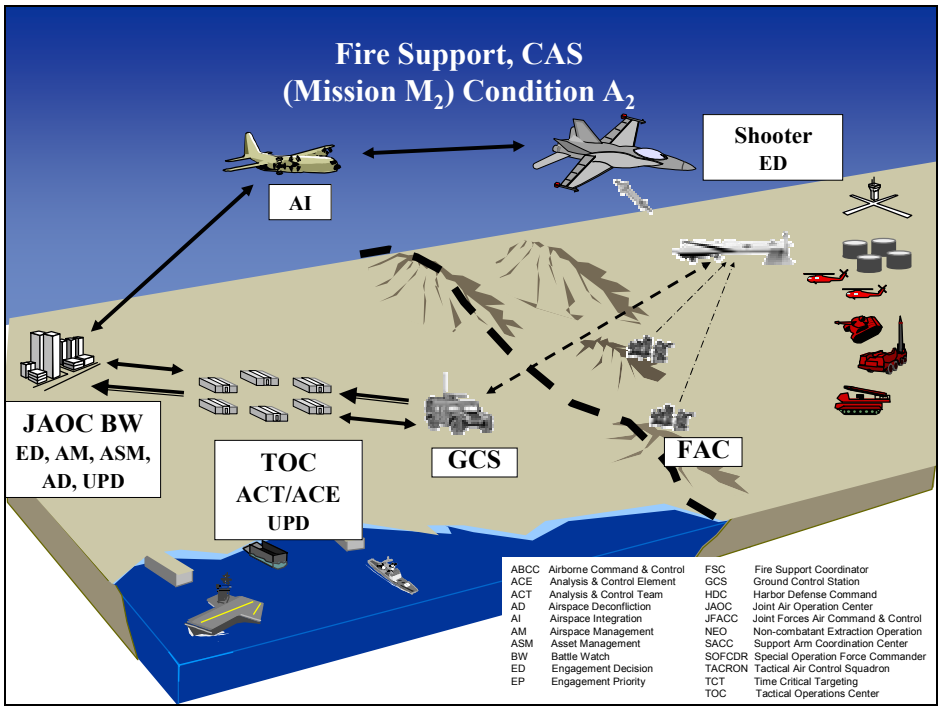

Figure D-31 Scenario M_2A_2: Fire Support: CAS

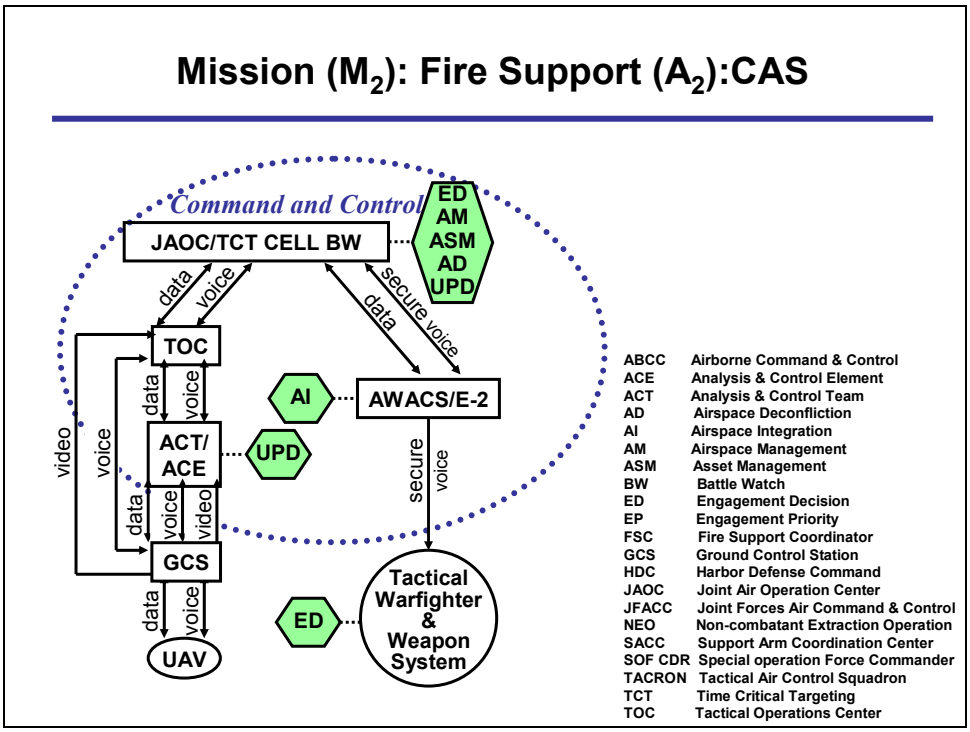

Figure D-32 Scenario M_2A_2: Fire Support: CAS Communications Block Diagram

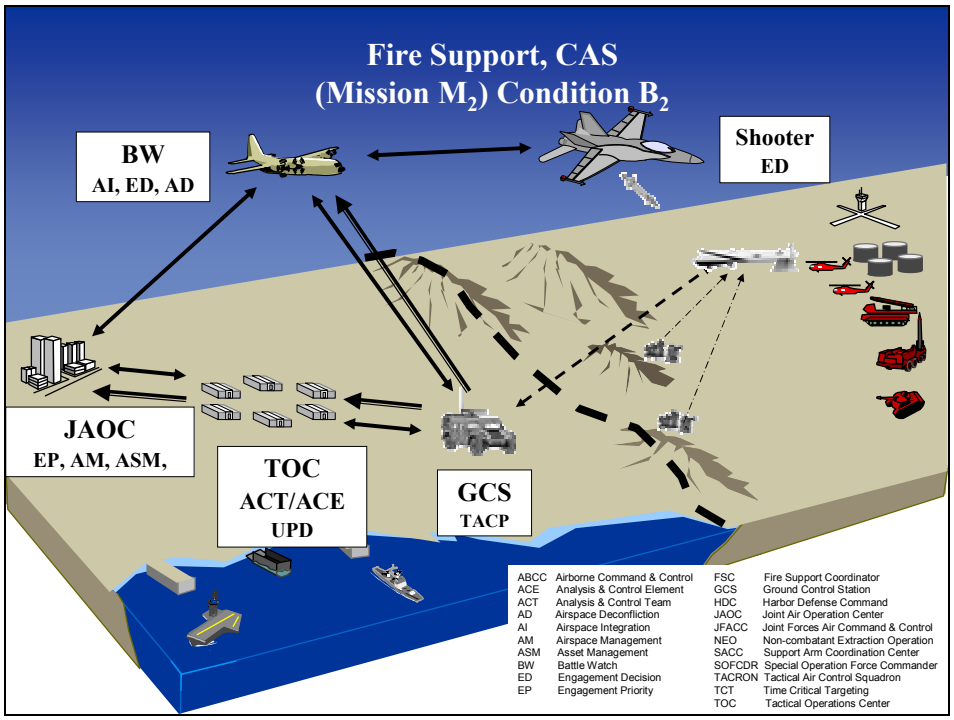

Figure D-33 Scenario M_2B_2: Fire Support: CAS

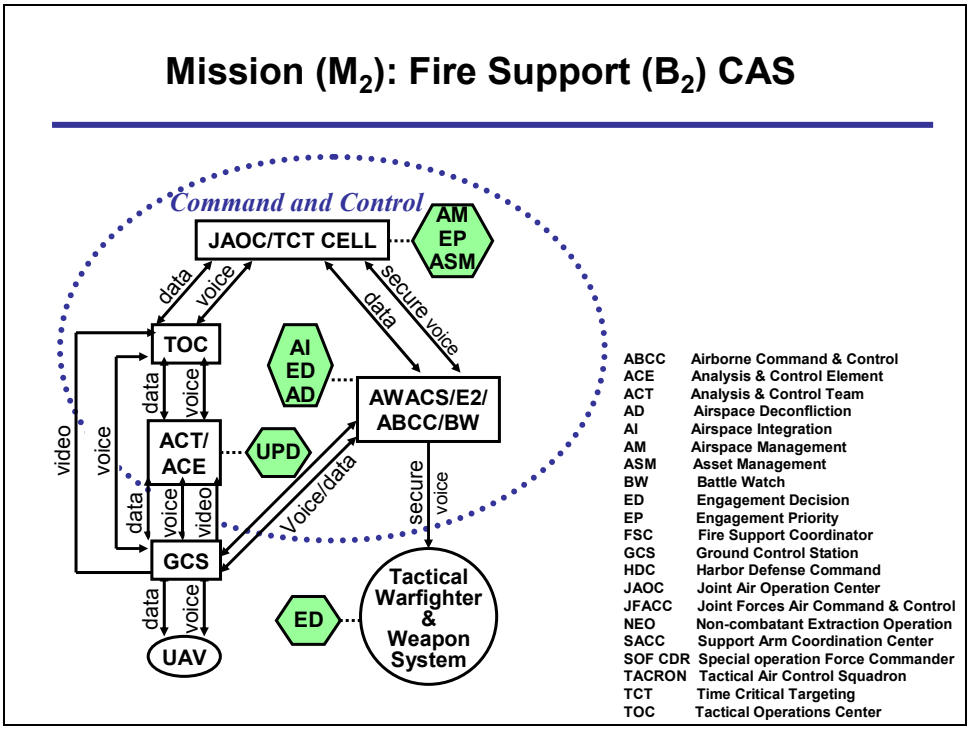

Figure D-34 Scenario M_2B_2: Fire Support: CAS Communications Block Diagram

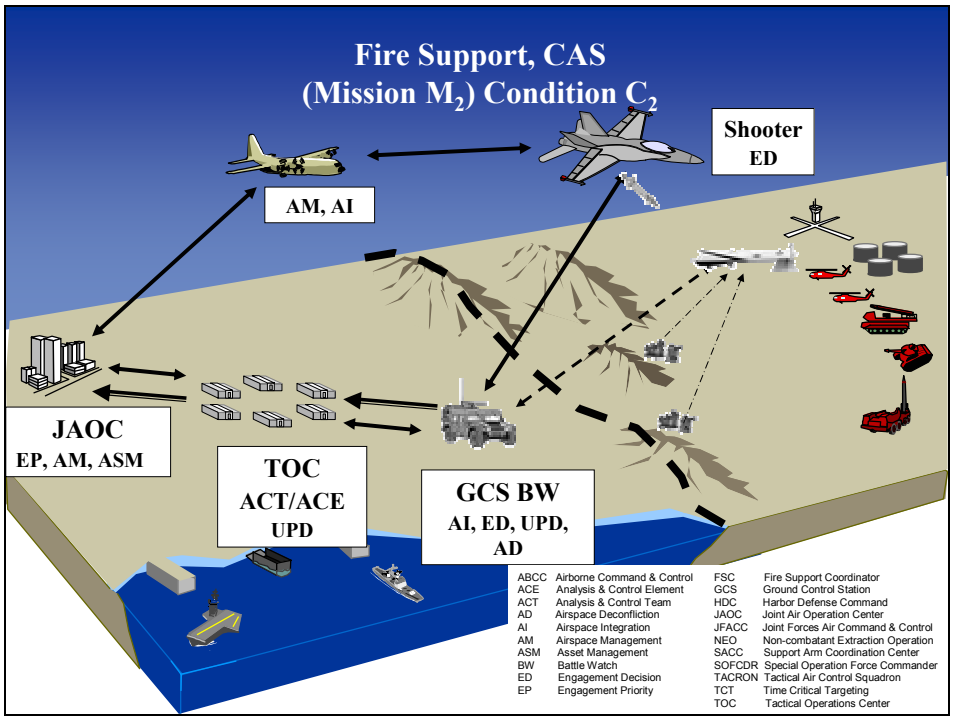

Figure D-35 Scenario M_2C_2: Fire Support: CAS

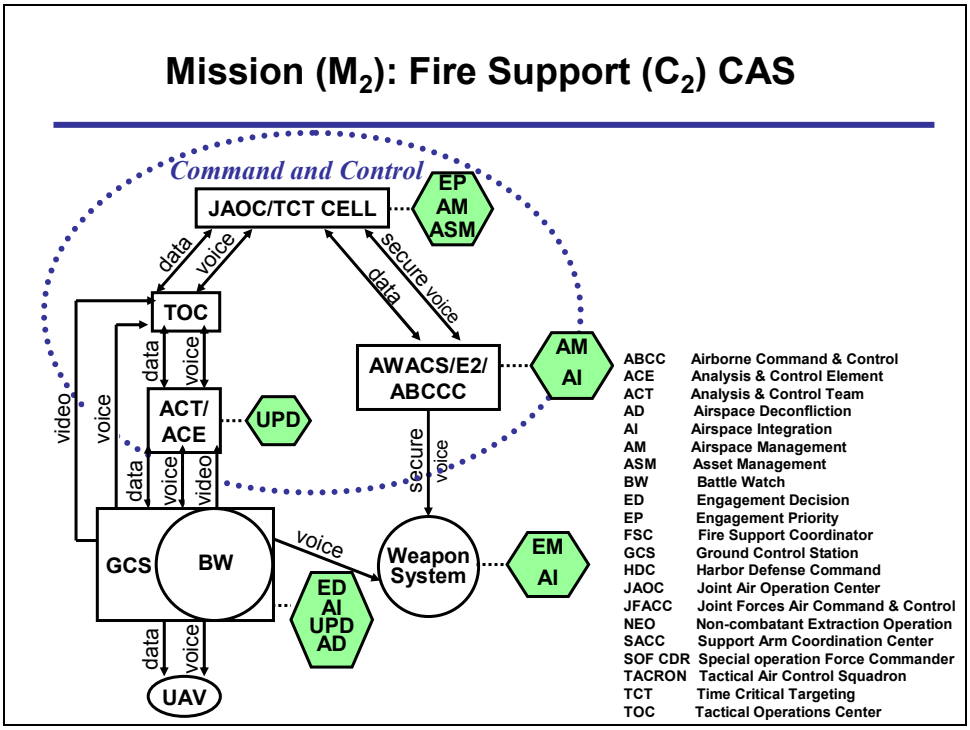

Figure D-36 Scenario M_2C_2: Fire Support: CAS Communications Block Diagram

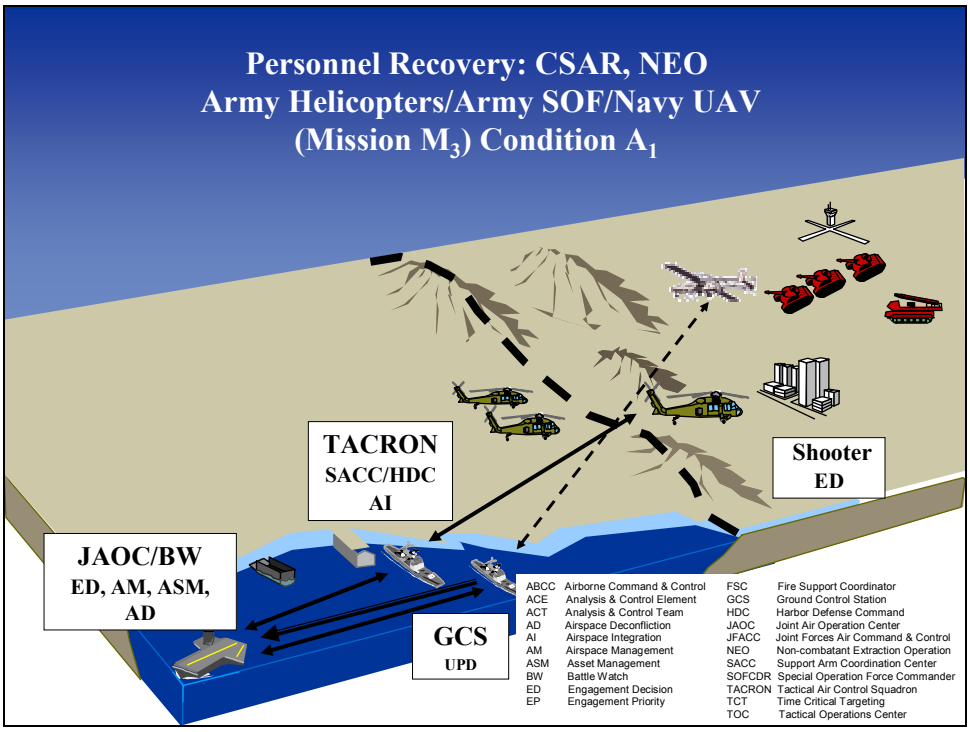

Figure D-37 Scenario M_3A_1: Personnel Recovery: CSAR, NEO

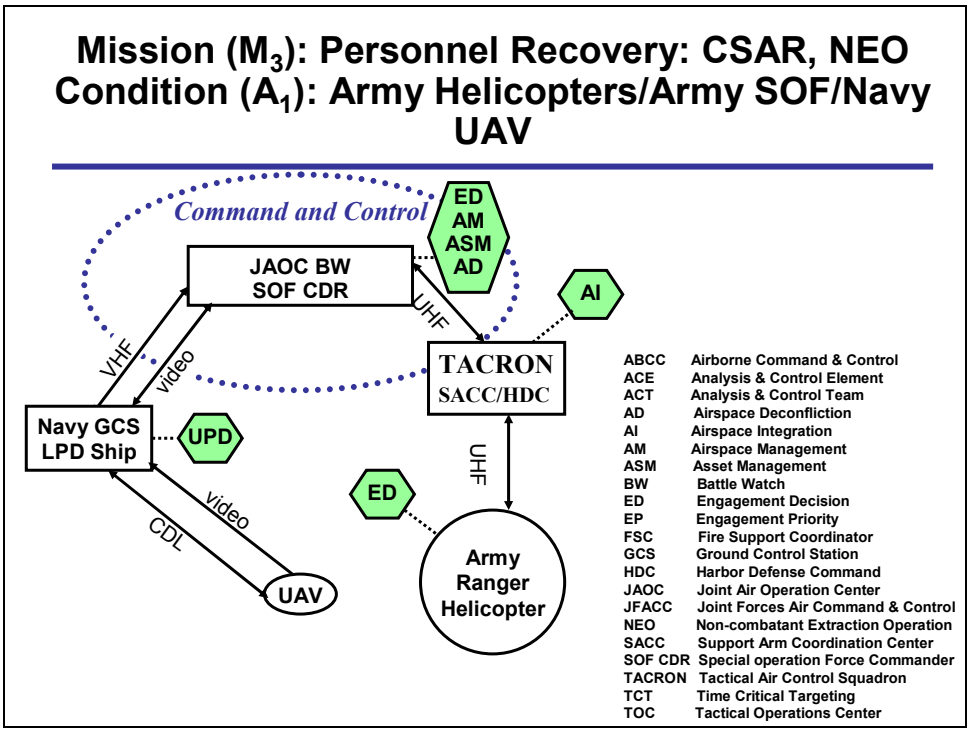

Figure D-38 Scenario M_3A_1: Personnel Recovery: CSAR, NEO Communications Block Diagram

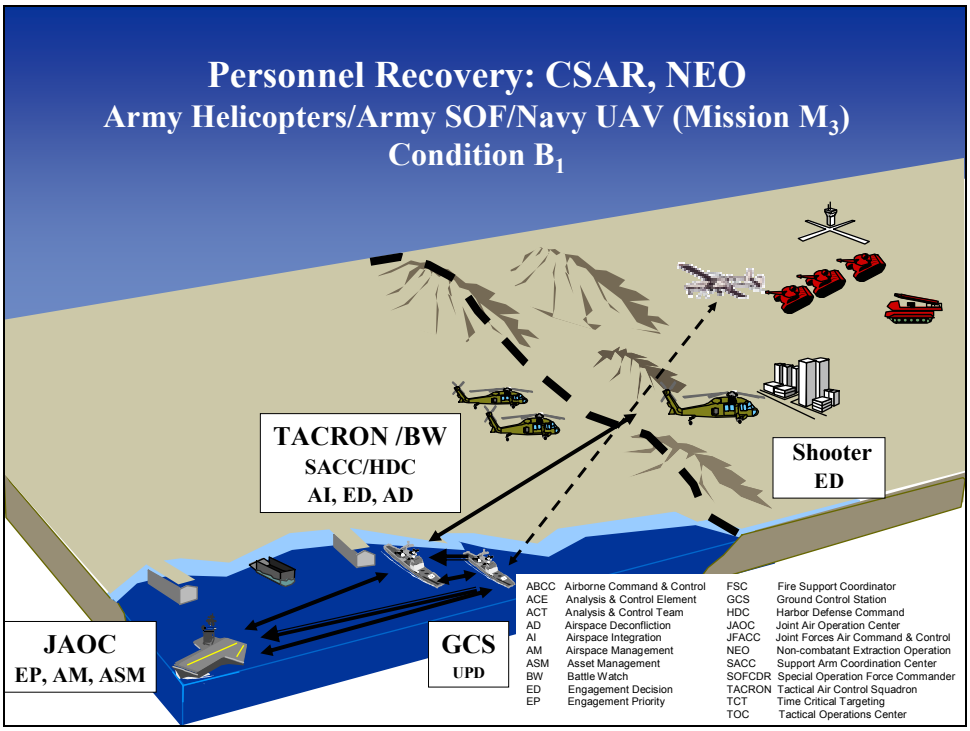

Figure D-39 Scenario M_3B_1: Personnel Recovery: CSAR, NEO

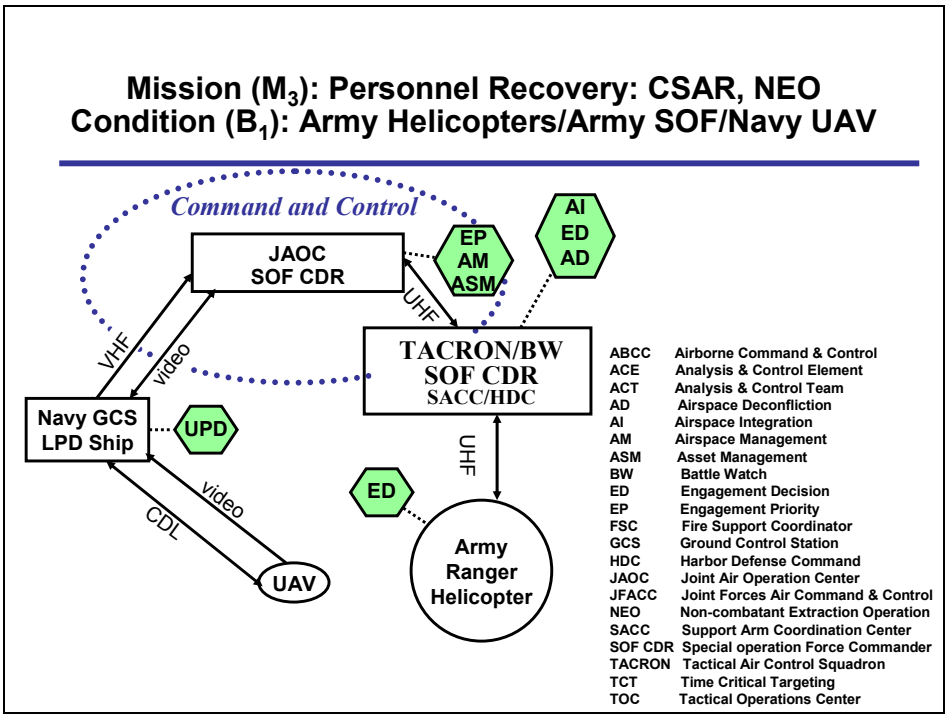

Figure D-40 Scenario M_3B_1: Personnel Recovery: CSAR, NEO Communications Block Diagram

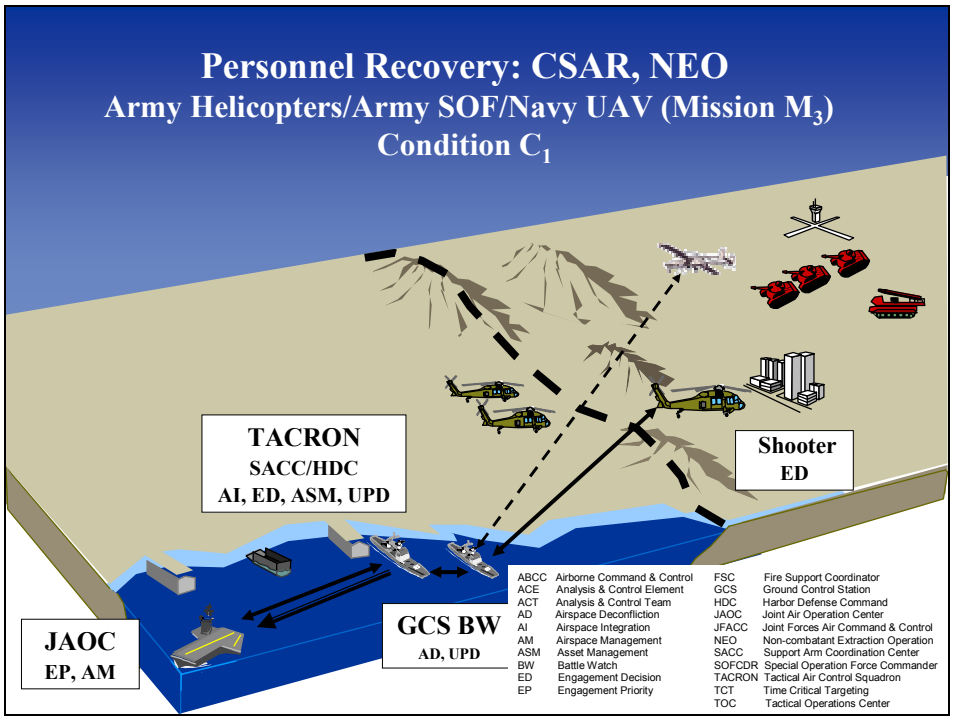

Figure D-41 Scenario M_3C_1: Personnel Recovery: CSAR, NEO

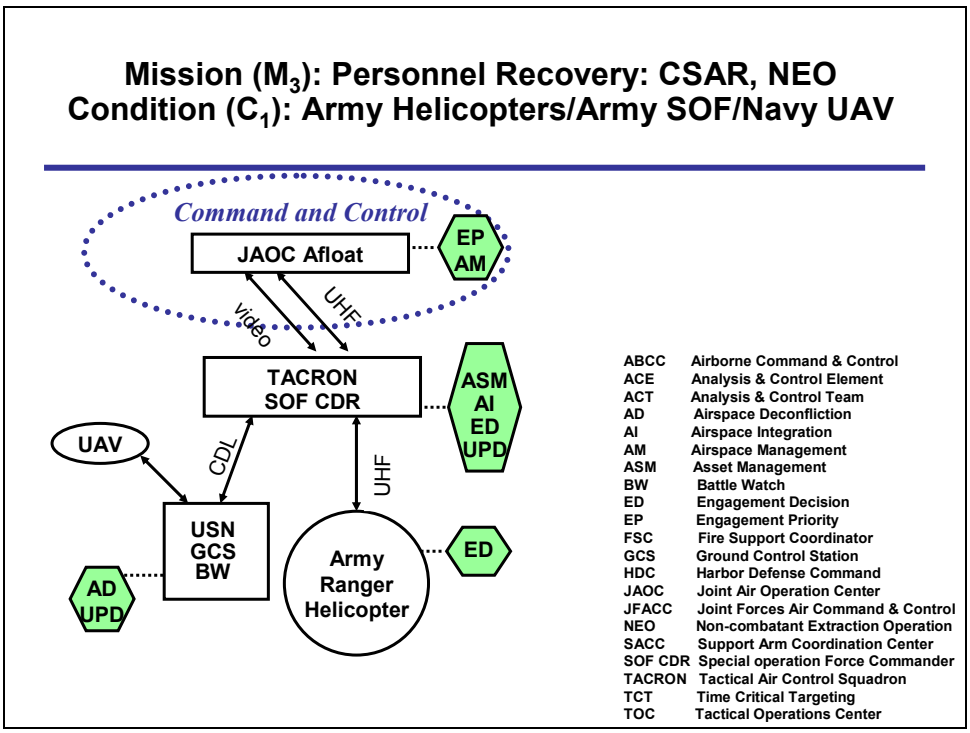

Figure D-42 Scenario M_3C_1: Personnel Recovery: CSAR, NEO Communications Block Diagram

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ANNEX E MODELING AND SIMULATION PLAN

E.1 OVERVIEW

During the JFS, available simulations and models were surveyed for potential suitability as a venue for test rehearsals as well as application to the development of JTTP. Existing modeling and simulation (M&S) facilities and systems were evaluated on the basis of addressing Joint UAV employment in a multi-Service, dynamic battlespace. The primary concern was to determine if the JT&E could use a virtual environment to exercise test procedures and evaluate data collection methods, thereby reducing risk for the live field tests and JVTE. A secondary consideration was the potential for using M&S in the development or refinement of JTTP. The JFS research was supported by an M&S Working Group (M&S WG). The group included the JFS Technical Director, M&S program sponsors, SMEs, and a technical advisor from OSD. The JFS surveyed legacy M&S tools on the basis of capabilities, correctness, accuracy of results, and usability in the intended application.

The following are the basic objectives for the use of M&S:

- Rehearse and improve test procedures for later live testing
- Develop and rehearse data collection forms
- Practice using data collection tools such as palmtop computers and recording equipment
- Develop UAV mission planning tools for live testing
- Refine tactical terminology and communications practices for live testing
- Provide familiarization with the geographic operational areas for live testing
- Allow for direct interaction with warfighters (Invitation to participate in simulation sessions will always be extended to the JWAG and to the operational communities. If real-world operational demands preclude warfighter participation, members of the JUAV Joint Test Force (JTF), along with the simulation facilities engineering staff, will work through rehearsals.)

M&S requirements and potential contributions were developed through a series of M&S WG meetings, site visits by JFS team members, and review of M&S design and documentation. These efforts culminated in a proof-of-concept demonstration conducted at the Integrated Battlespace Arena (IBAR) Laboratory in April 2001. This process determined that, although no single model or simulation system currently exists designed specifically to JUAV requirements, legacy models and simulations exist that can be used either "as is" or with minimal modification for rehearsing test procedures, training the JTF members, and practicing data collection. Such use would support risk reduction and provide a VR environment. The existing facilities and documented capabilities and experiences of IBAR and the Advanced Prototyping, Engineering, and Experimentation (APEX) Laboratories include use for similar applications. Although there is no architecture specifically dedicated to JUAV objectives, there are networks and procedures for federating M&S and these can be used. Sufficient fidelity could be achieved for risk reduction and rehearsing test procedures, thereby optimizing the use of the live field tests and the JVTE. The focus of the VRs will be on preparing the JTF and test equipment for live events.

The JFS survey determined that current M&S systems and tools lacked sufficient fidelity for use in test execution. Limitations of the M&S in the areas of communications performance, weapon accuracy, WDP performance, UAV video quality, UAV and aircraft sensor performance, and current

terrain databases were noted. These limitations were not expected to constrain the use of the M&S tools for risk reduction and rehearsing test procedures. The identification of the limitations did lead to a decision not to use M&S to develop or refine JTTP.

The following are the M&S facilities identified for use in the JT&E:

- Naval Air Warfare Center, Weapons Division (NAWCWD), IBAR at Naval Air Weapons Station (NAWS) China Lake, CA. This includes, but is not limited to, the Multiple Unified Simulation Environment (MUSE) UAV simulation and Virtual Prototype Facility (VPF) reconfigurable cockpit simulation. Refer to Section E.4 for details.
- The APEX Lab, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL, Battlefield Highly Immersive Virtual Environment (BHIVE). Refer to Section E.4 for details.

The Defense Research and Engineering Network (DREN) and SECRET DREN (SDREN) will support networking requirements for connecting APEX and IBAR for distributed simulation. Using these simulation facilities and federation capabilities will enable the JTF to construct a simulation environment that will support risk reduction through the rehearsal of test procedures, the use of test data collection methods and equipment, and operational area familiarization for JTF members.

E.2 PURPOSE OF MODELING AND SIMULATION

The JTF will use legacy M&S tools in test planning to optimize use of test resources, develop test data collection tools and data collection procedures, train JTF members, and reduce risk prior to live tests. During VR 1 and VR 3, the use of terrain databases for the geographic areas where live tests will later be conducted will provide basic area and range familiarization for JTF members. In addition, VRs, when warfighters can participate, will provide a forum for discussion and demonstration of current tactics and procedures.

Lessons learned during simulation sessions will allow the improvement of test procedures and assessment of test objectives prior to data collection in the live field tests and the JVTE. Figure E-1 illustrates the overall JT&E project schedule, including the VRs. The use of the VRs will generally follow the JUAV JT&E test concept (detailed in Chapter 2) that is based on progressively complex military environments.

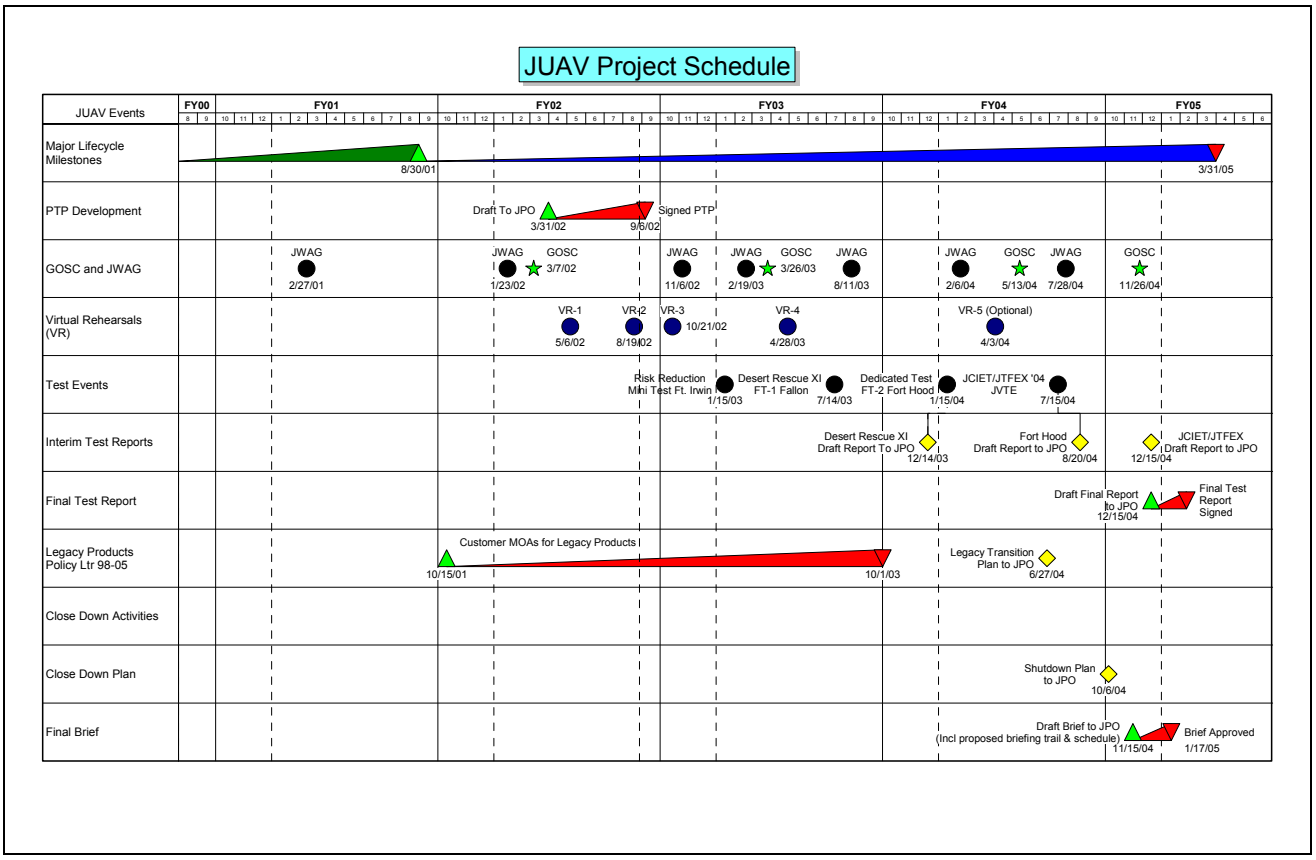

Figure E-1 JT&E Project Schedule

E.3 MODELING AND SIMULATION SCHEDULE

Four VRs are planned and scheduled to occur prior to the live field tests (FT-1 and FT-2) and the JVTE. Test procedures and data collection will be exercised in VRs before being used in live field tests. The simulation event schedules for VRs 2, 3, and 4 will evolve based on the outcome and experience from VR 1 and in accordance with the overall plans for the Risk Reduction Mini-Test, FT-1, FT-2, and the JVTE. The degree of complexity, number of simulated participants (UAV, aircraft, C2 nodes), and mission area for VR 2-4 will evolve from VR 1 and be based on objectives for the live test sessions. A contingency fifth rehearsal is tentatively planned for FY04, prior to the JVTE, but will be used only if rescheduling is required to accommodate other overall test-schedule modifications. The schedule for VRs is elaborated in Table E-1.

Table E-1 Schedule for Virtual Rehearsals

Date	Description	Remarks
06 – 10 May 02	• VR 1 • 1 UAV • 1 fixed-wing fighter/attack aircraft	VR 1 will be the initial opportunity to exercise data collection methods and procedures, utilize recording equipment, and observe current TTP for situations where a single UAV would be operating in coordination with a single aircraft in the mission area of fixed-wing Air Interdiction: Armed Reconnaissance.
Aug 02	• VR 2 • Exercise JCS-1 • 1 UAV	Detailed schedules and scripts will be developed in accordance with classified exercise planning conferences in mid-FY02. The exercise is an annual, multinational Joint Force command post exercise (CPX) that makes extensive use of M&S. The scenario is expected to include a Personnel Recovery (CSAR or NEO) event. A MUSE workstation located at IBAR will receive a one-way data feed from JCS-1. This will provide the exercise database and allow the MUSE to be operated in conjunction with the JCS exercise play. Experimentation can be done with the MUSE at IBAR on a not-to-interfere basis with the JCS. Overall objectives are to practice data collection methods and tools, data recording procedures and equipment, and evaluating the JCS virtual database for possible incorporation in future JUAV M&S events. Also, the opportunity to observe a large-scale, multinational Joint Force CPX provides a significant training opportunity for JTF members.
Oct 02	• VR 3 • 1 UAV • 2 fixed-wing fighter/attack aircraft	Air Interdiction: Armed Reconnaissance mission. Tentatively scheduled for Oct. 2002 for two fixed-wing aircraft and a single UAV. This session supports the upcoming Risk Reduction Mini-Test at Ft. Irwin. VR 3 adds complexity by simulating multiple aircraft in the same mission area as used in VR 1. Air integration will involve one more fixed-wing asset.
Apr 03	• VR 4 • Min. of 2 UAV • Multiple rotary-wing and fixed-wing aircraft	VR 4 adds complexity by simulating operation of two UAVs and at least two air platforms, one fixed-wing fighter/attack aircraft and one helicopter. Airspace integration will involve an additional UAV and a rotary-wing platform in place of one of the fixed-wing platforms used in VR 3. VR 4 is scheduled as a specific rehearsal for FT-1.

E.4 DESCRIPTION OF MODELS AND SIMULATIONS

E.4.1 IBAR

E.4.1.1 IBAR Description

The IBAR is a high-fidelity distributed simulation centered on the VPF reconfigurable cockpit simulation. IBAR provides a general-purpose virtual reality environment for human-machine interaction. IBAR is an active participant in the Naval Air Systems Command (NAVAIR) Defense Network (DNet) using the nationwide SDREN. IBAR capabilities of specific interest to the JUAV JT&E are:

(1) The command infrastructure capabilities supporting the UAV, sensor payload, and GCS simulations.

(2) The VPF reconfigurable aircraft cockpit and control simulation.

The UAV simulation is a platform generic distributed simulation incorporating a MUSE to emulate a wide variety of payload configurations. (Section E.4.1.7 describes MUSE.) The reconfigurable aircraft cockpit can represent a variety of fixed-wing strike aircraft such as the F-15 E, AV-8B, and the F/A-18 C/D and E/F models. The IBAR provides a unique opportunity to exercise UAV strike aircraft and C2 architectures to support them within a single facility.

The various M&S systems that are elements of the IBAR can be joined with each other and can be connected with ranges and facilities throughout the U.S. and worldwide through various media including fiber optic, SIPRNET, Ethernet, microwave, and telecommunication. IBAR is one of nine laboratories in the NAVAIR DNet using the SDREN. IBAR is High-Level Architecture (HLA) and Distributed Interactive Simulation (DIS) compliant. IBAR capabilities supporting the JUAV JT&E are detailed in Table E-2.

Depending on the nature of the simulation requirements, users may use a single IBAR laboratory or system, a combination, or a national integrated network of simulation capabilities. Sections E.4.1.2 through E.4.1.7 describe the specific components and subsystems used for the JUAV JT&E.

Table E-2 IBAR Capabilities Supporting JUAV

System or Lab within IBAR	Functions
Virtual Prototype Facility (VPF)	F/A-18 attack aircraft Digital reconfigurable cockpit environment
Precision Engagement Center (PEC)	Joint C2 node Targeting Cell Tactical C2
UAV Simulation (MUSE)	GCS and aerial vehicle
Mission Planning	Targeting, C2
Data-Link Network Integration Facility (DLNIF) a.k.a. Lab Data Link	Data-Link communications between nodes
Visual Presentation Lab (VISLAB)	Scene generation
High Performance Computing Distributed Center (HPCDC) and Networking	Computing support

Figure E-2 illustrates the laboratory floor plan of IBAR and indicates the location of simulation systems and facilities of specific interest for JUAV use.

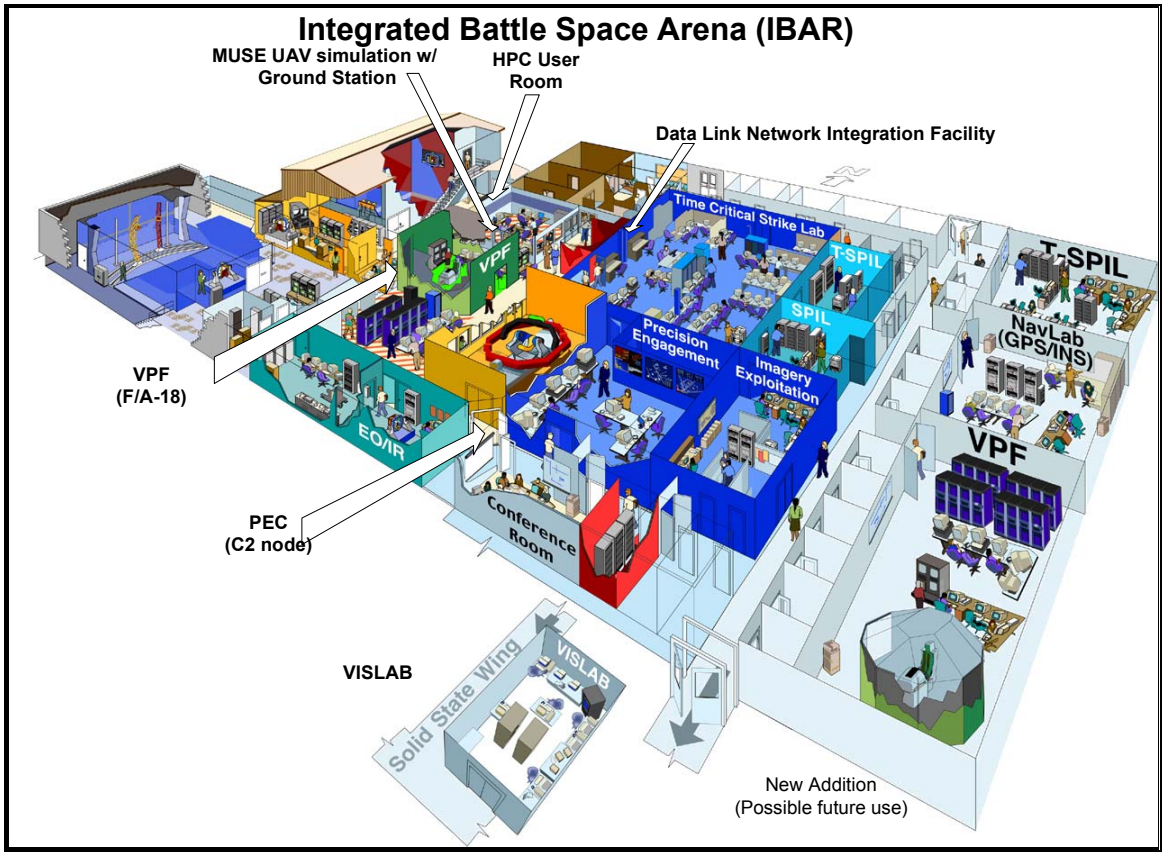

Figure E-2 Floor Plan of IBAR

E.4.1.2 Virtual Prototype Facility

For the JUAV JT&E, the VPF will be used for man-in-the-loop simulation of fixed-wing strike aircraft such as the F-15 E, F/A-18, and AV-8B, and launching of air-to-surface weapons.

VPF is an all-digital, six degrees of freedom (DOF) readily configurable cockpit environment in which Naval strike-warfare technology is tested and evaluated. Developed to help weapon designers address critical system interactions, the VPF treats the weapon system as a system of systems: surveillance, off-board communications, mission planning, advanced weapons guidance, and bomb-damage assessment. At the heart of the VPF is a stand-alone cockpit that can be reconfigured in minutes to emulate a variety of military aircraft including the F/A-18, AV-8B, and F-15. The out-the-window display is created by draping high-resolution satellite images over a three-dimensional grid of the terrain derived from Digital Terrain Elevation Data (DTED) Level I and II data. Air-launched and surface-launched weapons can be simulated. As a highly flexible facility, the VPF offers one-on-one and one-on-many aircraft engagements for manned and unmanned aircraft. The VPF bridges the gap between conceptual studies and hardware-in-the-loop simulations and can be networked with a growing number of similar facilities around the country.

VPF limitations exist in the areas of aircraft flight performance and cockpit functionality. As previously stated, VPF was developed to support weapon design and engineering and not airframe design, cockpit instrumentation, or flight performance precisely. IBAR's use of VPF is in weapon development

and not aircrew training or airframe design. Flight performance may be an approximate simulation and not exact for specific aircraft. The reconfigurable cockpit is adapted for each of the three types of fixed-wing aircraft. Basic functions for weapon selection and delivery are simulated, but the exact physical switches and button positions for each aircraft type may not be replicated. Reconfiguration may be required to switch from air-to-air to air-to-ground strike warfare operations for the same airframe such as the F/A-18 Hornet.

These limitations are not critical factors if the JTF uses VPF for rehearsing test procedures and practicing test data collection methods and tools.

E.4.1.3 Precision Engagement Center

Two specialized laboratories make up the PEC. These are the Imagery Exploitation and Support Laboratory and the Strike Planning and Rapid Targeting Laboratory.

The Imagery Exploitation and Support Laboratory provides imagery and intelligence expertise and products to the NAWCWD community and its customers. The workstations and communications networks used by the PEC are the same as those used in operational fleet C2 facilities. The laboratory provides:

- Intelligence collection management services
- Controlled image archives
- Mapping
- Charting
- Geodesy data
- Expert image exploitation and manipulation

The Strike Planning and Rapid Targeting Laboratory of the PEC represents a Navy Command, Control, Communications, Computers and Intelligence (C4I) mission planning and targeting facility. The laboratory replicates many support systems within the Aircraft Carrier Intelligence Center (CVIC). During the VRs at the IBAR, the PEC will simulate a Joint C2 node or a Tactical C2 node, whereas the Imagery Exploitation Lab will provide target imagery and simulate targeting functions of a Joint C2 node.

Limitations of the PEC depend on whether connectivity is limited to other systems within IBAR or extended to other C2 facilities that may be afloat, ashore, or airborne. Data quality and communications network performance, when operating within IBAR, do not replicate the degradation observed in real-world operations between widely distributed facilities, ships, and aircraft. During fleet exercises when PEC is connected with fleet units, it is subject to all the communications performance problems seen in the real world including bandwidth availability, data loss, and timing delays.

E.4.1.4 Visual Presentation Lab

The VISLAB combines environmental data (e.g., terrain, weather) with target images to generate composite scenes. The scene generation and injection capabilities from the VISLAB will provide area and target scenes for the MUSE and the VPF.

E.4.1.5 Data Laboratory

The Data-Link Network Integration Facility (DLNIF) provides a variety of actual and simulated data links. This laboratory also provides simulated and actual Link-16 and Link-11 connectivity and traffic. The DLNIF will support VRs by providing Link-16 communications paths between the Joint C2 node and the Tactical C2 node. In addition, IBAR has developed a capability locally to incorporate GCS reported position reports for the UAV on the Link-16 tactical display in the PEC.

E.4.1.6 High Performance Computing Distributed Center and Networking

Additional computational horsepower for the IBAR is supplied by the on-site HPCDC. The HPCDC contains more than $4 million in state-of-the-art computing resources including two Silicon Graphics Reality Monster Bases (32 processors total) and an Amherst Systems digital output processor and associated software. The HPCDC supports graphics intensive real-time computing and multi-processing computing and is linked to the DoD HPC community.

IBAR has national connectivity via the DREN and SDREN. NAVAIR-wide networking also connects IBAR to nine NAVAIR laboratories and facilities.

E.4.1.7 UAV Simulation/MUSE

IBAR has incorporated and adapted MUSE as its local UAV simulation including the laser designator enhancement for the Predator UAV simulation. The UAV simulation provides a human-controller interface plus a six DOF simulation of several UAVs and simulated Infrared Surveillance Targeting (IRST). The JTF will employ MUSE to simulate UAV flight, UAV sensor performance, and GCS functionality in addition to related C2 communications paths. The GCS operators' workstation controls the UAV with the proper data link. The MUSE simulation system is the primary UAV training system used within DoD for command and staff level.

The standard MUSE released by Joint Technology Center/Systems Integration Laboratory (JTC/SIL) has not yet incorporated a laser designator. IBAR's adaptation of MUSE included incorporation of a prototype laser designator simulation. The IBAR MUSE can simulate the lasing of a potential target for either illumination or designation with limitations. The IBAR's prototype UAV laser simulates line of sight (LOS) constraints but does not incorporate range limitations or target surface characteristics that affect real-world target acquisition. The UAV laser spot on a target may be acquired with unrealistic ease by a WDP or a laser-guided weapon.

There is no simulation of the effects of environmental factors, such as wind, on UAV flight performance. The Electro-Optic (EO) sensor performance can be affected by simulated weather such as clouds or haze. There are also limitations in the IBAR's MUSE video infrared (IR) presentation. The MUSE can create the effect of IR by allowing the operator to select "white hot" or "black hot display," but the only effect is to change the effects on the video presentation. There is no M&S of actual IR sensor collection or IR characterization in the scene presentation. Only the "look" of an IR scene is presented.

Database availability is another factor directly affecting potential use of MUSE for the JUAV JT&E. IBAR does not currently have a worldwide terrain database developed for MUSE, so preparation for each VR must include a review of available databases and a decision whether to use an existing database or develop one.

E.4.1.7.1 MUSE Program Description

MUSE was developed by the JTC/SIL at the Army Aviation and Missile Command (AMCOM), Redstone Arsenal, AL. JTC/SIL manages MUSE as part of the Air Force Synthetic Environment for Reconnaissance and Surveillance (AFSERS). The JTC/SIL was established to provide a cost-effective test bed for UAV technology assessment, insertion, demonstration, and transfer. MUSE consists of a generic UAV GCS, air vehicle and data link simulation, and a visualization system to generate payload and sensor scenes of ground search. The MUSE air vehicle and visualization system can be tied directly into tactical UAV ground stations when military units want to train with their organic equipment. Standard National Imagery and Mapping Agency (NIMA) products, such as DTED and Controlled Image Base (CIB), are used to produce the visualization system database. The UAV ground station simulation is Defense Information Infrastructure-Common Operating Environment (DII-COE) compliant, uses the Joint Mapping Toolkit (JMTK), and can communicate to a variety of Joint C4I systems.

The elements of the MUSE system can be tailored for specific organizations and their operational environment (as is the case within IBAR). IBAR has modified their MUSE workstation to support the use of a laser designator for the Predator model as previously discussed in paragraph E.4.1.7. Some users employ MUSE in a fixed lab and others use a mobile configuration to support field exercises. The JTF will employ MUSE as an integrated component system in the IBAR lab.

E.4.1.7.2 Existing Functionality in MUSE

MUSE has been used primarily as a command and staff level trainer for UAVs. Originally developed in early 1994 as a demonstration Hunter UAV simulation suite, MUSE has evolved into a broad-based simulation suite that has been upgraded to include new UAV models, tactical communications, Synthetic Aperture Radar (SAR) payload, and mission planning. MUSE has supported a variety of users in diverse military exercises and demonstrations. MUSE normally uses DIS Institute of Electrical and Electronics Engineers (IEEE) standard 1278-1.a-1998 for distributed simulations but can also use the Aggregate-Level Simulation Protocol (ALSP) for interoperability with dissimilar Service and Joint constructive simulations. MUSE is HLA and DIS compliant and can receive entity data from other DIS simulations such as the IBAR's VPF.

E.4.1.7.3 MUSE Architecture

MUSE can be used as a standalone UAV simulation or integrated into a complex simulation laboratory such as IBAR or APEX in more complex scenarios. The JTF will use MUSE as one of the component systems within IBAR as illustrated in Figure E-3.

MUSE consists of three primary components:

- Payload Visualization System
- Control Station Surrogate
- MUSE Driver

The Payload Visualization System generates synthetic payload scene video or imagery of the three-dimensional battlefield with simulated target entities. The MUSE visualization system is a commercial-off-the-shelf (COTS) product that generates an EO/IR payload scene with overlays for the platform being flown. Presentation of UAV ground search is accomplished using COTS visualization products and a terrain database either developed with high-resolution imagery or made synthetically.

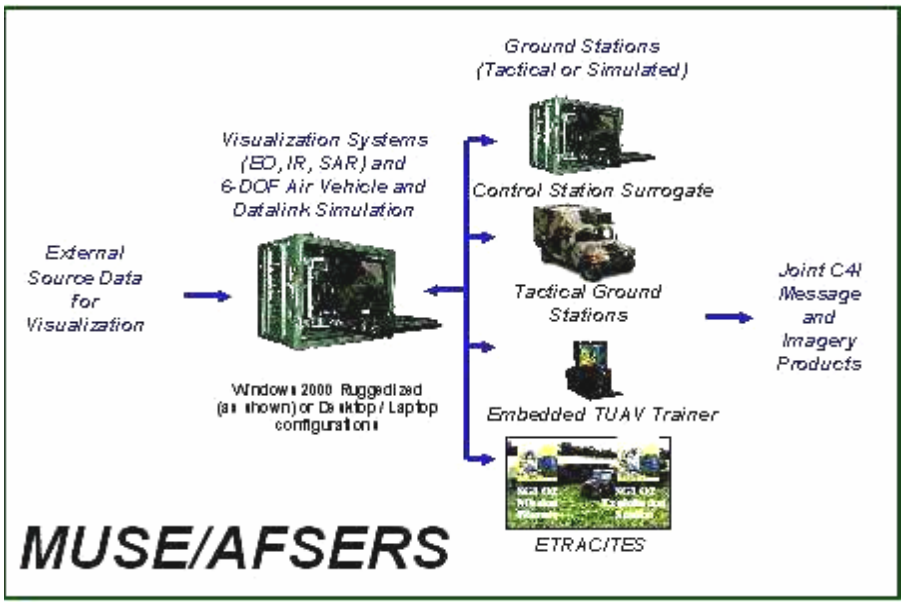

Figure E-3 MUSE Architecture

The UAV Control Station Surrogate (CSS) simulates a tactical or generic UAV platform control station where an Air Vehicle Operator and Mission Payload Operator perform air vehicle and payload control functions. Graphical User Interfaces (GUIs) are provided to conduct mission planning and generate tactical messages and imagery products for dissemination to tactical C4I systems. The JMTK segment provides the operator with the ability to display standard NIMA map and imagery products such as Arc Digitized Raster Graphics, Compressed Arc Digitized Raster Graphics, Digital Chart of the World (DCW), DTED, and CIB and provides MIL-STD 2525 symbology overlay capability.

The MUSE Driver simulates the data links and autopilot flight dynamics. The MUSE driver receives flight control, mission planning, and payload-pointing commands via telemetry data from a tactical or simulated GCS, flies the UAV in autopilot mode, and relays sensor-pointing information to the payload visualization system. Tactical interfaces are simulated by the MUSE Driver allowing communication with tactical UAV GCS. The MUSE Driver provides a six DOF autopilot model. Modifying air-vehicle data configuration files can change the flight models for different air vehicles including Hunter, Pioneer, and Predator. Typical entries in the data configuration files are minimum/maximum air speeds, climb and turn rates, and field of view (FOV) pointing information for the sensor/platform of interest.

E.4.1.8 Simulation Architecture, IBAR

The first simulation architecture for the JUAV JT&E, illustrated in Figure E-4, uses the IBAR facility to accomplish the simulation objectives for VR 1. VR 1 uses a basic scenario of a single fixed-wing attack aircraft and one UAV. Later phases in VR 2 and VR 3 add complexity through additional weapon systems or UAVs. An E-2C Hawkeye airborne Tactical C2 node will be simulated for the JT&E VRs using an Air Defense System Integrator (ADSI) AN/TSQ-214 (V) workstation. ADSI will receive Link-16 tactical data and includes a voice (radio) connection to other nodes. ADSI provides communications and display capabilities for a wide variety of strategic, tactical, and raw sensors systems and has tactically evolved into roles that support the Common Operating Picture (COP), the Single Integrated Air Picture (SIAP), and various other C4ISR echelons of command. Unlike PEC, VPF, and MUSE, ADSI does not have dedicated lab space. The workstation is contained in an equipment rack that will be set up in an area of the DLNIF that provides physical separation from the other nodes in the JT&E rehearsals.

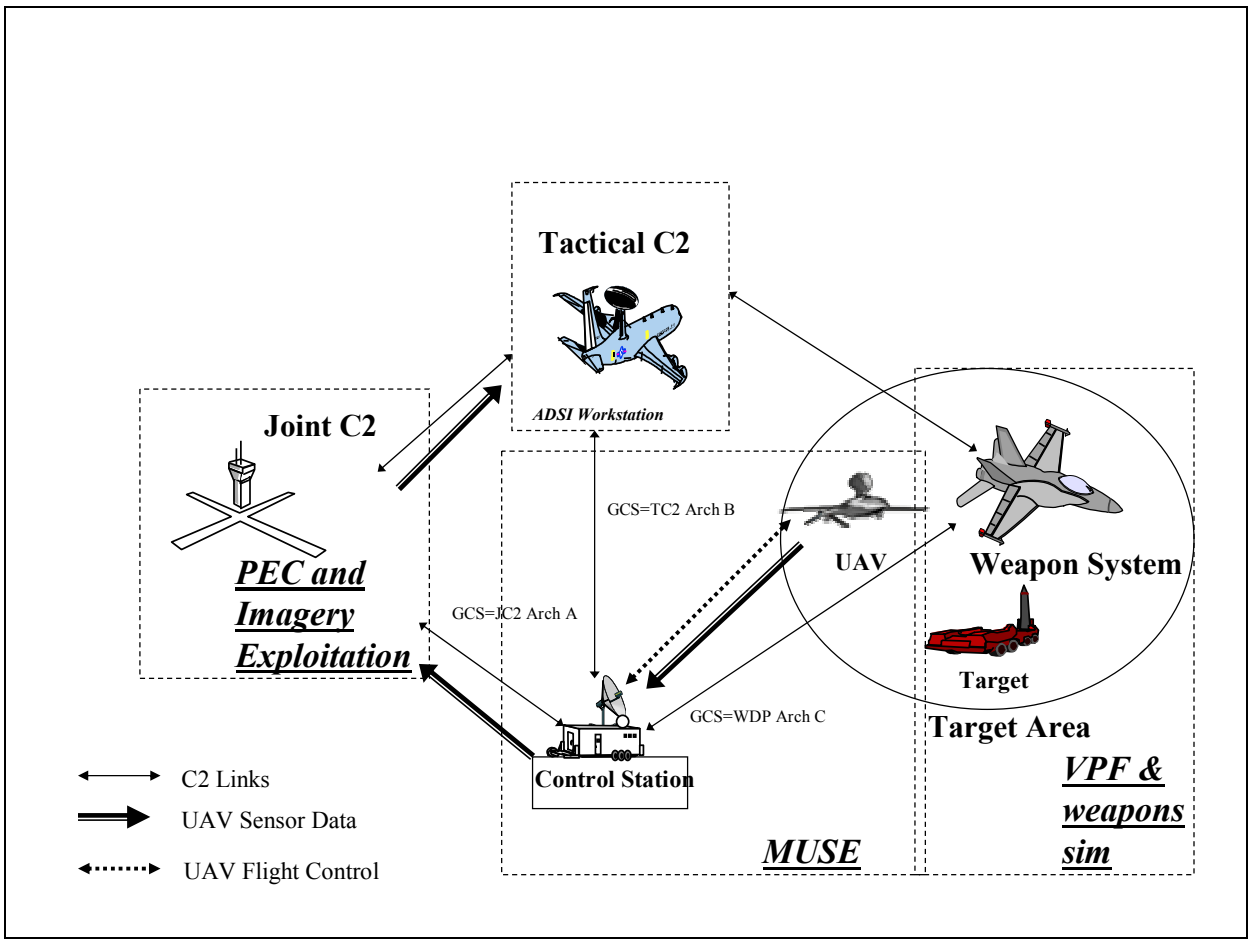

Figure E-4 Simulation Architecture, IBAR VRs 1, 2, and 3

E.4.2 APEX

E.4.2.1 APEX Facility Description

The APEX Lab is a research and development integration facility under the U.S. Army AMCOM, Systems Simulation and Development Directorate. The APEX mission is to address the existing gap between warfighter simulation and engineering-level simulation capabilities by applying DIS and emerging DoD HLA technologies. This integrates the dynamics of doctrine, tactics, mobility, logistic support, Command, Control, and Communications (C3) decision-making, Homeland Defense, and human reaction in a synthetic battlefield driven by both tactical and technical constraints. The APEX Lab provides a full-spectrum systems engineering approach for evaluating emerging systems and concepts in a virtual prototyping environment. APEX incorporates a diverse set of M&S tools and capabilities. The APEX capability of specific interest to the JT&E is the BHIVE (discussed in Section E.4.2.2). The JTF will use the capabilities of BHIVE for simulating rotary-wing platforms and a ground warfare environment prior to the live field tests and the JVTE in the mission areas of Armed Reconnaissance, Artillery Fire Support, and Personnel Recovery

E.4.2.2 BHIVE

BHIVE is designed for weapon system evaluation in a DIS man-in-the-loop virtual environment. The initial emphasis was to develop an AH-1W Cobra platform for Joint operations with the U.S. Marine Corps to evaluate air-to-air and air-to-ground weapon systems on a virtual battlefield. Work was also done to look at Unmanned Ground Vehicle (UGV) and Military Operations in Urban Terrain (MOUT) applications. Simulation of specific airframe flight performance, cockpit instrumentation, and communications systems was not a primary design requirement. There were no design requirements based on use of the rotary-wing platform as a node in a variety of C2 architectures. Voice and data communications paths can be simulated but may not be configurable beyond basic capabilities rather than tailored to a specific C2 architecture.

Table E-3 BHIVE Capabilities

Open Weapon System Architecture	Plug-n-Play six DOF Missile Models Dedicated processor(s) Shared-memory interface
High-Fidelity Flight Model Integration	Tactical hardware interface Dedicated processor
Reconfigurable	Multi-platform (air/sea/land) Multi-color LCD touch screens used for instrumentation Rapid-prototyping environment
Open-Hardware Configuration	Allows leverage of intelligent controller and reflective memory hardware interfaces Minimizes future hardware costs
Bi-Directional Curved Screen	150 by 40 degree FOV 3 soft edge blended projectors
Gunner Interface	Infrared sensor(s) Touch screen
Pilot Interface	Glass cockpit/touch screen Three-dimensional soft gauges and dials
Audio System Performance	Doppler shifts Propagation delays Range attenuation

BHIVE I is currently capable of simulating USMC AH-1Z Cobra, Army AH-64D Apache, and Army UH-60 Blackhawk helicopters. APEX has successfully integrated UAV simulation into BHIVE by incorporating a MUSE.

E.4.2.3 Simulation Architecture, IBAR and APEX

The simulation architecture will expand to incorporate the APEX Lab in VR 4. The APEX Lab will support simulations of rotary-wing aircraft by adding a single helicopter to the nodes and entities in the virtual architecture. The federation of simulation facilities will use DIS: the IEEE and DoD standard for connecting simulations. The expanded simulation architecture will integrate simulations for fixed-wing and rotary-wing aircraft, ground targets, UAVs, and other mobile entities. Both laboratories have extensive experience using DIS for similar federation. Data interactions between the two simulation laboratories will be accomplished primarily using DIS over the SDREN network with Secure Telephone Unit (STU) III telephone lines used for test coordination and control. Transactions over SDREN will include voice networking via Advanced Simulation Technology Inc. radio packets and C2 video requirements using Video Bricks (Vbricks) video on demand software. The STU IIIs will also provide back-up voice networking during the simulation sessions.

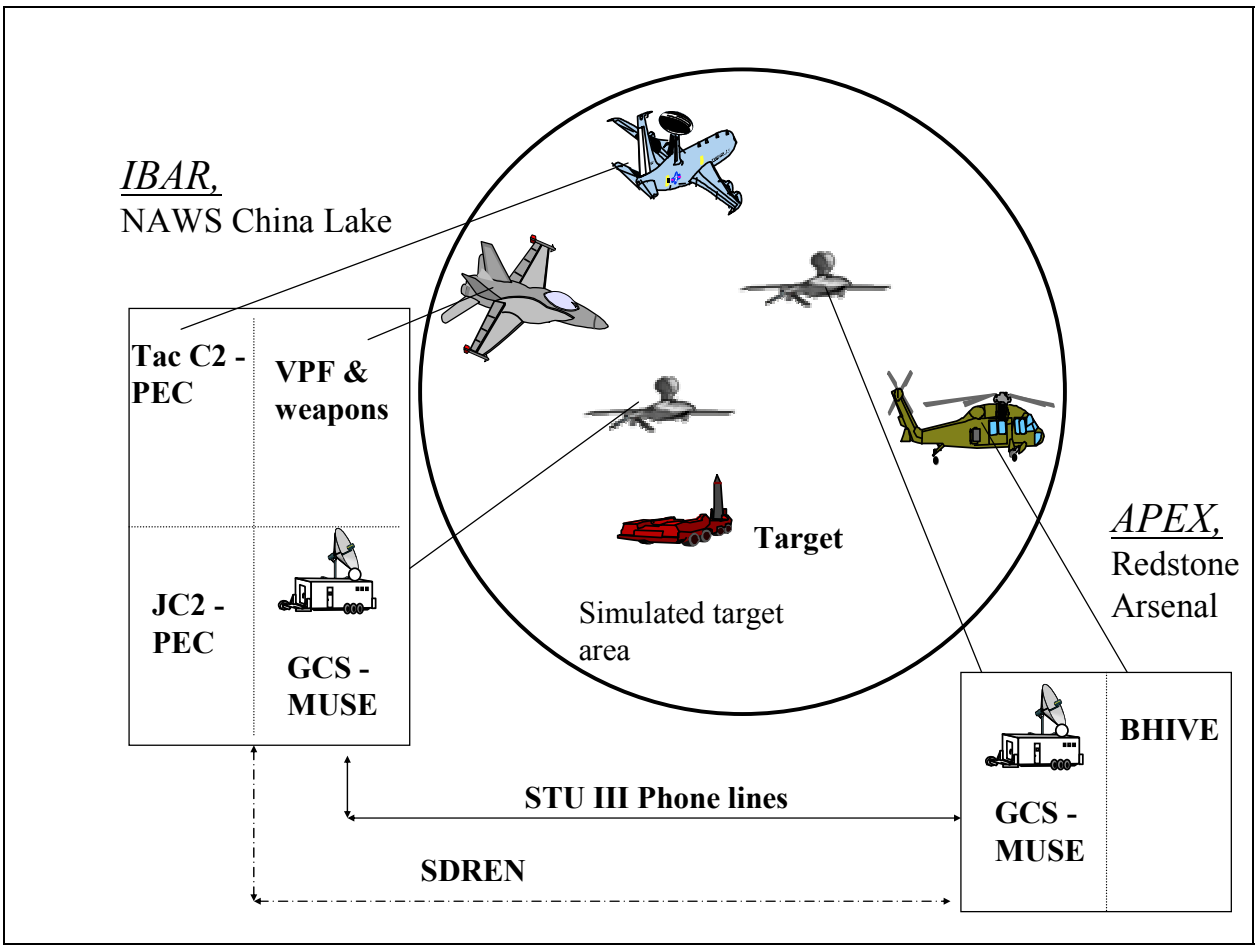

Figure E-5 Simulation Architecture 2: Virtual Rehearsal 4: IBAR and APEX

IBAR and APEX have established connectivity via SDREN for other exercise activity. The physical network between the two facilities exists and has been used between the two laboratories. The SDREN connection between IBAR and BHIVE will be done using DIS Protocols IEEE 1278.1a for exchange of simulation data. APEX and IBAR are experienced using SDREN for DIS federations. Their authority to connect was most recently documented in SDREN NOC MEMO 06.20/02. Both labs use the same MUSE UAV simulation. In addition, IBAR has previously used an APEX DIS simulation locally, linked into their VPF, to study Modernized Hellfire CONOPS on the F/A-18 and Joint Strike Fighter. There is an administrative procedural requirement within the APEX facility for an internal memorandum of agreement to authorize access to SDREN for the specific connection from the BHIVE laboratory via the Javelin Simulation Area where the SDREN ATM switch physically resides. After permission is granted, preliminary connectivity checks will be conducted to verify the data connection is working between IBAR and APEX prior to VR 4. The network connections to SDREN for IBAR and APEX are illustrated in Figure E-6 and Figure E-7.

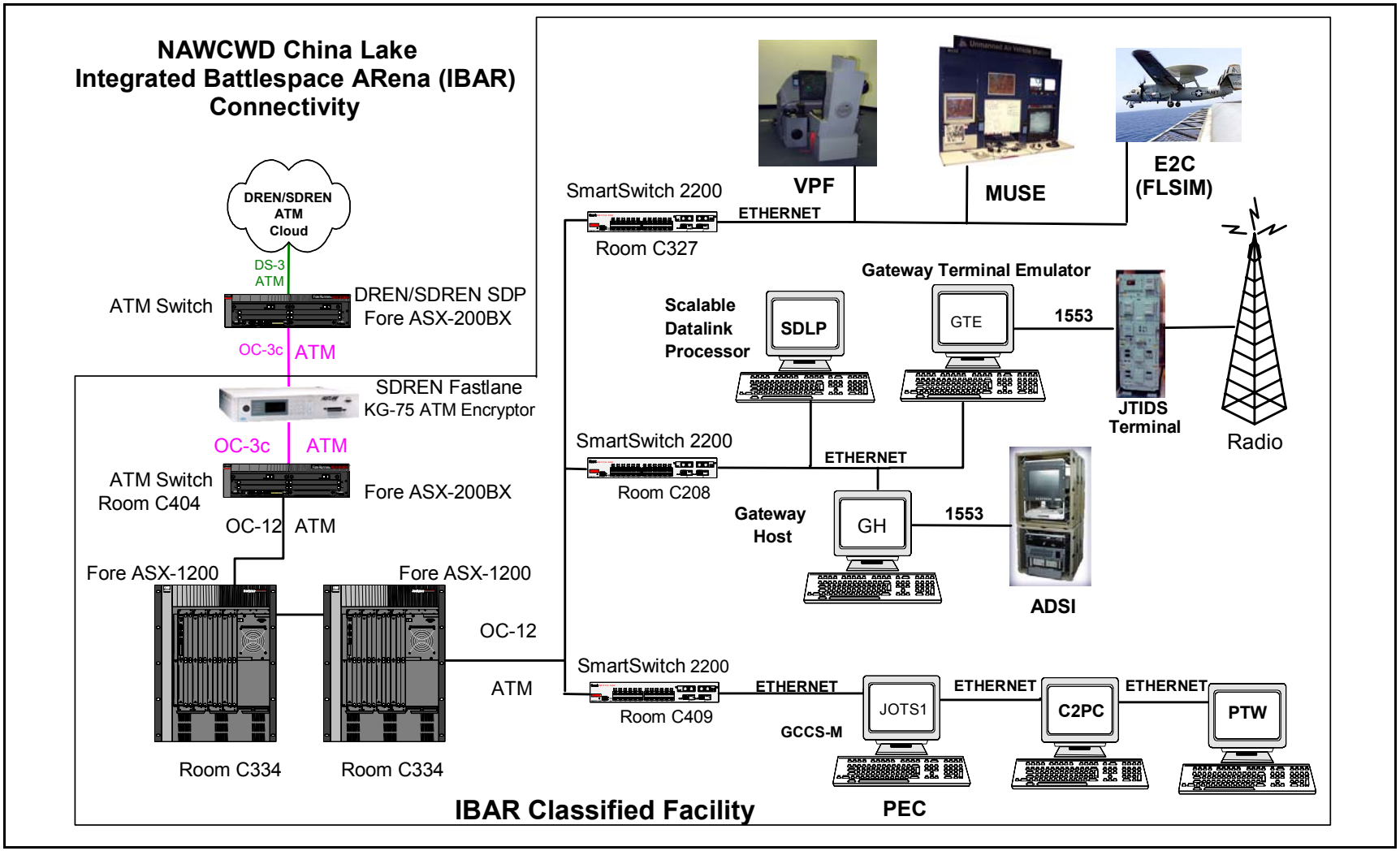

Figure E-6 IBAR Connectivity to SDREN

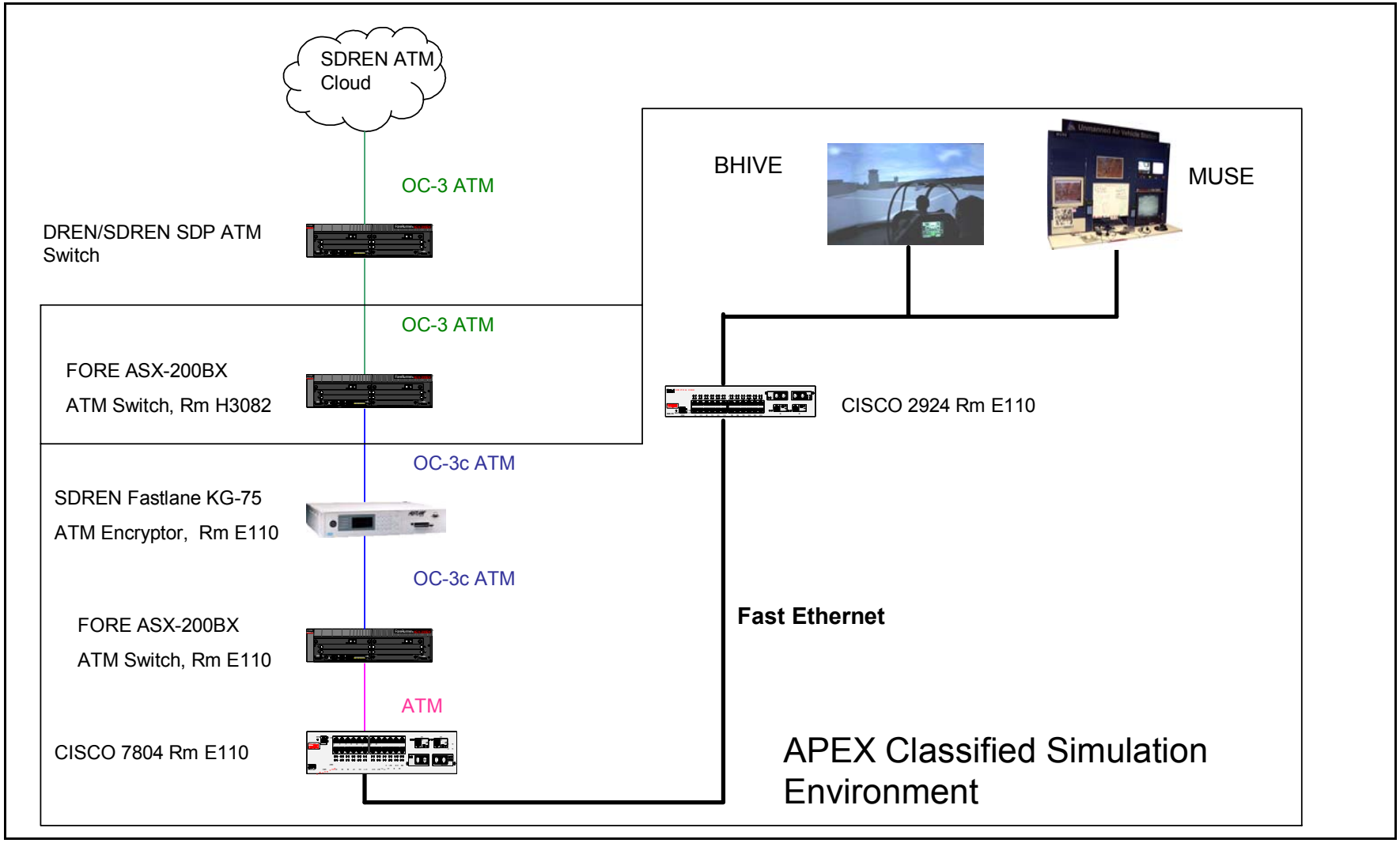

Figure E-7 SDREN Connectivity for APEX

E.5 MODELING AND SIMULATION FUNCTIONAL REQUIREMENTS

The JUAV JT&E will use models and simulations of the following platforms, events, and communications connectivity in the rehearsal of test procedures and data collection methods and tools:

- UAV, sensors, and GCS
- Weapons systems (The simulation will include vehicle performance, sensors, communications capability, and ordnance delivery.)

  Weapons systems simulated will be one or more of the following:
  - Fixed-wing attack aircraft: F/A-18, F-15, or AV-8
  - Rotary-wing: Cobra, Apache, or Blackhawk
- Communications (The requirements are for communication of content between the various nodes and entities. There are no requirements to simulate communications performance bandwidth or replicate technology.)
- Battlefield environment (terrain and weather)
- C2 nodes (including a targeting cell)
- Target
- Test Control (In addition to functional M&S, the facilities used will need to support test control activity such as data logging and audio-visual recording.)

M&S functional requirements for the JT&E VRs are listed in Table E-4.

Table E-4 Functional Requirements for M&S

SIM Subject	Function - activity	M&S
UAV Air vehicle flight performance and response to GCS controls need to be comparable to real-world UAV.	• Airspeed • Maneuverability • Rate of turn, radius • Rate of climb • Endurance • Report position	MUSE
UAV sensor payload Simulate the acquisition of a target and present EO images sufficient for target to be identified. EO only – There are no requirements related to sensor cross-cueing or any measurements related to different sensor capabilities. The objective is to get a target within the UAV's expected FOV.	• UAV laser for target designation and illumination • Orient sensors to the correct FOV • Provide FOV coordinates to the GCS operator • Tracking a target or targets	MUSE
UAV - GCS Simulate the functions related to controlling the air vehicle and the sensor/payload. Provide the displays for UAV status and sensor output. Simulate communications with other nodes and entities (see later sections for communications paths).	• Control the UAV in flight • Control sensors • Monitor and display UAV status and position • Monitor and display UAV EO data • Monitor and display UAV laser illuminator-designator	MUSE

SIM Subject	Function - activity	M&S
Weapons system (Wpn sys) - flight (FW Ftr-Atk acft) Flight performance based on an F/A-18 Hornet, F-15E Strike Eagle, or AV-8 Harrier.	• Speed • Turn • Climb • Position • Data link(s) • Voice communications	VPF
Wpn sys - Sensors (FW, Ftr-Atk acft) Simulate the acquisition of the same target as the UAV with sufficient resolution for a weapon delivery.	• Laser spot tracker • Cockpit instrumentation display for target • Simulate "out the window" view • Simulate FLIR • Targeting • Simulate EO targeting	VPF
Wpn sys - Weapon delivery (FW, Ftr-Atk acft) Simulate the targeting and delivery of three types of weapons: "dumb" bombs, GPS-guided bombs, and laser-guided bombs (LGB).	• Weapon set up and targeting • Weapon "release" • Weapon flight time	VPF
Wpn sys – Helicopter - flight Requirements for simulating flight performance are essentially the same as for those discussed under fixed-wing aircraft, with some additions specific to a rotary-wing aircraft. Platforms simulated will be one or more of the following: Cobra attack helicopter, Apache attack helicopter, or Blackhawk helicopter for Personnel Recovery.	• Speed • Turn • Climb • Hover • Position • Landings/takeoffs (Personnel Recovery)	BHIVE
Wpn sys - Helicopter – sensors Simulate the acquisition of the same target as "held" by the UAV with sufficient clarity for a weapon delivery.	• Laser spot tracker • Cockpit sensor display • Simulate "out the window" view	BHIVE
Wpn sys – Helicopter – weapon delivery Similar to the requirements for a fixed-wing attack aircraft, simulate carrying, targeting, and delivering one or more of the following weapons: Hellfire missile, rockets, or guns. The simulation must include acquiring the same target as the UAV with sufficient resolution for a weapon delivery.	• Weapon setup/targeting • Weapon release • Weapon flight • Weapon impact	BHIVE
Comm - GCS-UAV	• Flight control data (two-way) • UAV Sensor data (receive at GCS only) • Voice, computer chat, Voice is full duplex (phone), and half duplex (radio).	MUSE
Comm – GCS to Joint C2	• C2 data (two-way) • UAV Sensor Data (1-way, GCS-J C2) • Voice, computer chat	DLNIF (lab data link) and voice
Comm – GCS to Tac C2	• C2 data (two-way) • UAV sensor data (1-way, GCS-C2 node) • Voice, computer chat	DLNIF (lab data link) and MUSE

SIM Subject	Function - activity	M&S
Comm - Joint C2 to Tactical C2	• C2 data (two-way) • UAV sensor data (one-way, JC2-Tactical C2) • Voice, computer chat	DLNIF (lab data link) and voice
Comm - Tactical C2 to Wpn sys	• C2 data (two-way) • Voice	DLNIF (lab data link) and VPF
Environment - Terrain	• Urban • Non Urban	VISLAB
Environment - Weather	• Haze/clouds • No requirement for adverse weather	VISLAB
Joint C2 Node Provide simulated situational awareness displays.	• Target status/display • Unit/participant status display (including "own" status)- track picture similar to GCCS or other situational awareness display • Map/geo display of operational area of interest	PEC
Tactical C2 node	• Target status/display • Unit/participant status/display (including "own") • Situational awareness	PEC
Targeting Cell	• Simulate presentation of imagery for target or targets located by UAV • Perform targeting functions related to tasking/delivering a weapon • Analyze imagery from UAV for target decision-making (similar to PTW)	PEC - PTW
Target The simulation has to present a site, facility, equipment, or structure to support the rehearsal of target acquisition, identification, and then target designation or illumination.	• Target location • Target "identity" (facility, weapons system, etc.) • Target activity (mobile, fixed)	VISLAB

SIM Subject	Function - activity	M&S
Test Control Note – This requirement is for support and is not a simulation function. Test Control or Test Director support requirements are based on activities that are not integrated into the simulation of platforms, nodes, or entities. These are requirements to support the observation, control, recording, and follow-up analysis of test sessions conducted in the simulation facility.	• Display map of op area • Display tracks for entities in the simulation such as the UAV, aircraft, and target • Display the UAV video • Display the coordinates of a laser spot • Monitor voice communications • Record voice communications • Record data • Maintain data log/time, based on GPS time • Record data and voice by a format and means that will support JUAV JT&E data analysis • Display accurate time at all stations in the simulation, for simulation participants and test observation and Test Controller • Need capability for Test Controller and other data collectors or test observers to communicate outside the communications paths simulator participants use • Need clear indication of weapon launch and impact	Lab facility support

E.6 SIMULATION COMMUNICATION REQUIREMENTS

Communications requirements during VRs fall into two basic categories: simulation of operational communications and communications to support test control.

The objective of simulated operational communications between nodes and entities is to move appropriate data content and to provide voice communications similar to UHF Satellite Communications (SATCOM) voice. There are no requirements to simulate communications performance or replicate specific technologies. Data communications requirements include the following:

- UAV EO video: provided by existing MUSE capability
- Track (situational awareness) display: provided by existing simulated Link-16 tactical data link
- Sensor data: existing BHIVE and VPF communications simulations for platform organic sensors

Existing communications capabilities in MUSE, VPF, PEC, and BHIVE will support data transfer including UAV video. There is no requirement for the JTF to develop new communications simulations.

For test control, and to support rehearsal of test data collection procedures, the JTF will need a separate voice or computer chat network. JTF members need to be able to coordinate execution of test steps, make test observations, and to have the discussions and interactions recorded for post-rehearsal analysis.

E.7 MODELING AND SIMULATION LIMITATIONS AND CONSTRAINTS

Limitations and constraints in the JT&E's use of M&S are based on the capabilities of current M&S and the overall objectives and schedule of the project. Use of M&S is limited to legacy systems and capabilities, and the role of M&S is limited to risk reduction. This supports the overall project schedule and objectives by optimizing the use of live range time and field exercises.

The JUAV JFS survey of available M&S tools and facilities determined that existing capabilities were sufficient for risk reduction and test rehearsal with modification. The basic capability to simulate UAV performance, fixed-wing and rotary-wing weapon-system platforms, data and voice communications paths, and C2 entities is currently supported by MUSE and laboratory facilities at IBAR and APEX.

A JFS team conducted a site survey at IBAR and conducted a proof of concept demonstration using existing capabilities of the VPF and MUSE to determine applicability for JUAV JT&E use. Their findings were that the M&S systems and tools available lacked sufficient fidelity for use in test execution. However, with modification, a basic virtual environment could be created that would support the rehearsal of test procedures and the use of test data collection tools and methods. Depending on the geographic areas selected for the live tests, there could also be requirements to construct additional terrain databases and target models. The simulation architecture constructed within IBAR will integrate several systems with origins in experimental research and development for specific weaponry and supporting systems unrelated to the JT&E's interests. The adaptation of these M&S tools for the JT&E's use must be done without compromising or degrading tools and systems ability to fulfill their original purpose and primary function. Similarly, the JT&E's use of the BHIVE capability at APEX is constrained by BHIVE's primary function as a weapon systems research and development facility for rotary-wing attack aircraft.

Limitations specific to individual M&S systems and tools are discussed in their respective sections of the PTP. Table E-5 summarizes the limitations identified that affect the JT&E's use of the legacy M&S.

Table E-5 M&S Limitations and Constraints

Category	Limitation
Voice Communications	The number of frequencies and channels is limited, and software reconfiguration of the network requires a shutdown, reconfiguration, and restart. Changes from the JT&E's Architecture A to Architecture B, for example, cannot be made dynamically.
Data Communications	Situational awareness displays for the PEC integrate data sources that might not exist on a single display in real-world C2 nodes. This was an improvisation to accommodate available resources.
F/A-18 Laser tracking	Laser spot on target is "picked up" immediately regardless of the range – virtually unlimited LOS far exceeding real capabilities.
UAV laser designator	Presentation of laser spot on the target is constrained by line of sight only – no simulation of the effect of lasing different surfaces, materials, topography.

Category	Limitation
UAV sensor - EO	Quality of the video is much clearer than real world. Superimposing the target models on the terrain database creates an artificial contrast that makes target location and identification too simplistic.
UAV sensor - IR	The video display can be switch from EO to IR, but the display for "IR" is the same as displayed for EO merely with IR black-white or white-black effect. There's no M&S of actual IR profiles consistent with the terrain and targets.
Voice and Data Communications	No time delays such as can occur in real world. Network quality and performance are unrealistically good.
Situational awareness	No IFF capability simulated.
UAV sensor - SAR	No SAR simulation.
Terrain databases	Databases of sufficient fidelity and granularity do not exist for all possible geographic areas of interest. Databases may have to be either built or acquired for some operational areas or VR limited to a subset of all possible areas of interest.

E.8 SIMULATION INTERFACE REQUIREMENTS

All interfaces between simulations and models will be based on the established capabilities in the various M&S systems and facilities for distributed simulation. Networking capabilities and supported interfaces are included in the simulation descriptions and architectures in Section E.4.

E.9 SIMULATION MANAGEMENT AND CONTROL

During the JFS, an M&S Working Group (M&S WG) was established consisting of JFS team members (currently JTF team members) and engineering staff from IBAR and APEX (supported by SMEs in M&S). The M&S WG will continue throughout the JT&E to provide a simulation management process encompassing:

- M&S requirement review
- M&S enhancements or modifications specific to the JUAV JT&E
- M&S architectures and federations
- A detailed review of scripts and objectives for individual simulation sessions
- Management of simulation schedules
- Facility preparation
- JTF training
- M&S technical support during sessions
- M&S performance review and analysis

For each scheduled simulation event, the JTF M&S team will work with the respective M&S sponsors and engineering staff to ensure means exist to monitor and record simulation states and

interactions during each session. The coordinated efforts of the JTF and M&S staff will further ensure the capabilities to definitively begin, pause, resume, end, and restore each simulation run. Simulation management, as part of overall test control, will include the logging of voice, video, and data transactions. All simulation-management functions will be centralized at IBAR with voice links between simulation stations and APEX.

E.10 DOD HIGH LEVEL ARCHITECTURE REQUIREMENTS

The DoD standard for HLA for Simulation Interoperability provides the capability to link disparate simulations. The capability to create a virtual environment that can simulate the diverse C2 nodes, sensor and weapon systems, and communications paths characteristic of the envisioned battlefield environment depends on compliance with DoD standards for HLA and DIS. The legacy simulations considered for the JT&E have established HLA, are DIS compliant, and have a proven track record for connectivity with other simulation facilities.

E.11 MODELING AND SIMULATION LEGACY PRODUCT APPLICATIONS

The simulation architectures implemented for the JT&E will demonstrate a virtual environment integrating Joint C2, multi-Service weaponry, and UAV operations and products. The modifications and upgrades required to support the JT&E's use of the existing M&S facilities will be documented in the minutes of the M&S WG in order to record the extent of the changes and the requirements that stimulated them. The lessons learned from this process may be referred to by subsequent activities that might be interested in the same M&S tools or systems. No legacy product from the JUAV JT&E will be developed from M&S.

ANNEX F DATA MANAGEMENT AND ANALYSIS PLAN

F.1 INTRODUCTION

F.1.1 Background

This annex describes data management and analysis activities designed to answer the JUAV JT&E issues. Data management includes identifying, collecting, controlling, processing, archiving, and disseminating test data from multiple sources and locations. Data management activities also include identification of data sources, determination of data media and database design, determination of data collection instrumentation requirements, data control, data quality assurance checks and data certification, data storage, and data security. Data analysis includes data reduction, application of statistical methods and techniques, selection and grouping of data elements according to test issues and conditions, and interpretation of data analysis results to answer JUAV JT&E test issues and resolve the Joint problem.

Data management will be integrated with the host venue data collection capabilities. The JTF will not duplicate data collection accomplished by the host venue or another participating agency. JTF personnel will coordinate closely with such agencies to ensure the data products will satisfy JTF needs. Conversely, the JTF may furnish some of the data it collects to the host venue. Detailed data management planning processes and schedules will be synchronized with those of the host venues, and MOA will document these data sharing arrangements.

Data analysis will include a quick-look analysis immediately after each test period to ensure data collection objectives are met. The quick-look analysis will include post-test data review and preliminary data analysis. The quick-look analysis will assess the adequacy of test data. Data management will include performing quality assurance checks for data completeness and correct ranges of data. Valid data will be entered into the JTF database following a formal data review for validity and completeness. A detailed analysis of data will then be done to calculate MLM, MOE, and MOP required to answer JUAV JT&E test issues. Analysis will include evaluation that generates findings and conclusions. These will be reported, lessons learned will be documented, and proposed JTTP for each alternative C2 architecture will be generated and validated.

F.1.2 Purpose

The JUAV DMAP addresses data requirements, data management, data processing, analysis, and evaluation. Data requirements are derived from a systematic decomposition of the problem statement into issues, sub-issues, measures, data elements, and raw-data collection methods. Data management includes data collection, verification, certification, storage, and retrieval. Data processing includes automatic and manual processes to convert raw data into the formats specified for the analysis database. Analysis develops descriptive statistics for test data sets, tests hypotheses concerning differences in TTP, and identifies opportunities for improvement. The evaluation phase is intended to merge the scientific, statistically based results of a rigorous Joint test project with operational considerations that may be difficult to replicate in an exercise environment to reach operationally implementable findings, conclusions, and recommendations. During evaluation, operational SMEs who have an in-depth operational understanding of UAVs and how UAVs could integrate into the Joint Force will review the analytical results to determine the most promising and realistic JTTP and associated architectures. This annex addresses these technical activities from initial planning through the final technical report.

F.1.3 Schedule

The JUAV JT&E includes the Risk Reduction Mini-Test, two field tests, and the JVTE. The mini-test will rehearse data collection and analysis procedures in the field. Data required to answer the JUAV JT&E issues and sub-issues will be collected in the two field tests. A JVTE (JCIET04/JTFEX) is planned to validate JTTP developed during the JT&E project. Four Virtual Rehearsals (VRs), using legacy M&S tools, will help prepare the JTF for the live test events.

The mini-test will be conducted at NTC, Ft. Irwin, CA. The exact date is the subject of a memorandum of agreement being coordinated with NTC and JCAS but is expected to be in January 2003. The memorandum of agreement will coordinate all test and resource requirements. The JTF will develop a DTP for the mini-test.

The field tests are major test activities where the JTF will be responsible for managing much of the operational planning. A DTP and supporting DMAP will be developed for each. Interim test reports will be developed and distributed following DD, DT&E approval. FT-1 will use the DR XI exercise at NASF, NV. This exercise will include participants from all Services and will focus on the CSAR mission area. FT-1 is scheduled for 14 July – 1 August 2003. This exercise normally lasts two weeks and will provide sufficient opportunity to test and evaluate UAV JTTP and the three C2 architectures in the CSAR and Air Interdiction mission areas. In addition, the JTF is planning a third dedicated week of testing that will provide a level of test control not possible during the normal exercise.

FT-2 will occur in January 2004 at Ft. Hood, TX, as a dedicated test coordinated with III Corps. This test and venue will provide the opportunity to test revisions to the JTTP and the three alternative architectures. This test will focus on the CAS and Air Interdiction mission areas.

After refining JTTP results from data in the two field tests, JTTP and supporting architectures will be validated in JCIET04/JTFEX. JUAV and JCIET are coordinating a memorandum of agreement that will define the exact timing of the exercise. The purpose of the JVTE is to validate JTTP and C2 architectures that have been refined in the field tests in a more complicated operational environment.

The JTF will publish a test activity report after each field test and the JVTE. The JTF will also publish a JUAV JT&E final report 120 days prior to the end of the project.

VRs will be primarily executed at the Navy's IBAR facility at NAWS, China Lake, CA. The JTF will also link to the Army's APEX facility at Huntsville, AL. APEX provides additional resources, including simulation of attack helicopters and incorporation of ground forces, for improved fire support coordination. VRs will serve as risk reduction for the mini-test, the field tests, and the JVTE.

F.2 DATA ANALYSIS APPROACH

F.2.1 Why Study UAV Integration into the Operations of a Joint Force

UAV units have been fielded by the Services. Each Service has its own set of UAV platforms, operating procedures, and personnel selection and training procedures. This has resulted in a lack of uniformity in training, airspace integration procedures, and C2 functions related to the efficient implementation of UAVs in a Joint Force. This nonuniformity results in platform-specific, Service-centric equipment and procedures. The JUAV JFS determined that existing TTP do not adequately address Joint UAV employment in dynamic Time-Sensitive Operations (TSO). Figure F-1 represents the JUAV Joint problem as agreed to by the Service members of the JWAG.

Existing tactics, techniques, and procedures do not adequately address Joint UAV employment in dynamic time-sensitive operations (TSO).

Figure F-1 Problem Statement

Recent developments have combined to offer additional capabilities to integrate UAVs into Joint Force operations. These include communications equipment on UAVs, such as Predator, Hunter, Shadow, and Global Hawk, designed to enable communications relay but which also offers the ability for the GCS crew to communicate with other aircrew. UAVs, such as Predator, Hunter, and Shadow, are being equipped with laser illuminators or laser designators. Hunter UAVs are being equipped with tactical data links, such as Situation Awareness Data Link (SADL), to enable GCS crews to increase their situational awareness. Finally, the Global Broadcasting Service now allows dissemination of UAV video to U.S. Forces throughout the world. These developments create an environment for an increased role for UAVs in Joint Force operations.

The JUAV-TSO JT&E was chartered to test and evaluate the Services' ability to integrate UAVs into time sensitive, Joint tactical operations. The JUAV JT&E will measure and compare Service and platform specific TTP against a set of alternative JTTP that are platform-independent. Under the guidance of the JUAV GOSC, and with the support of the JWAG, the JTF will develop JTTP that are not platform or Service specific and that can be employed to allow Joint Forces to use UAVs to support TSO.

F.2.2 Data Analysis Requirements

F.2.2.1 Missions

Data will be collected in three primary mission areas:

(1) Air Interdiction (Armed Reconnaissance): This mission is to impede enemy operations, in the enemy rear, away from friendly forces by detecting, recognizing, identifying, localizing, targeting, and engaging targets of opportunity. The UAV can play a role throughout by supporting fixed-wing and rotary-wing ground attack aircraft executing the mission.

(2) Fire Support: This mission is to support friendly ground forces in their fire and maneuver operations against the enemy. Fire support may be provided by aircraft, artillery, and naval gunfire. Thus, friendly ground forces will be in the vicinity of the targets, and target engagement will be requested and controlled by the ground forces usually through a Tactical Air Control Party (TACP) or FACs and artillery forward observers. Fire support from air platforms is known as CAS. For JUAV JT&E purposes, CAS also includes organic, combined-arms air-ground operations in the Army and Marine Corps. The UAV provides targeting support for FACs and TACPs and adjusts artillery fire.

(3) Personnel Recovery: This mission involves the extraction of friendly personnel from dangerous positions (often behind enemy lines). The JT&E is focusing on the two main types of Personnel Recovery missions: CSAR and NEO. The UAV may locate the personnel to be recovered. It may also survey the potential ingress and egress routes and landing zones.

F.2.2.2 Principal Test Variables

Various ways exist for a UAV to be integrated into the operations of a Joint Force. The JUAV JT&E is focused on the interrelationship between four operational nodes in the Joint Force as listed in Table F-1. For test purposes, these nodes include all sensors and weapons onboard or collocated with the node.

Table F-1 Critical Elements of a Joint Force for JUAV

Nodes	Description
C2 node	Joint C2 node or operations center (such as a JAOC)
Forward control node	A forward Tactical C2 node (FAC-A, TACP, E-2, E-3, Aegis)
UAV	One or more UAVs with associated GCS
WDPs/RPs	One or more weapon delivery platforms or rescue platforms

It is the interactions (communications, directions, and reporting) between these nodes in a Joint Force that are critical for the JUAV JT&E. The three alternative C2 architectures (Table F-2) presented in the JUAV JFS and the JTTP to be developed in the JUAV JT&E specifically define how these four nodes may communicate and respond to each other.

Table F-2 Summary of Alternative C2 Architectures

Alternative	BWF Location	Description
A	C2 node	The BWF are placed at the Joint C2 node
B	Forward Tactical C2 node	Specific BWF related to UAV integration are delegated to a forward Tactical C2 node
C	UAV ground station	Specific BWF related to UAV integration are delegated to the UAV GCS

During the JT&E, the JTF will consider other architecture variations should they appear. For example, should two variants of Architecture B emerge as different and significant, one of the two variants may be defined as a new Architecture D. Thus, the JTF will focus on three quite different architectures but will keep open the possibility of others.

F.2.3 Test Cell Matrix

F.2.3.1 Controlled Variables

The primary controlled variables are the three alternative C2 architectures and their associated JTTP described in Section F.2.2.2. The secondary controlled variables are the mission types outlined in Section F.2.2.1 and the type of UAV.

F.2.3.2 Uncontrolled Variables

Uncontrolled variables include the type of WDP, environmental conditions at the test sites, weapons involved, and the experience level of the UAV GCS personnel. The JTF will collect data on these factors during each trial.

F.2.3.3 Sample-Size Requirements

Sample size represents the number of test trials that must be executed to ensure that data collected for each permutation represented in the test cell matrix (discussed in paragraph F.2.3.4) are statistically defensible. Collecting more samples generally produces higher confidence in the results (less chance of

error) but also increases cost. Therefore, the samples collected must be sufficient to achieve adequate confidence in the result. Data sample requirements will be based on achieving 75% confidence in the result.

The test is a comparison among three C2 architectures and their procedures for conducting TSO. A baseline Joint capability does not exist. Architecture A was designed based on real-world experience and keeps engagement authority at the JAOC. Architectures B and C push engagement authority forward on the battlefield, and to be viable alternatives, must show improvement in the ability to conduct these operations in a timely manner. The test will collect data for each trial on whether the engagement was conducted successfully and the time it took to engage the target.

There are four possible outcomes:

(1) The JTF can correctly conclude that architectural and procedural changes improved performance.

(2) The JTF can correctly conclude that architectural and procedural changes did not improve performance.

(3) The JTF can falsely conclude that architectural and procedural changes improved performance (Type I error).

(4) The JTF can falsely conclude that architectural and procedural changes did not improve performance (Type II error).

The JTF will pair-wise compare the three architectures across the three mission areas. Architectures B and C will be compared with A. Architectures B and C will also be compared with each other. The Chi-square contingency table methodology, described in Appendix F-1, will be used to determine whether two architectures present significantly different probabilities of success. The JTF will use this methodology in reverse to estimate the number of trials needed for statistical and operational significance.

One factor the JTF considered is ensuring that the number of trials would be sufficient to determine a meaningful separation in probability estimates between two architectures. As an extreme, the JTF with sufficient resources would need to execute thousands of trials to detect very small separations with statistical rigor. However, very small separations would probably not be operationally meaningful. In determining the required sample size, the JTF estimated that a 20% separation in results would be operationally meaningful. In the actual evaluation process, after samples have been collected, SMEs will determine if the results have operational significance and statisticians will determine if the results have statistical significance, but for purposes of estimating the required number of trials, the JTF used a 20% separation in the samples for operationally meaningful results.

Without a baseline, the JTF does not have data to suggest what resulting probabilities should be expected. Therefore, in computing the required number of trials, the JTF parameterized the results. Thus, for any two conditions being compared (for example, condition 1 and condition 2)[a] the results were parameterized with condition 1 having 10%, 20%, 30%, 40%, 50%, 60%, and 70%. Condition 2 was parameterized at 20% higher than condition 1. In effect, the JTF looked at a boundary condition between operationally significant and not operationally significant results.

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[a] These notional conditions 1 and 2 could be any two of the alternative C2 architectures A, B, C. One or both could conceivably be other architectures that may be determined during the test. They could represent other conditions (WDPs, ordnance types, or UAV types) that may be used in the test.

Figure F-2 shows the results of a spreadsheet computation that computed the probability of a Type I error (i.e., erroneously concluding that separation exists) for a given number of trials and 20% separation between resulting samples. The figure shows several curves reducing toward 0 as the number of trials increases. These curves were generated assuming results for two conditions being compared that had success probabilities of 10% and 30%, 20% and 40%, 30% and 50%, 40% and 60%, 50% and 70%, 60% and 80%, and 70% and 90% respectively. Each curve retained a 20% separation in results for the two compared conditions.

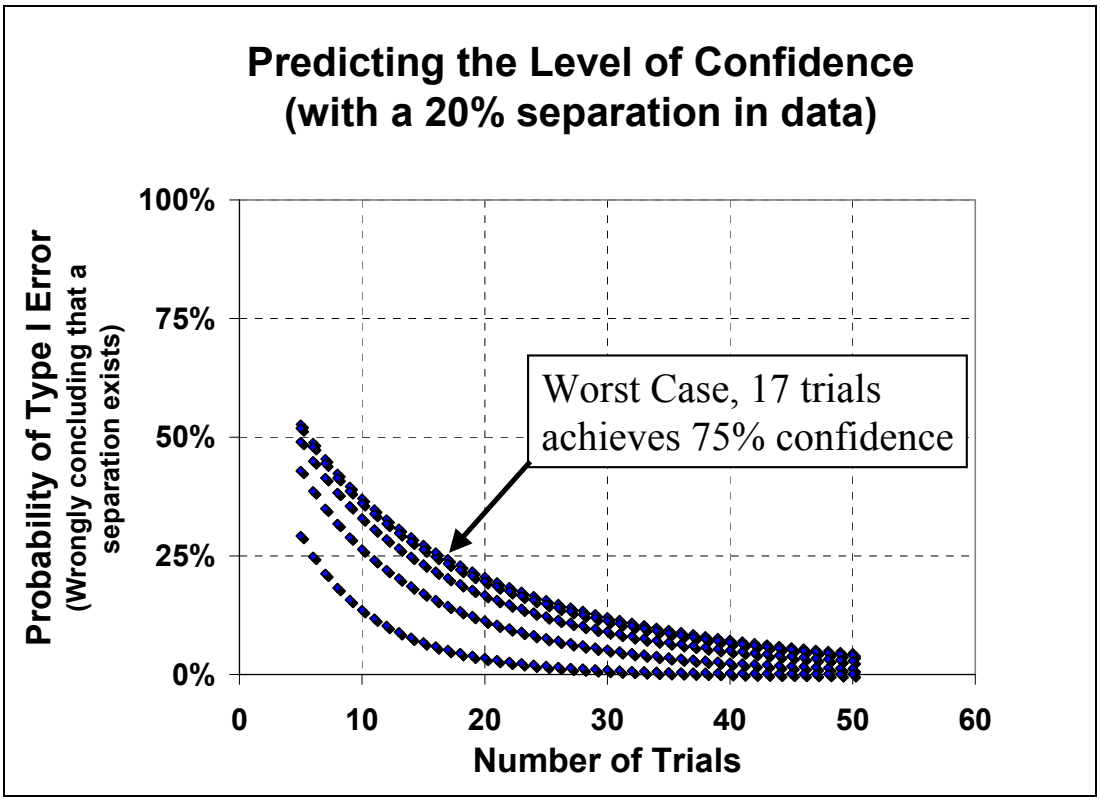

Figure F-2 Estimating the Required Number of Trials

All curves drop below the 25% Type I error criterion the JTF expects to use at or less than 17 trials. The worst case is the 40% and 60% curve.

As an example, if two conditions are being compared and after 17 trials one condition has 7 successes (41%) and the other condition has 10 successes (59%), the result is an 18% separation in samples and a 30% probability of Type I error (70% confidence). Thus, the JT&E would not conclude operational or statistical separation. If instead one condition has 6 successes (35%) and the other 10 successes (59%), the separation in the sample results is 24% and the probability of Type I error is 17% (83% confidence). In this case, the JTF can conclude with more than 75% confidence that there is a statistical separation between the two. Also, the JTF can conclude that the second condition produces an operationally meaningful improvement over the first condition because the results exceed the 20% criterion.

The 40% and 60% case is the worst case. It straddles the middle of the probability spectrum. If the resulting sample probabilities are displaced from the middle of the spectrum, the number of trials needed to achieve the 75% confidence level decreases. Alternatively, 17 trials results in a higher

confidence level for comparing two conditions. For example, if one condition results in a 20% success probability and the other a 40% success, then 15 trials would be sufficient to achieve a 75% confidence interval and 17 would achieve an 80% confidence interval.

If the separation between the two conditions is more than 20% (for example, condition 1 has a success rate of 20% and condition 2 has a success rate of 50%, then a 30% separation in the sample results), then the number of trials needed to have a 75% confidence would also decrease.

Based on the above computations, the JTF concluded that 17 trials for each architecture and for each mission area will either produce separations greater than 20%, enabling conclusions that the architectures result in operationally and statistically meaningful separations (with about 75% confidence), or they will produce a lesser separation, in which the JTF will not be able to conclude that one architecture is operationally and statistically superior to another. However, 17 trials cover the worst case. Greater separations could use fewer trials to achieve a 75% confidence.

The JTF will also be collecting timing data for each trial. The JTF can employ a parameter for the critical time needed to complete a mission. Therefore, the probability of success includes the probability that the mission was successfully completed within the critical-time parameter. The JTF expects, *a priori*, that for small values of the critical-time parameter, success for all architectures and missions will be at or near zero. For large values of the critical-time parameter, the probability of success should be high. The JTF expects to find transition regions (in the value of the critical-time parameter) for each architecture and for each mission area that show the change in probability from low to high. The JTF can focus on these transition regions where the possibility exists that one architecture will have a low probability of success and another will have a high probability of success. Thus, in transition regions, the JTF may find much more than 20% improvement between architectures. To avoid a danger of misleading results, JTF analysts and SMEs will document the extent of the transition regions and estimate their relevance to real-world situations.

Given the above results, a minimum of 17 samples per architecture and mission area, as illustrated in Table F-3, will be collected during the test. Further analysis relating to sample size is presented in Appendix F-2.

F.2.3.4 The Test Cell Matrix

The above considerations determined that 17 trials per architecture and mission area will be sufficient and possibly more than adequate. This does not include potential losses due to weather or other interference. The JTF examined the venues and estimated the number of trials possible during the anticipated time frame of the test. In all cases, 20 or more trials were set aside for each C2 architecture and each mission area. This result is summarized in the test cell matrix and is presented in Table F-3.

Table F-3 Test Cell Matrix

Alternative C2 Architecture	Air Interdiction Fixed-Wing		Air Interdiction Rotary-Wing		Fire Support			Personnel Recovery
	Non-Laser Wpns	Laser Desig.	Non-Laser Wpns	Laser Desig.	CAS F/W	CAS R/W	Artillery	CSAR/NEO
A	20	22	20	22	21	21	22	24
B	20	22	20	22	21	21	22	24
C	20	22	20	22	21	21	22	24
Total	60	66	60	66	63	63	66	72

The Risk Reduction Mini-Test trials are not included in the table. The table includes planned trials for FT-1, FT-2, and the JVTE.

The Air Interdiction mission area will be conducted using fixed-wing and rotary-wing aircraft for weapon delivery. The JTF plans to conduct test trials, collect data, and analyze fixed-wing and rotary-wing separately. Laser designation by the UAV is planned for approximately half of the Air Interdiction trials.

Fire Support consists of CAS or artillery fire support. Differences in the engagement phase will require separate trials for each. The JTF plans to conduct tests over the entire targeting-decision-engagement process as well as detailed tests concerning adjustment of fires in the engagement phase for artillery. All CAS missions will use laser designation.

Personnel Recovery trials will primarily be for CSAR: a mission that will be conducted during FT-1. The JTF expects a small number of NEO missions during both FT-1 and FT-2, but the number will be insufficient for quantitative comparison.

F.2.4 Data Processing

The JTF will generate quantitative and qualitative data. Field test data (raw data) will be recorded by instrumentation packages, video and audio tapes, and other devices. Data collectors will also record data manually on paper, palmtop computers, or laptop computers to collect data items that cannot be obtained automatically. All data recordings will be synchronized using GPS time as a time base for time stamping data at time of collection.

A requirement exists for a data collector for each critical C2 node in the test events. Data collectors will report their pre-test operational ready status to the Test Director and will immediately report observed data anomalies. Procedures are defined in Section F.5.2.

After collection, data will be processed by translating them from the raw data product into a format that is convenient for handling and interpretation by analysts. Specification for this format will be determined during the pre-test planning phase.

Quick-look analysis is vital to test management and quality assurance. Near real-time quick-look analysis will provide the JTD with information to ensure test mission objectives are met during test execution.

After the quick-look analysis, all data will be examined for realism, reasonableness, and continuity. This data verification will be conducted during the test but may continue after completion of testing.

Data will be archived in the JUAV database upon return to home station. All data will be transcribed onto automated data recording media. The purpose of the archive is to store and protect raw data from loss and contamination and prepare data for use in the post-test analysis process. Protective measures will be incorporated into the archival database to prevent contamination. The archival database will be designed for controlled and efficient retrieval of data for post-test analysis. Data retrieval products will be formatted for compatibility with automated post-test analysis tools wherever practical.

Data analysis includes all of the processes and procedures associated with calculating measures, conducting supporting analyses, conducting the evaluation, developing data presentations, and determining findings in a manner that leads to calculating the JUAV JT&E measures and answering test issues.

F.2.4.1 Data Reduction Approach and Methods

In general, data reduction is the process by which raw test data collected from each event are converted into data suitable for analysis. This definition includes doing some or all of the following:

- Data extraction or selection
- Format conversions
- Measure computations
- Verification, validation, and certification
- Archiving

This section focuses on the first three, Section F.2.4.2 discusses the fourth, and Section F.2.4 has discussed archiving.

For the JUAV JT&E, data reduction will consist of the processes that convert the raw data into the inputs for the quantitative and qualitative analyses. The output of the processes will be a database containing the dendritic data elements for quantitative analyses and anomalies as well as other data of interest for the qualitative analyses.

At first glance, most of the dendritic data elements will be obtained in a straightforward manner. These data elements relate to the 18 events specified in Section F.3.1.3. In general, each of these events has two potential data elements. One is whether the event occurs and the other is the event time for those events that do occur.

Data collectors will be assigned to collect data from each of the primary nodes: the Joint C2 node (i.e., JAOC), the UAV GCS, the forward Tactical C2 node (i.e., E-2, E-3, FAC, etc.), and each WDP. These data collectors will synchronize time at the beginning of each session each day using GPS time as the standard. In field tests, it will be possible to put data collectors with the Joint C2 node and with the GCS. Debrief interview surveys will be used to collect data from aircrew. These forms will be evaluated and revised as necessary during the VRs to ensure their validity for use during the field tests and the JVTE. In VRs, it will be possible to put a data collector with every node. In VR 1 and 2, data collected for rehearsal purposes will include data collectors with the aircrew, primarily to facilitate the JTF's understanding of the processes in these platforms. The JTF will transition aircrew data collection procedures in VR 3 and 4 to aircrew debrief forms to maximize similarity with field tests.

Automated data collection, in specified formats, will be used at each node. These collection methods include audio tapes of communications channels, over-the-shoulder video cameras, TSPI, and tactical data from air platforms. The Integrated Data Requirements List (IDRL) outlined in Section F.3.3

defines the specific data elements and the types of automated data collection used to capture these elements. The JUAV JT&E will collect TSPI player information from the range telemetry systems at each test venue. Table F-4 provides an overview of the range telemetry systems used at each test venue.

Table F-4 Test Venue Range Telemetry Systems

Test Venues	Range Telemetry System
Risk Reduction Mini-Test	Air Warrior
Field Test 1 (DR XI)	Tactical Air Combat Training System (TACTS)
Field Test 2 (Ft. Hood)	Janus
JVTE (JCIET04/JTFEX)	WAM (Warfare Assessment Module)

During VRs and field tests, data collectors will use data collection forms, automated on palmtop computers, that will request control data that include trial number, C2 architecture, mission number, UAV platform, WDP or RP, weapon type, data collector name, and data collector responsibility. The format will have a line for each of the events in Section F.3.1.3. The data collector will have a choice of three buttons to push for each event: Yes, No, or Unobserved. When any of the buttons is checked, the palmtop computer will record the time that the button is pushed and the button's value. The palmtop computers will be time-synchronized by the issuing agent prior to issue to the data collectors. Data from the palmtop computers will be extracted by the issuing agent after the test or event. The data from the live tests will be merged into the database for subsequent analysis.

The first step for data reduction is a comparison of the data collection results for each node. If the lists are consistent [all claiming knowledge having the same success or failure for the event and all have approximately the same times (within a reasonable error) initially assumed to be 5 seconds, but this standard can vary as the JTF gains experience collecting data] they will produce the official success or failure data element for the trial and a time range for the event. The data element preparation then proceeds to the next step.

If a disagreement occurs among the data collectors about the success or timing of the event, beyond the reasonable error criteria, the event is submitted to the qualitative-analysis process with a statement of the disagreement.

The second step of the process is comparison with automated data collection. Sources of automated data include audio tapes of communications; over-the-shoulder video tapes from the GCS, from the Joint C2 node, and from other sources as available; TSPI data; and mission log data from aircraft. The result is either a confirmation that the event occurred and a definitive time produced or an anomaly produced. In the former case, the definitive time and success for the event will be placed into the system. The results then proceed through the verification, validation, and certification process.

F.2.4.2 Data Verification, Validation, and Certification

The JTF will conduct data verification, validation, and certification for the data collected from field tests and from the M&S events (VRs).

F.2.4.2.1 Field Testing

Data verification will be a critical step to ensure that data are certified for analysis. Data verification will be comprised of two primary steps: data entry verification and database verification.

Data entry verification will be designed to ensure that data from manual forms are entered exactly as they appear on the data collection forms. Database verification is designed to ensure that data contained within the database are consistent with original data and that conversions or manipulations performed to standardize entries are consistent and accurate as well as in accordance with analytical needs.

Data verification checks will be completed for all data contained within the database. If data elements conflict with one another, the affected elements will be flagged as possible errors and be reviewed by an analysis team. The review will determine what aspects of the data are in conflict and what corrections, if any, are needed. If conflicts cannot be resolved, a data anomaly report will be generated outlining the problems and their possible impact on analyses.

The next function consists of extracting data elements from the data collected at the test site and entering them into an initial database. Data elements are the individual pieces of information used to compute measures and to conduct the exploratory analyses that provide in-depth understanding of the effectiveness of the alternative C2 architectures. Automated collection systems may provide more data than are required for JUAV JT&E purposes; therefore, it will be necessary to extract the data of interest from the larger data set. The process of extracting data elements can be random sampling through automated procedures, as when a computer program reviews data to extract time and location data for trials of interest, or it can be a manual process, as when a system's status is taken from a post-mission debrief form and entered into a database.

As discussed earlier, data obtained during field tests may be in audio, video, digital, or paper format. It will be necessary to process these raw data to yield the data elements needed to support JUAV JT&E analysis. An analysis team will perform this data extraction. The analysis team will consist of operations research analysts, data specialists, and mission specialists. The operations research analysts will be essential for interpreting system-specific data and correlating extracted data. The data specialists will have primary responsibility for interfacing with the JUAV JT&E database and ensuring data residing in the database are correct and that trial validity flags (codes for designating data validity decisions for various data) are set appropriately throughout the trial validation and certification process. Mission specialists will be responsible for interpreting data relative to mission objectives and ensuring results make sense from the standpoint of a military mission commander. Their assessments will also be added to the database.

After the fusion process, data elements are verified to ensure integrity and consistency. An automated process will check the integrity of each data element to the extent possible. Correlation of data ranges, measurement units, trial source, and time-related information can be accomplished automatically. Data elements that have redundant collection sources or known relationships to other elements will be examined and compared to ensure that the data correlate. These data element comparisons will be completed for every candidate trial. If data element values conflict with one another, the affected elements will be flagged as possible errors and reviewed by an analyst team before being reported to the Data Quality Review Team (DQRT). After verification, the data will be loaded into the JUAV JT&E database in preparation for more detailed analysis and calculation of the measures.

The Data Certification Committee (DCC) will review the integrity of the JUAV JT&E database. The data will be checked for consistency, completeness, and validity. If data values do not appear acceptable or correlate with corresponding data values, questions may be raised, and invalid test event data may be removed. No data may move to the final database without being certified by the DCC. The JTD will act as the final certification authority for all data used and disseminated by the JTF.

Erroneous data that can be corrected will be replaced in the database. For instance, if the certification process questioned the validity of a particular time that a sensor collected information on an attacked target, the original sensor data would be rechecked to verify the correct value. This important step allows incongruities to be resolved in the JUAV JT&E database before analysis is conducted. All errors or suspected errors will be documented and remain a permanent part of the data set.

F.2.4.2.2 Modeling and Simulation

The JTF will use VRs for risk reduction and to focus architecture variants used in the field tests. Data will be collected from the VRs and will be verified, validated, and certified in a similar manner to that collected during field tests for rehearsal purposes. This process will serve as risk reduction and may result in modified procedures for the field tests.

F.2.4.3 Data Analysis Methods, Techniques, and Tools

Analysis characterizes the operational performance of the three alternative C2 architectures proposed for the JUAV JT&E and identifies promising opportunities for process improvement. Analysis begins with performance measurements of the architectures. It then addresses the JTTP contribution from each to the three mission areas considered in the test. Finally, it assesses limiting factors and potential solutions. The analysis can be viewed as three fundamental parts:

- Descriptive analysis (characterize architecture performance)
- Comparative analysis (assess each architecture's contribution)
- Process analysis (identify limitations and improvement opportunities)

This analysis uses the database to calculate measures (MLM, MOE, and MOP as defined in Section F.3.1). Data populations will be established according to the independent variables (e.g., test cells). Data, from each architecture under the individual mission areas, will constitute separate test cells unless analysis shows there is no statistical difference between the sample populations of specific measures. Anomaly analysis will be used at any point if the results are inconsistent or if they indicate interoperability problems.

F.2.4.3.1 Exploratory and Descriptive Analysis

The data collected during each test will provide the means to compute test measures and conduct analysis and evaluation of the C2 processes to resolve JUAV issues. During the initial analysis phase, analysts will perform exploratory analysis using statistical and graphical methods and tools, such as Microsoft (MS) Excel, Statistica, or SPSS, to characterize and understand the data. These explorations provide the analyst with descriptive characteristics, measures of statistical descriptors (e.g., shapes and scaling of underlying distributions, central tendency and dispersion, and multivariate correlation), and insight for handling outliers and missing data.

Analysts will use descriptive analysis of the C2 architectures to characterize C2 processes and develop tentative findings and conclusions addressing issues and sub-issues based on data sample populations. For JUAV JT&E purposes, the method of descriptive analysis refers to using descriptive statistics to portray the distribution of test measures such as central tendencies, variance, and quartiles. In addition, graphic plots, such as stem and leaf plots, box and whisker plots, and scatter plots provide visual indication of test-measure distribution properties. The results of the descriptive analysis will provide the means for identification of deficiencies and may suggest enhancements for subsequent test events.

Possible analysis tools and methods for the exploratory and descriptive analysis include the following:

- Pie charts summarize categorical data
- Bar charts summarize categorical data
- Dot plots summarize data distribution
- Histograms summarize data (discrete or continuous) on an interval scale
- Stem and leaf plots summarize data (discrete or continuous) on an interval scale

- Box and whisker plots summarize data on an interval scale illustrating extremes (minimum and maximum), medians, quartiles, and outliers
- Scatter plots summarize bivariate (two variable) data and show relationships

F.2.4.3.2 Comparative Analysis

Comparative analysis methods will be used to assess the effects of proposed JTTP C2 processes on operational capability. This analysis will be done using hypothesis testing to determine if a tested JTTP had a positive or negative effect. Both non-parametric and parametric statistical techniques will be used in comparative analysis. The very nature of large-scale field tests in operational environments prevents collecting large data samples under identical conditions. Therefore, analysts will use statistical tests to evaluate the contributions of measured sub-processes to establish confidence in conclusions given the available sample size.

Test data are assumed to be independent samples from populations with unknown distribution. To the extent practical, data sets will be grouped according to test conditions to establish homogenous data sets (same probabilities for measurements in a data set). Actual data distributions will be determined during exploratory descriptive analysis, and the strongest appropriate hypothesis tests will be used.

Possible parametric analysis tools and methods for comparative analysis, are not limited to, but include:

- One sample t-test is a hypothesis test to determine if an independent data sample is from a specified normal distribution.
- Two sample t-test is a hypothesis test to determine if two independent data samples are from the same (normal) distribution.
- Paired sample t-test determines if there is a significant difference between the average values under two different conditions.
- Chi-squared goodness of fit test compares observed data to a theoretical distribution (e.g., Normal, Poisson, etc.).
- A confidence interval is a range of values calculated from a data set that is likely to include an unknown population parameter (e.g., mean).
- One-way analysis of variance (ANOVA) compares several groups of independent observations to determine if the means are equal.
- Two-way ANOVA is a way of studying the effects of two factors separately (their main effects) and together (their interaction effect).

Non-parametric tests may be, and often are, more powerful than parametric tests in detecting population differences when certain assumptions about the underlying population are not satisfied or are questionable such as assuming that the differences between the samples are normally distributed. The following are examples of non-parametric tests that may be used by the JUAV analysts:

- The Wilcoxon Mann-Whitney Test is a test for comparing two populations. It does not require normal distributions, so it can be used instead of the two-sample t-test if the normality assumption is questionable.
- The Wilcoxon Signed Ranks Test is another test for comparing two populations using matched pairs. It may be used in place of the paired-sample t-test if the normality assumption is questionable.
- The Sign Test is a less powerful alternative to the Wilcoxon Signed Ranks Test but does not assume the population probability distribution to be symmetric or normally distributed. The

Sign Test is designed to test a hypothesis about the location of a population distribution. It is most often used to test the hypothesis about a population median and often involves the use of matched pairs.

- The Kolmogorov-Smirnov Test is used to determine if a sample of data is consistent with a specified distribution function or whether two samples of data may be assumed to come from the same distribution. It does not require the population to be normally distributed.
- The Kruskal-Wallis Test compares three or more samples to determine if all populations have the same distribution: a logical extension of the Wilcoxon Mann-Whitney Test. It is the analogue to the F-Test used in ANOVA but does not depend on the assumption that all populations are normally distributed.

F.2.4.3.3 Process Analysis

Process analysis will study cause-and-effect relationships (beyond statistical correlation) for the principal issues and sub-issues for corresponding C2 process areas. Analysts and SMEs will use time-correlated, multi-media tools, which overlay tactical voice communications, participant logs, video recordings, digital communications, tactical system data, and truth data (TSPI and target signature) to conduct an in-depth study of the process. This technique will allow SMEs and analysts to better understand process limitations and potential improvements. Analysts will consider hypotheses implied by the issues and may consider other hypotheses based on tactical experience, data distributions, and real-time test observations. The JUAV JT&E analysts will work with staff and SMEs to identify potential enhancements that may be implemented and tested in future field tests and to resolve observed operational deficiencies.

Some analysis tools that may be applied during the process analysis phase include the following:

- Synchronized audio, video, tactical data, and truth data replay tools such as the Warfare Assessment Model (WAM), Combined Media Battlefield Analysis Tool (COMBAT), MetaVR, TAC Office, Command and Control Personal Computer, or Falcon View.
- Process modeling is a formal, structured diagramming technique showing the process components and interrelationships between them [e.g., Integration Definition for Function Modeling (IDEFM)].
- Cause-effect charts represent the relationships between an effect (problem) and potential causes.
- Scatter diagrams depict the relationship between two factors.
- Pareto charts are bar charts that display the relative contribution of each sub-problem to the total problem. Bars are arranged in descending order with the largest to the left.
- Information Flow Analysis is a structured system to improve a process by eliminating unnecessary tasks and streamlining the information flow.

F.2.4.4 Quick-Look Analysis

Quick-look analysis is the analysis performed on site or as soon as possible after a test period to ensure that test objectives are met. Preliminary quality assurance checks will help ensure data are complete and parameters fall within anticipated ranges. The quick-look analysis may also identify problems with data collection and test methods that need to be corrected by the JTF members. Audio and video sources will be quality checked for defects such as static, high levels of background noise on audio recordings, and snow and jitter on video recordings. Questionnaire and interview data will be evaluated to ensure that all items were answered and were internally consistent.

All data related problems must be corrected immediately to avoid a no-test before the next test period. Quick-look findings may also help to scope, prioritize, and speed the more detailed mission reconstruction and subsequent analysis.

F.2.5 Data Analysis Pre-Test Rehearsals

Prior to each field test, data collectors and analysts will collect data in the same manner they would in an actual test event as if the data had been generated from the sources expected from the test venue. Erroneous, incomplete, and null data sets will be inserted into the collected pre-test rehearsal data to verify that data quality processes function properly. The data will transition through the mission reconstruction process as outlined in F.5.2.3, and will continue through the process up to F.5.2.10. At this point, analysts will apply the reconstruction tools (e.g., COMBAT) and analysis tools to populate the data elements in the dendritic and calculate the MLM, MOE, and MOP of the JUAV JT&E.

F.2.6 Joint Test Evaluation Plan

The JTF will evaluate the analysis results using a process that includes JTF analytical results and SMEs from the Tactical Aircraft (TACAIR), C2, and UAV communities to ensure that JUAV findings, conclusions, and recommendations can be implemented by the Services and Joint community. This process will occur after each test event and at the end of the test for the final report.

The purpose of the evaluation plan is to answer the questions posed by the test issues and sub-issues. This evaluation plan outlines the general approach the JTF will use in answering the issues and explains how the test activities are integrated to provide the information required for the analysis.

The following steps will be followed for each field test:

(1) Data will be collected from the test.

(2) Data will be reduced, verified, validated, and archived in the analysis database.

(3) Quantitative analysis will be conducted computing the MLM, MOE, and MOP and analyzing their characteristics using previously described statistical tools.

(4) Qualitative analysis will be conducted including analysis of anomalies or problem areas.

(5) Initial assessments will be proposed by analysts on how quantitative and qualitative analytic results impact the issues and sub-issues. The focus will be on the impact on JTTP.

(6) SME panels will be convened to review and evaluate the quantitative and qualitative results and the initial assessments.

(7) Results and areas of disagreement will be presented to JTF management for information and resolution.

(8) Results will be used in refining follow-on tests and evaluation exercises.

F.3 DATA REQUIREMENTS

F.3.1 Dendritic Breakdown

The test design is based on the dendritic decomposition that begins with the problem statement. Test issues and sub-issues were identified, which are questions that need to be answered to resolve the problem statement. Measures, which are computable from data elements collected from the test, are used to answer the issues and sub-issues. Data elements are identified for collection to compute the measures.

The JUAV dendrite is relatively straightforward. To solve the problem, three alternative C2 architectures, believed to cover the most likely possibilities, have been developed and will be further refined during the test. The test focuses on which of these architectures may provide superior results (faster mission accomplishment and higher probabilities of success) under specific circumstances. Circumstances include the mission areas of Air Interdiction: Armed Reconnaissance, Fire Support, and Personnel Recovery. The dendrite is repeated for each of these mission areas.

Other potential complications are differences in UAV type, WDP or RP type, and weapon used. The JTF will focus on producing platform-independent and Joint TTP. There are procedures that are platform-independent for controlling strike aircraft on target. The forward air controller, for example, follows the same procedure regardless of strike aircraft. Similarly, the goal of the JTF is to develop and test JTTP for UAV integration into Joint operations that are independent of the UAV type.

In the three test issues, alternative procedures for each phase of an engagement (Table F-5) are considered. The alternative procedures are defined using one of three alternative C2 architectures. These alternative C2 architectures form the comparison basis for this JT&E. The architectures are defined in detail in Annex G and are summarized in Table F-2. A key distinguishing feature is the node that is assigned specific BWF for purposes of engagement decisions and airspace integration of the UAV. The BWF are also described in detail in Annex G.

Table F-5 Mission Phases

Phase	Description
Targeting or Search	The phase in which targets are located with sufficient accuracy for weaponeering, or the phase in which ingress routes and the landing zone are sanitized for Personnel Recovery operations.
Decision	The phase in which the controlling authority decides to allocate and commit forces to engage a target or to rescue personnel.
Engagement or Rescue	The phase in which the actual employment of weapons or the actual rescue of personnel occurs.

F.3.1.1 Test Issues and Sub-issues

To address the problem statement, the JTF has focused efforts on three primary issues. These issues concern the three phases of a TSO: the targeting phase, the decision phase, and the engagement phase. The JTF will concentrate on specific procedures required to accomplish tasks during these phases. The issues are listed in Table F-6.

Table F-6 Test Issues

Issue	Description
1.	To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?
2.	To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?
3.	To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?

Each of these test issues is sub-divided into sub-issues. Table F-7 shows the list of seven sub-issues that have been identified. Targeting procedures are used in employment of the UAV's sensors, in determining the identification of the target, and in localizing the target. Decision-making processes include the flow of information in the architecture required to support engagement decisions and the decisions to allocate a WDP and clear it to fire.

The engagement phase of a mission offers complications that result in Issue 3 and its sub-issues. The complications occur because the UAV and the engagement platform attempt to operate in the same space. Coordination issues emerge from considerably different speeds under normal operating conditions of UAVs and attack aircraft and the lack of a pilot in the UAV to assist in eyes-on coordination.

Table F-7 Test Sub-Issues

Issue	Description
1.	To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?
1.1	What is the effect of the alternative C2 architectures on sensor employment procedures?
1.2	What is the effect of the alternative C2 architectures on target identification procedures?
1.3	What is the effect of the alternative C2 architectures on providing target location?
2.	To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?
2.1	What is the effect of the alternative C2 architectures on information flow in decision-making?
2.2	What is the effect of the alternative C2 architectures on the ability to make key engagement decisions?
3.	To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?
3.1	What is the effect of the alternative C2 architectures on executing dynamic airspace integration procedures?
3.2	What is the effect of the alternative C2 architectures on ability to laser designate?

The test includes JTTP required for limited target-area airspace management. This includes integrating the airspace through dynamic separation as opposed to procedural separation. Procedural separation consists of UAVs operating in assigned Restricted Operating Zones (ROZs) and tactical aviation remaining clear of these ROZs. Dynamic separation involves direct coordination between the UAV and WDP. Dynamic separation is the process by which attack aircraft are deconflicted enabling them to operate in the same space.

An important airspace integration issue is the ability of the UAV to laser designate for the WDP. This includes the time the laser is turned on and off and whether the appropriate UAV-target geometry is maintained.

F.3.1.2 Measures Overview

Measures are means of answering the issues and sub-issues. Most of the measures the JTF will use fall into one of two categories:

(1) The mean time it takes to complete a task for those trials in which the task is completed successfully.

(2) The probability the task is completed successfully.

The JTF will estimate the probability by computing the ratio of the number of trials that complete the task successfully to the number of trials in which the task was attempted.

The JTF will use three levels of measures to estimate the relative effectiveness of the three architectures in the mission areas considered. The JTF is capitalizing on the following associations: The MLM are associated with the mission areas, the MOE with the issues and mission areas, and the MOP with the sub-issues and mission areas. Descriptions of each level and their respective naming conventions follow:

First, there are two MLM for each of the three mission areas. These MLM are the probability the entire mission is completed successfully and the mean time to successfully complete the mission. The mean time to complete the mission successfully is defined as the mean of the times to complete the mission for those trials when the mission was successful. The time to complete a mission is given by the time the UAV arrives on station, which is roughly considered to be when the target is in the Field of Regard (FOR) of the UAV's sensors, until either a weapon is launched, or until a RP arrives at the position of those that need rescuing (non-combatants to be evacuated or downed aircrew to be rescued). From this time, the JTF will subtract the time the WDP or RP takes to arrive on station. This time is deducted to avoid biasing the tests because of the possibility that transit times may be different in the test trials for the architectures. The JTF will collect these transit times, but the *a priori* assumption is that transit time is not a function of the C2 architecture being considered. Similarly, the time to complete the mission ends when the weapon is launched or the RP links with those needing rescue because weapon flyouts and times to load helicopters could vary and should not be a function of the C2 architecture. In the specific case of laser-guided weapons, additional measures will capture the average time and probability of success that go beyond weapon launch to weapon impact. Again, the JTF will collect data on these times, but architectures will not benefit from or be penalized by these times not dependent on the C2 architecture.

MLM are computed for the mission area and architecture. There are only two for the JTF and they are indicated by a single digit (1 or 2).

Second, the JTF has identified MOE for each of the three issues. These issues represent the targeting or search, decision, and engagement or rescue phases. Each of these phases represents processes executed by a system of nodes and is appropriate for MOE. MOE will be computed for each C2 architecture and for each mission area. These MOE include both the mean time it takes to execute the process in each phase (for those trials that are successful) and the probability that the process in each phase is successfully completed.

MOE are designated by two digits. The first digit indicates the issue the MOE supports. The second digit indicates the particular MOE supporting that issue.

Third, the JTF has identified MOP for each of the seven sub-issues. These sub-issues represent tasks executed by essentially a single operator, single node, or single platform. Therefore, these tasks are appropriate for MOP. MOP will be computed for each C2 architecture and each mission area. Most sub-issues have two MOP: mean time to complete the task for those trials in which the task is completed successfully and the probability of successfully completing the task.

MOP are designated by three digits. The first two digits indicate the sub-issue the MOP supports. The third digit indicates the particular MOP supporting that sub-issue.

Sub-Issue 1.3, which concerns the provision of target coordinates, has an additional MOP (MOP 1.3.2) that compares the relative accuracy of the determined coordinates with ground truth.

Sub-Issue 3.2 concerns the ability of the UAV to laser-designate targets. MOP associated with this sub-issue will only be computed when laser-guided weapons are used in the Air Interdiction or Fire Support missions.

The measures will be computed for each alternative C2 architecture and for each mission area. The measures will be further identified by a prefix Xn where X is A, B, or C and indicates the architecture and n is 1, 2, or 3 and indicates the mission area. Thus, A2-MOP 1.2.1 indicates the computation of MOP 1.2.1 for Architecture A and mission 2. If necessary, additional parameters will be added to uniquely identify the measure. Table F-8 shows the MLM, MOE, and MOP associated with the test that will be used to analyze and evaluate each alternative C2 architecture and associated JTTP.

Table F-8 Measures

Measure	Title	Description
MLM 1	Mean elapsed time of successfully completing the mission	The mean total time from when the UAV receives tasking to successful completion of the mission. Times will be normalized to account for the UAV not being on station when tasking arrives, for the WDP not being on station when it is allocated, and for unusually long flight times for weapons.
MLM 2	Probability of successfully completing the mission	The fraction of trials in which the determination was made that the mission was successful. Success is defined as the UAV succeeded in supporting the attack or rescue and not in terms of BDA assessed later.
MOE 1.1	Mean elapsed time of completing targeting procedures	The mean time required for targeting procedures, including detection and recognition of a potential target, target identification, and target localization, to occur.
MOE 1.2	Probability of completing targeting procedures to required accuracy	The fraction of trials in which the UAV's integration into the targeting phase was completed successfully. Success will be determined by completion of these procedures.
MOP 1.1.1	Mean elapsed time to recognize potential targets	The mean time from when the UAV receives tasking to the time a potential target is detected and recognized.
MOP 1.1.2	Probability of detecting and recognizing a potential target	The fraction of trials in which the determination was made that the intended target was detected and recognized.
MOP 1.2.1	Mean elapsed time to identify targets	The mean time from when the potential target is recognized to when it is identified as a target (hostile and on the authorized target list).
MOP 1.2.2	Probability of identifying target	The fraction of trials with success in detection and recognition that are also determined to have success in identifying the target.
MOP 1.3.1	Mean elapsed time to localize targets	The mean time from when the target is identified to when its position is determined to sufficient accuracy to direct a WDP or RP on station.
MOP 1.3.2	Probability of localization of targets	The fraction of trials with success in ID that are also determined to have success in localizing the target.
MOP 1.3.3	Accuracy of determined coordinates	The mean difference in position from the determined coordinates from the ground truth position of the target.
MOE 2.1	Mean elapsed time for completing the decision-making processes	The mean time from when the target ID is determined to when the WDP is allocated plus the time from when the WDP is on station to when it is cleared to attack.
MOE 2.2	Probability of successfully completing decision-making processes	The fraction of trials with a target ID in which information flow is successful and a WDP is allocated and cleared to attack.

Measure	Title	Description
MOP 2.1.1	Mean elapsed time for target identification to arrive at the location of the BWF	The mean time from when the target ID is determined to when it arrives at the location of the BWF for action.
MOP 2.1.2	Mean elapsed time for target location data to arrive at the location of the BWF	The mean time from when the target location is determined to when it arrives at the location of the BWF for action.
MOP 2.1.3	Mean elapsed time for target location data to arrive at the WDP	The mean time from when the WDP is allocated to when target location data arrive at the WDP.
MOP 2.1.4	Probability target identification arrives at location of the BWF	The fraction of trials that successfully completed target identification procedures in which the target identification arrived at the location of the BWF.
MOP 2.1.5	Probability that target location arrives at the location of the BWF	The fraction of trials that successfully localized the target in which target location arrived at the location of the BWF.
MOP 2.1.6	Probability that target location arrives at the WDP	The fraction of trials that allocated a WDP in which the target location arrived at the WDP.
MOP 2.2.1	Mean elapsed time to allocate WDP	The mean time from the arrival of target identification to when the WDP is allocated.
MOP 2.2.2	Mean elapsed time to clear the WDP to attack	The mean time from when the WDP arrives on station to when it is cleared to attack.
MOP 2.2.3	Probability that a WDP is allocated	The fraction of trials in which target identification arrives at the location of the BWF in which a WDP is allocated.
MOP 2.2.4	Probability that WDP is cleared to attack	The fraction of trials with the WDP arriving on station in which the WDP is cleared to attack.
MOE 3.1	Mean elapsed time for weapon launch	The mean time from when the WDP arrives on station to when the weapon is launched.
MOE 3.2	Probability of weapon launch	The fraction of trials with the WDP arriving on station in which a weapon is launched.
MOP 3.1.1	Mean elapsed time to dynamically deconflict UAV and WDP	The mean time from WDP arriving on station to when the UAV and WDP are dynamically deconflicted.
MOP 3.1.2	Probability that UAV and WDP are dynamically deconflicted	The fraction of trials with a WDP arriving on station that dynamically deconflicted the UAV and WDP and maintained deconfliction for the rest of the engagement or rescue.
MOP 3.1.3	Mean elapsed time for WDP to acquire target	The mean time from when the WDP arrives on station to when that platform acquires the target. The focus is on UAV support to the platform through talk-ons or other means.
MOP 3.1.4	Probability WDP acquires target	The fraction of trials with a WDP arriving on station in which a determination is made that the WDP acquires the target.

Measure	Title	Description
MOP 3.1.5	Mean elapsed time for WDP to launch	The mean time from WDP acquiring the target to when the weapon is launched.
MOP 3.1.6	Probability of weapon launch	The fraction of trials with the WDP acquiring the target in which a weapon is launched.
MOP 3.2.1	Mean elapsed time to set up laser designation	The mean time from when the WDP receives the targeting data to when the weapon is launched for laser designation test events.
MOP 3.2.2	Probability of successful laser designation	For test events that use laser designation in the Armed Reconnaissance and CAS mission areas, this is the fraction of trials in which a determination is made that laser designation successfully occurred. This assessment will be made in post mission analysis and will include laser designation on and off times, weapon launch and impact times, weapon type, and the relative geometry throughout the time of laser support of the UAV, WDP, and the target.

F.3.1.3 Data Requirements Overview

After determining the measures in the dendrite, the JTF focused on the required data to compute the measures. The JTF determined that most of the required data come from 18 discrete events in each trial. Some of these events are the same regardless of mission, weapon system, or UAV. Others are tailored for the mission. Table F-9 shows the list of events. For most events, the data consist of both the time of the event and whether the event was successful. Events vary by mission area from events 6 on. The JTF has established a single event list that recognizes this variance. In Fire Support or Air Interdiction: Armed Reconnaissance, WDPs are allocated and launch weapons. In the Personnel Recovery missions of CSAR and NEO, a RP is allocated and links with those requiring rescuing. Laser-guided weapons, designated from the UAV, provide a complication for study in the engagement phase of some Air Interdiction: Armed Reconnaissance or Fire Support missions. Laser designation on and laser designation off are events only when laser-guided weapons are used.

Table F-9 Event Table

Event	Time of Event (date-time format)	Success of Event (logical—1 or 0)	Result of Event
1. UAV receives tasking	t1	s1	
2. UAV arrives on station	t2	s2	
3. Target is detected and recognized	t3	s3	
4. Target is identified	t4	s4	
5. Target is localized	t5	s5	x4: coordinates as determined
6. Target ID arrives at location of the BWF	t6	s6	
7. Target location data arrive at location of the BWF	t7	s7	
8. WDP or RP requested (Alternative C)	t8	s8	
9. WDP or RP allocated	t9	s9	
10. WDP or RP arrives on station	t10	s10	
11. UAV and WDP are dynamically deconflicted	t11	s11	
12. WDP receives targeting data	t12	s12	
13. WDP is cleared to attack	t13	s13	
14. Laser designation of target begins	t14	s14	
15. WDP acquires target	t15	s15	
16. Weapon launch or arrival of RP	t16	s16	
17. Weapon impact or departure of RP with recovered personnel	t17	s17	
18. Laser designation ceases	t18	s18	
21. UAV-target geometry maintained		s21 (appropriate UAV-target geometry achieved)	

Event 1 is when the UAV receives tasking which contains target acquisition instructions. These instructions could be to search a road for a possible target, examine an airfield, or recon an ingress route. Event 2 is designed to normalize for transit time. The UAV is considered to be on station if it has the ability to conduct the mission with the onboard sensor or when it receives its target acquisition instructions if the target is already inside its sensor range. Otherwise, it will be considered on station when it reaches a circle with radius equal to the sensor range from the target. The on station data elements may need to be computed in post-mission reconstruction using TSPI data and the target's location.

The next three events represent the targeting phase and correspond to definitions in JP 1-02 as explained in Table F-10. Events 5 and 6 correspond to the decision phase and represent C2 aspects of the trial. Events 7 through 13 represent important aspects of the engagement phase.

Table F-10 Targeting Phase Events

Term	JP 1-02 Definition	Event Table Entry
Target Acquisition	The detection, identification, and localization of a target in sufficient detail to permit the effective employment of weapons.	Events 3 through 5
Detection	In tactical operations, the perception of an object of possible military interest but unconfirmed by recognition.	Event 3 pre-requisite
Recognition	1. The determination by any means of the individuality of persons, or of objects such as aircraft, ships, or tanks, or of phenomena such as communications-electronics patterns. 2. In ground combat operations, the determination that an object is similar within a category of something already known (e.g., tank, truck, man).	Event 3
Identification	1. The process of determining the friendly or hostile character of an unknown detected contact. 2. In ground combat operations, discrimination between recognizable objects as being friendly or enemy, or the name that belongs to the object as a member of a class.	Event 4
Localization	(Not defined in JP 1-02 but referred to in Target Acquisition. The JUAV definition is provided below.)	Event 5

Detection of "an object of possible military interest" is the first step in the target acquisition process. The JTF has decided not to collect data on this event for several reasons. First, detection can occur frequently on many objects that upon recognition are immediately determined not to be targets. Second, from UAV operator experience, recognition of the class or category of object (tank, truck, or man) generally occurs quickly after detection. Third, for the above reasons, UAV operators generally do not state or report detections. They do, however, report when those detections are recognized.

Recognition of the object class or category serves to confirm that the object is a potential target. Event 3, the first after the UAV's arrival on station, will be when a detected object is recognized. Detection will have occurred before recognition (possibly immediately before). To keep the integrity of the Joint definitions, the JTF is calling event 3 "detection and recognition"; however, the time is actually that of recognition alone. Recognition can be determined by the GCS or by anybody seeing the UAV video.

For JUAV JT&E purposes, identification is the event where the person or node exercising the BWF determines that the recognized object is (1) hostile and (2) on the list of potential targets that the holder of the BWF is authorized to engage. This authority may be delegated to an agency with the

appropriate tools to determine ID such as an image analyst. Identification is the process by which a recognized object is converted into a target.

For JUAV JT&E purposes, localization is when the location of the target is defined with accuracy determined by the holder of the BWF to be sufficient for engagement. This could be the determination of a lat-lon or grid point, a description of the area sufficient for a "talk-on" for the WDP, or a laser illumination spot.

Events 6 and 7 represent the times targeting information (ID and location, respectively) arrives at the location of the BWF. The time it takes for information to flow through each alternative C2 architecture is of interest both in understanding the C2 architecture and in comparisons between them. The information flow is required to support decision-making.

Events 8, 9, and 12 represent key decision events. Event 9 is the allocation of a WDP to engage the target. Event 8 is included because in Alternative C2 Architecture C, it is unlikely that the GCS will control a WDP and will need to request it. This may be an example of a streamlined architecture actually requiring additional time to complete a mission. Event 12 is the exercise of engagement authority by the holder of the BWF to clear the WDP to engage the target.

Event 10 is the WDP arriving on station. This begins the process whereby the UAV and the WDP are "sharing" the airspace. On station will be determined geographically as a circle with radius of the speed of the aircraft times 5 minutes for fixed-wing and times 10 minutes for rotary-wing.

Two data elements are required that are not associated with the events. First, the exact position of the target needs to be known for comparison with the coordinate determination. This will be a control variable for each trial. Second, the assessment by the UAV operators or BWO on whether the desired UAV-target geometry was maintained adequately throughout the engagement phase will be collected by survey. This data element is shown in Table F-9 as "event 21."

F.3.1.4 Dendritic Analysis Matrix

Table F-11 shows the data elements needed to compute the MLM for each scenario (mission area, alternative C2 architecture, and weapon system). Table F-12 shoes the dendritic table for the JUAV JT&E for the MOE and MOP and their association with the issues and sub-issues. The MOE and MOP will be computed from data elements to support answering the issues and sub-issues for each mission.

Table F-11 Data Elements to Compute the Mission-Level Measures

MLM	Data Elements
MLM 1 Mean elapsed time of successfully completing the mission	1.1.1.1 Time UAV receives tasking 1.1.1.2 Time UAV arrives on station 2.1.3.1 Time WDP is allocated 2.2.2.1 Time WDP arrives on station 3.2.2.3 Time of weapon impact
MLM 2 Probability of successfully completing the mission	1.1.2.1 UAV receives tasking 1.1.2.2 UAV arrives on station 1.1.2.3 Target is detected and recognized 1.2.2.1 Target is identified 1.3.2.1 Target is localized 2.1.4.1 Target identification arrives at the location of the BWF 2.1.5.1 Target location data arrive at the location of the BWF 2.1.6.2 WDP receives targeting data 2.2.4.2 WDP is cleared to attack 3.1.2.1 UAV and WDP are dynamically deconflicted 3.1.3.4 UAV-Geometry maintained 3.1.4.1 WDP acquires target 3.1.5.2 Weapon launch 3.1.5.1 Time of weapon launch 3.2.2.1 Laser designation begins 3.2.2.2 Laser designation ceases 3.2.2.3 Time of weapon impact

Table F-12 Dendritic Table

Issue	Sub-Issue	MOE	MOP	Data Element
Issue 1. To what extent do targeting procedures in the alternative C2 architectures affect TSO mission accomplishment?		1.1 Mean elapsed time of completing targeting procedures		1.1.1.1 Time UAV receives tasking 1.1.1.2 Time UAV arrives on station 1.2.1.1 Time target is identified 1.3.1.1 Time target is localized
		1.2 Probability of completing targeting procedures to required accuracy		1.1.2.1 UAV receives tasking 1.1.2.2 UAV arrives on station 1.1.2.3 Target is detected and recognized 1.2.2.1 Target is identified 1.3.2.1 Target is localized
	Sub-Issue 1.1. What is the effect of the alternative C2 architectures on sensor employment procedures?		1.1.1 Mean elapsed time to recognize potential targets	1.1.1.1 Time UAV receives tasking 1.1.1.2 Time UAV arrives on station 1.1.1.3 Time target is detected and recognized
			1.1.2 Probability of detecting and recognizing a potential target	1.1.2.1 UAV receives tasking 1.1.2.2 UAV arrives on station 1.1.2.3 Target is detected and recognized
	Sub-Issue 1.2. What is the effect of the alternative C2 architectures on target identification procedures?		1.2.1 Mean elapsed time to identify targets	1.1.1.3 Time target is detected and recognized 1.2.1.1 Time target is identified
			1.2.2 Probability of identifying target	1.1.2.3 Target is detected and recognized 1.2.2.1 Target is identified
	Sub-Issue 1.3. What is the effect of the alternative C2 architectures on providing target location?		1.3.1 Mean elapsed time to localize targets	1.2.1.1 Time target is identified 1.3.1.1 Time target is localized
			1.3.2 Probability of localization of targets	1.2.2.1 Target is identified 1.3.2.1 Target is localized
			1.3.3 Accuracy of determined coordinates	1.3.3.1 Target coordinates as determined 1.3.3.2 Ground truth target coordinates

Issue	Sub-Issue	MOE	MOP	Data Element
Issue 2. To what extent do decision-making processes in the alternative C2 architectures affect TSO mission accomplishment?		2.1 Mean elapsed time for completing the decision-making process		1.2.1.1 Time target is identified 2.1.3.1 Time WDP is allocated 2.2.2.1 Time WDP arrives on station 2.2.2.2 Time WDP is cleared to attack
		2.2 Probability of successfully completing the decision-making process		1.2.2.1 Target is identified 2.1.4.1 Target identification arrives at the location of the BWF 2.1.5.1 Target location data arrive at the location of the BWF 2.1.6.1 WDP is allocated 2.2.4.2 WDP is cleared to attack
	Sub-issue 2.1. What is the effect of the alternative C2 architecture on information flow in decision-making?		2.1.1 Mean elapsed time for target identification to arrive at the location of the BWF	1.2.1.1 Time target is identified 2.1.1.1 Time target identification arrives at location of the BWF
			2.1.2 Mean elapsed time for target location data to arrive at the location of the BWF	1.3.1.1 Time target is localized 2.1.2.1 Time target location data arrive at the location of the BWF
			2.1.3 Mean elapsed time for target location data to arrive at the location of the WDP	2.1.3.1 Time WDP is allocated 2.1.3.2 Time WDP receives targeting data
			2.1.4 Probability target identification arrives at the location of the BWF	1.2.2.1 Target is identified 2.1.4.1 Target identification arrives at the location of the BWF
			2.1.5 Probability target location arrives at the location of the BWF	1.3.2.1 Target is localized 2.1.5.1 Target location data arrive at the location of the BWF
			2.1.6 Probability that target location arrives at the WDP	2.1.6.1 WDP is allocated 2.1.6.2 WDP receives targeting data
	Sub-issue 2.2. What is the effect of the alternative C2 architectures on the ability to make key engagement decisions?		2.2.1 Mean elapsed time to allocate WDP	2.1.1.1 Time target identification arrives at location of the BWF 2.1.3.1 Time WDP is allocated
			2.2.2 Mean elapsed time to clear the WDP to attack	2.2.2.1 Time WDP arrives on station 2.2.2.2 Time WDP is cleared to attack
			2.2.3 Probability that a WDP is allocated	2.1.4.1 Target identification arrives at the location of the BWF 2.1.6.1 WDP is allocated
			2.2.4 Probability that WDP is cleared to attack	2.2.4.1 WDP arrives on station 2.2.4.2 WDP is cleared to attack

Issue	Sub-Issue	MOE	MOP	Data Element
Issue 3. To what extent do airspace integration procedures in the alternative C2 architectures affect TSO mission accomplishment?		3.1 Mean elapsed time for weapon launch		2.2.2.1 Time WDP arrives on station 3.1.5.1 Time of weapon launch
		3.2 Probability of weapon launch		2.2.4.1 WDP arrives on station 3.1.5.2 Weapon launch
	Sub-issue 3.1. What is the effect of the alternative C2 architectures on executing dynamic airspace integration procedures?		3.1.1 Mean elapsed time to dynamically deconflict UAV and WDP	2.2.2.1 Time WDP arrives on station 3.1.1.1 Time UAV and WDP are dynamically deconflicted
			3.1.2 Probability that UAV and WDP are dynamically deconflicted	2.2.4.1 WDP arrives on station 3.1.2.1 UAV and WDP are dynamically deconflicted
			3.1.3 Mean elapsed time for WDP to acquire target	2.2.2.1 Time WDP arrives on station 3.1.3.1 Time WDP acquires target
			3.1.4 Probability WDP acquires target	2.2.4.1 WDP arrives on station 3.1.4.1 WDP acquires target
			3.1.5 Mean elapsed time for WDP to launch	3.1.3.1 Time WDP acquires target 3.1.5.1 Time of weapon launch
			3.1.6 Probability of weapon launch	3.1.4.1 WDP acquires target 3.1.5.2 Weapon launched
	Sub-Issue 3.2. What is the effect of the alternative C2 architectures on ability to laser designate?		3.2.1 Mean elapsed time to set up laser designation	2.1.3.2 Time WDP receives targeting data 3.1.5.1 Time of weapon launch
			3.2.2 Probability of successful laser designation	2.2.4.1 WDP arrives on station 3.2.2.1 Laser designation begins 3.1.3.1 Time WDP acquires target 3.1.5.1 Time of weapon launch 3.2.2.2 Laser designation ceases 3.2.2.3 Weapon impact 3.1.3.4 UAV-target geometry maintained

F.3.2 Integrated Data Requirements List Overview

The IDRL was generated from the dendrite. The purpose of the IDRL is to specify what data need to be collected, the criteria (where, when, and how) for data collection, and the means of collection.

The first column in the IDRL (Table F-13) is the data element number from the dendrite (Table F-12). The second column is the label for the data element (s for success or f for failure, t for time, or x for other data) from the event table (Table F-9).

The third column is the description of the data element. Then, the JTF identifies measures that use the data element in the calculation.

The fifth and sixth columns identify the primary and secondary means of collecting the data. Data collectors are involved in collecting most of the data elements. They will be equipped with palmtop computers that are programmed to collect the dendritic data elements. Other data collection means include the video from the GCSs, over-the-shoulder video, audio recording of voice channels, and Heads Up Display (HUD) tapes. TSPI data will be collected on all air platforms.

The seventh and eighth columns list the data format and unit scale. Time data will be collected in a date-time format. This may be the date-time format used for MS Excel and other tools or it may be seconds from the start of the year. The JTF is investigating the preferred date-time format system, in which the date and time to fractions of seconds is captured in a single field. The DTP for each event will specify the exact date-time format. The date-time format will have resolution at or less than 1 second. A second data type is Boolean or logical. This is simply a true-false data element and is expressed as 1 = true and 0 = false. A third data format is a coordinate. This is a two-dimensional number indicating position of the target and the computed position that is estimated for it. The JTF is investigating the most appropriate data format (lat-lon in degrees, grid in meters).

The ninth and tenth columns are the type of instrumentation and media that will be used to collect the data. Data collectors will collect data on palmtop computers. Data from data collectors will be transferred to a central computer and then stored on Compact Disk-Recordables (CD-Rs) at the event. Zip disks will be available for backup should the CD-R system fail. Video and audio streams will be recorded on video and audio tapes.

The eleventh through fourteenth columns outline the expected number of trials per each field test. The computation of required trials led to a worst-case number of 17 trials. For mission areas 2 (Fire Support) and 3 (Personnel Recovery), the JTF plans for 18 trials per architecture during FT-1 (NASF) and FT-2 (Ft. Hood). Mission area 1 (Armed Reconnaissance) will require additional trials for each architecture to investigate laser-guided weapons and fixed-wing and rotary-wing platforms. This is an ambitious plan, and contingency analysis plans are being investigated for fewer numbers of trials. Events to occur in the JVTE are being investigated.

F.3.3 IDRL Matrix

F.3.3.1 IDRL for Field Tests

Table F-13 shows the IDRL for the field tests. Field tests will be the source of data for the JT&E. Each mission area will have its own IDRL. The field tests will focus on different mission areas. Table F-13 represents the requirement for data. This is the number of trials that will guarantee required quantitative results. It is less than the planned trials in the Test Cell Matrix, which also includes extra trials to account for missed opportunities. There are 17 trials that are required but 20-24 are planned for each C2 architecture and mission area.

Table F-13 Integrated Data Requirements List

DE #[a]	DE Symbol	DE Description	Associated Measures	Primary Data Source	Secondary Data Source	Data Format	Unit Scale	Instru-mentation	Media[b]	Required per Test[c]		
										FT-1	FT-2	JVTE
1.1.1.1	t1	UAV receives tasking	MOE 1.1 MOP 1.1.1	Data Collector	Audio	date-time	date-time[d]	Video IRIG B	Tape CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.1.1.2	t2	UAV arrives on station	MOE 1.1 MOP 1.1.1	Data Collector	TSPI	date-time	date-time	Video IRIG B	Tape CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.1.1.3	t3	Time target is detected/ recognized	MOP 1.1.1 MOP 1.2.1	GCS Video	Data Collector	date-time	date-time	Video	Tape CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.1.2.1	s1	Did UAV receive tasking?	MOE 1.2 MOP 1.1.2	Data Collector	Audio	Boolean	logical	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.1.2.2	s2	Did UAV arrive on station?	MOE 1.2 MOP 1.1.2	Data Collector	GCS Video	Boolean	logical	Video	Tape CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.1.2.3	s3	Was target detected & recognized?	MOE 1.2 MOP 1.1.2 MOP 1.2.2	Data Collector	Data Collector	Boolean	logical	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)

[a] Data Element (DE) numbers cross-reference to Dendritic. DE symbol cross-references to the event table.

[b] Tape is video or audio as required. CD-R is Compact Disk-Recordable. Zip disks will be available as back-up should the CD-R system fail.

[c] This estimated number of data samples is based on the planned number of target presentations during each test. The number represents the planned number of trials for each command and control architecture. Thus, multiply the number by 3 for total trials. M# is mission area (1 = Armed Reconnaissance, 2 = Fire Support, 3 = Personnel Recovery). M1-F is fixed-wing events Armed Reconnaissance. M1-R is rotary-wing events Armed Reconnaissance. M2-F is fixed-wing Fire Support. M2-R is rotary-wing Fire Support. M2-A is Fire Support Artillery. M3 is Personnel Recovery. A small number of NEO are also planned, but the number will be insufficient for quantitative findings and conclusions. Adequate data for the test program will be captured in the two field tests. The JVTE will capture additional data and will be used to validate JTTP derived from the findings and conclusions from the field tests.

[d] Date-time unit scale will have resolution of seconds.

DE #[a]	DE Symbol	DE Description	Associated Measures	Primary Data Source	Secondary Data Source	Data Format	Unit Scale	Instru-mentation	Media[b]	Required per Test[c]		
										FT-1	FT-2	JVTE
1.2.1.1	t4	Time target is identified	MOE 1.1 MOE 2.1 MOP 1.2.1 MOP 1.3.1 MOP 2.1.1	Data Collector	Audio Video (A/V)	date-time	date-time	PDA	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.2.2.1	s4	Was target identified?	MOE 1.2 MOE 2.2 MOP 1.2.2 MOP 1.3.2 MOP 2.1.4	Data Collector	A/V	Boolean	logical	PDA	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.3.1.1	t5	Time target is localized	MOE 1.1 MOP 1.3.1 MOP 2.1.2	Data Collector	A/V	date-time	date-time	PDA	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.3.2.1	s5	Was target localized?	MOE 1.2 MOP 1.3.2 MOP 2.1.5	Data Collector	A/V	Boolean	logical	PDA	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.3.3.1	x5	Target coordinates as determined	MOP 1.3.3	Data Collector	Surveys	coordin ate	meters	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
1.3.3.2	N/A	Ground truth coordinates	MOP 1.3.3	From test design	N/A	coordin ate	meters	N/A	N/A	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.1.1	t6	Time target ID arrives at BWO	MOP 2.1.1 MOP 2.2.1	Data Collector	Audio	date-time	date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.2.1	t7	Time targeting location arrives at BWO	MOP 2.1.2	Data Collector	Audio	Date-time	Date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)

DE #[a]	DE Symbol	DE Description	Associated Measures	Primary Data Source	Secondary Data Source	Data Format	Unit Scale	Instru-mentation	Media[b]	Required per Test[c]		
										FT-1	FT-2	JVTE
2.1.3.1	t9	Time WDP is allocated	MOE 2.1 MOP 2.1.3 MOP 2.2.1	Data Collector	Audio	date-time	date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.3.2	t12	Time WDP receives targeting data	MOP 2.1.3 MOP 3.2.1	Data Collector	Video	date-time	date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.4.1	s6	Did target ID arrive at BWO?	MOE 2.2 MOP 2.1.4 MOP 2.2.3	Data Collector	Audio	Boolean	logical	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.5.1	s7	Did target location data arrive at the BWO?	MOE 2.2 MOP 2.1.5	Data Collector	Audio	Boolean	logical	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.6.1	s9	Was WDP allocated?	MOE 2.2 MOP 2.1.6 MOP 2.2.3	Data Collector	Audio	Boolean	logical	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.1.6.2	s12	Did WDP receive targeting data?	MOP 2.1.6	Data Collector	Survey	Boolean	logical	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.2.2.1	t10	Time WDP arrives on station	MOE 2.1 MOE 3.1 MOP 2.2.2 MOP 3.1.1 MOP 3.1.3	Data Collector	Video	date-time	date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.2.2.2	t13	Time WDP is cleared to attack	MOE 2.1 MOP 2.2.2	Data Collector	Audio Survey	Date-time	Date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)

DE #[a]	DE Symbol	DE Description	Associated Measures	Primary Data Source	Secondary Data Source	Data Format	Unit Scale	Instru-mentation	Media[b]	Required per Test[c]		
										FT-1	FT-2	JVTE
2.2.4.1	s10	Did WDP arrive on station?	MOE 3.2 MOP 2.2.4 MOP 3.1.2 MOP 3.1.4 MOP 3.2.2	Data Collector	Survey	Boolean	logical	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
2.2.4.2	s13	Was WDP cleared to attack?	MOE 2.2 MOP 2.2.4	Data Collector	Survey Audio	Boolean	logical	PDA Recorder	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.1.1.1	t11	Time UAV & WDP are dynamically deconflicted	MOP 3.1.1	Data Collector	Survey Audio	date-time	date-time	PDA Recorder	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.1.2.1	s11	Were UAV and WDP dynamically deconflicted ?	MOP 3.1.2	Data Collector	Survey	Boolean	logical	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.1.3.1	t15	Time WDP acquires target	MOP 3.1.3 MOP 3.1.5 MOP 3.2.2	Data Collector	Survey	date-time	date-time	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.1.3.4	s21	Was UAV-WDP-target geometry maintained?	MOP 3.2.2	Data Collector	Survey Video HUD	Boolean	logical	PDA Recorder[e]	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.1.4.1	s15	Did WDP acquire target?	MOP 3.1.4 MOP 3.1.2	Data Collector	Survey	Boolean	logical	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.1.5.1	t16	Time of weapon launch	MOE 3.1 MOP 3.1.5 MOP 3.2.1 MOP 3.2.2	Data Collector	Survey	date-time	date-time	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)

DE #[a]	DE Symbol	DE Description	Associated Measures	Primary Data Source	Secondary Data Source	Data Format	Unit Scale	Instru-mentation	Media[b]	Required per Test[c]		
										FT-1	FT-2	JVTE
3.1.5.2	s16	Were weapons launched?	MOE 3.2 MOP 3.3.2	Data Collector	Survey Video HUD	Boolean	logical	PDA Recorder[e]	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.2.2.1	t14	Time laser designation begins	MOP 3.2.2	Data Collector	Video	date-time	date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.2.2.2	t18	Time laser designation ceases	MOP 3.2.2	Data Collector	Video	date-time	date-time	PDA Recorder	CD-R Tape	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)
3.2.2.3	t17	Time of weapon impact	MOP 3.2.2	Data Collector	Survey	date-time	date-time	PDA	CD-R	17 (M1-F) 17 (M2-F) 17 (M3)	17 (M1-R) 17 (M2-R) 17 (M2-A)	12 (M1) 10 (M2) 3 (M3)

[e] Specifically, Over-the-Shoulder Video

F.3.3.2 IDRL for Simulation Tests

The JTF will execute a series of VRs. These events will rehearse data collection procedures for field tests. They will execute the field test IDRL for rehearsal purposes. As such, the JTF will not execute any simulation tests; however, data that are representative of the expected test environment will be collected during the VRs. These data will be used to exercise the data collection and analysis procedures and processes using the same IDRL for the Risk Reduction Mini-Test, the two field tests, and the JVTE.

F.4 DATA SOURCES

F.4.1 Test Scenario Overview

The JUAV JT&E project scenario concentrates on the pre-hostilities to initial hostilities phases of conflict (Figure F-3). The JTF is working in conjunction with DIA and has an open dialog with DIA analysts assigned to operations involving UAVs. The scenario is based on a third-world country in Africa. This country has a consistent set of problems including corrupt government officials, poverty, and a willingness to engage in hostilities in the region. In addition, its military possesses modestly sophisticated weaponry and operational capabilities. The scenario includes significant combat operations in built-up or urban areas. The JUAV JT&E project will test with manned and unmanned aircraft, personnel, and equipment representing the Army, Air Force, Navy, and Marine Corps. Furthermore, data will be collected under operationally realistic test conditions, and the test will be conducted using the three alternative C2 architectures.

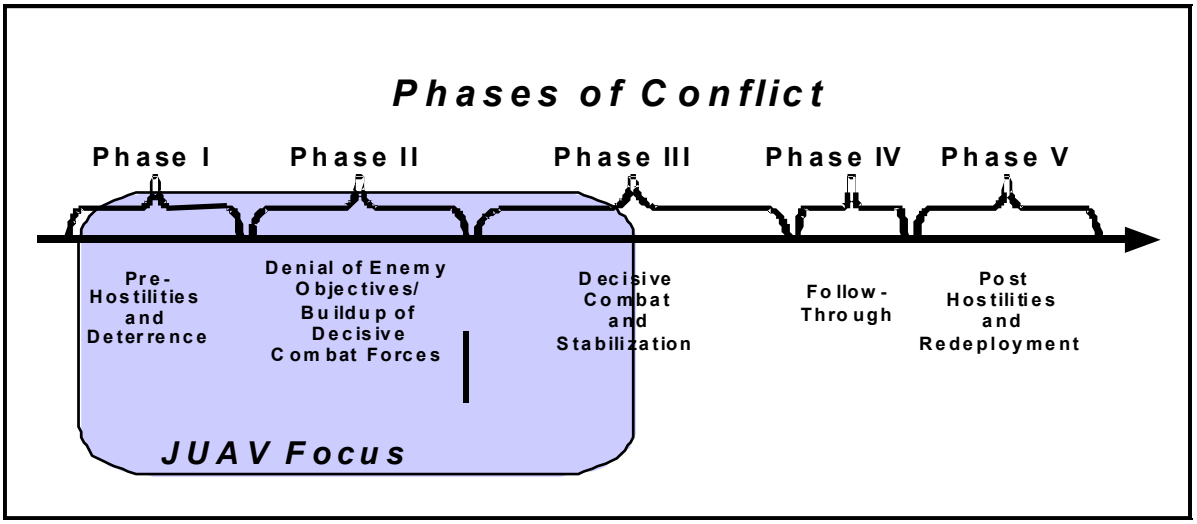

Figure F-3 Phases of Conflict

F.4.2 Test Venues Overview

Data collection requirements will be integrated with and supplement any data collection capability of the host venue. The JUAV JT&E will not duplicate data collection accomplished by the host venue or another participating agency, but JTF personnel will coordinate closely with such agencies to ensure the data products will satisfy JUAV JT&E needs. The JTF may furnish some of the data it collects to the host venue. Detailed data management planning processes and schedules will be synchronized with

those of the host venues, and MOA will document the data collection responsibilities of each to include data-sharing arrangements.

F.4.2.1 Risk Reduction Mini-Test

The Risk Reduction Mini-Test will be conducted at Ft. Irwin at the NTC in January 2003. Data, primarily for the Fire Support mission area, will be collected.

F.4.2.2 Field Tests

FT-1 (DR XI) will be conducted from 14 July to 1 August 2003 at NASF. FT-1 will take advantage of the annual multi-Service DR XI training event. The focus of DR XI is CSAR, with some NEO and Air Interdiction operations as well. The JTF intends to collect most, if not all, the data required for Personnel Recovery missions, particularly CSAR, in FT-1. Data for the Air Interdiction mission area will also be collected.

FT-2 will be conducted in January 2004 at Ft. Hood. Details, including the timing, are still being negotiated. FT-2 will focus on the Fire Support (including CAS) mission area. Most, if not all, Fire Support mission area data will be collected during FT-2. FT-2 will also provide much of the Air Interdiction data as well.

F.4.2.3 Joint Validation Test Event

The JTF is planning on using JCIET04/JTFEX (expected in spring 2004) to validate the JTTP that were developed during the previous tests.

F.4.3 Data Collection Coordination Requirements

The JTF will coordinate with venues to ensure data collection requirements are met. This will be done via MOA and LOA with owners of the test venues.

F.4.4 Modeling and Simulation Data Sources

M&S will be used during the JUAV JT&E in VRs for risk reduction. These rehearsals will allow the JTF to refine test procedures associated with specific JTTP, rehearse test execution, and validate test data collection equipment such as data recorders. The VRs will help validate and refine analysis methodologies using data generated in the simulations. Analysis methods will be exercised with realistic data to ensure data analysis tools are compatible with data in both form and format.

The VRs will also provide an opportunity for warfighter participation and feedback on the DTPs and methods. There is no intent or requirement to use any data from these rehearsals to support test findings and conclusions. However, as part of the rehearsal of test methods and data collection procedures for live testing, the following data sources will be exercised and refined during the VRs:

- Procedural checklists maintained by data collectors, test control personnel, simulation support personnel, and workstation/platform SME operators
- Post-event debriefs/questionnaires
- Manual data logs kept during the event
- Automated data logs and recorders
- Video recorders
- Audio recorders

F.5 DATA MANAGEMENT OVERVIEW

F.5.1 Data Management Functions

Data management processes include identifying, collecting, controlling, processing, archiving, and disseminating test data from multiple sources and locations. Specific data management activities include data source identification or development, data media identification, data collection instrumentation, data processing, database development, quality checks, storage and distribution, security and control, and data disposition. The output of the data management process will be a media library and online database that will support the data analysis and evaluation phases.

F.5.2 Data Handling Procedures and Methods

Data handling procedures involve the following steps, which (for test and post-test data handling) are also shown graphically in Figure F-4:

- Pre-test
  - Establishing the data collection organization
  - Training for data collectors
- During test
  - Collecting of manual and automatic data
  - Quick-look analysis
- Post-test
  - Data extraction and entry into initial database
  - Initial database analyses
    - Mission reconstruction
    - Trial reconstruction
    - Anomaly analysis
    - Debrief analysis
  - Data entry verification
  - Data reconciliation into intermediate database
  - Data fusion/database verification of intermediate database
  - Data certification and error correction
  - Final database for analysis

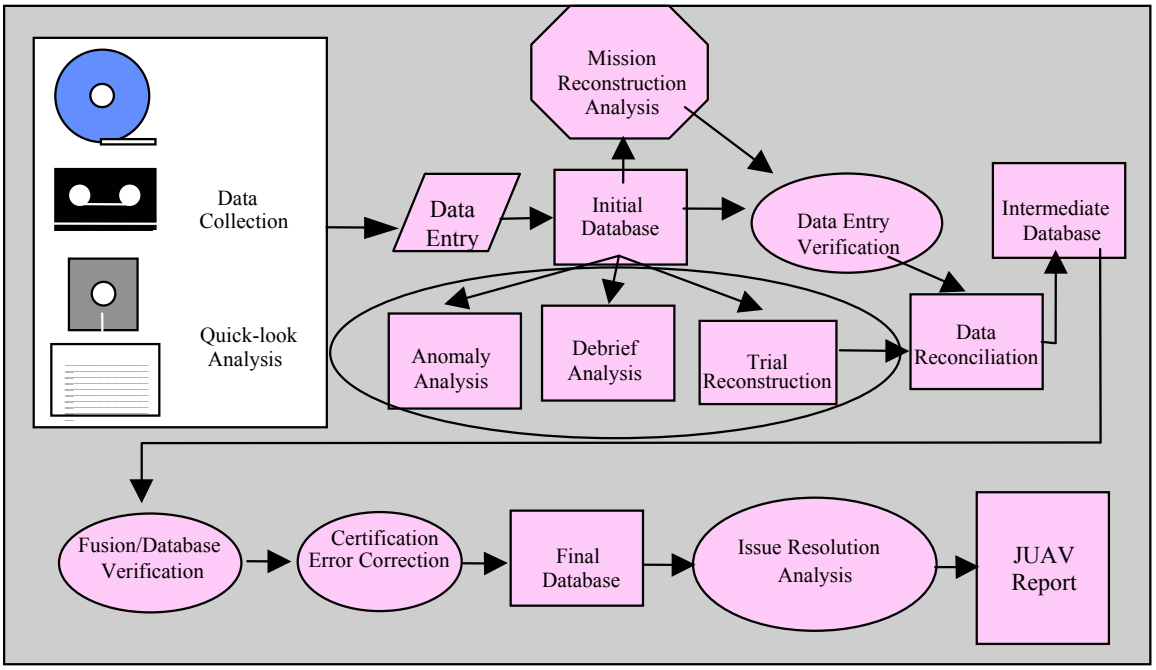

Figure F-4 Data Handling Procedures

After discussing the data collection organization and training requirements, the various portions of Figure F-4 are discussed in detail. This process will produce three databases. The first or initial database will contain the raw data collected during the test. The second or intermediate database will contain results of analyses using data from the initial database. Once the data are fused into the dendritic data elements, verified, and certified, they will be placed in the final database, which will be made available to analysts to compute the measures and support answering the issues and sub-issues and resolving the problem statement.

F.5.2.1 Data Collection Organization

Effective data management will be the responsibility of the JUAV Lead Analyst and the JUAV Data Manager. The JUAV Lead Analyst is responsible for quality of the analysis product and for the staff and augmentee analysts who will perform much of the data collection. The JUAV Data Manager is the individual tasked with the responsibility to ensure high quality data are collected and available for analysis. The JUAV Data Manager will be supported by an instrumentation engineer who will plan and execute the collection and verification of automatic data from such sources as TSPI, UAV data links, and communications systems. The JUAV Data Manager will also be supported by the JUAV Data Librarian who will receive, catalogue, and archive all data collected during the test.

Prior to the VRs, the Risk Reduction Mini-Test, the field tests, and the JVTE, a data collection organization will be established. This organization will have a lead data collector for each test event. Subordinate organizations will be developed as needed but will include a UAV data collection team, a JAOC data collection team, a forward Tactical C2 node data collection team, and a WDP data collection team. Each team will be staffed with sufficient data collectors to enable them to collect the required data and cover all the test trials with time to report quick-look issues.

F.5.2.2 Data Collector Training

There are three sources of personnel for data collectors: JTF staff, augmentees dedicated for a particular test event, and data collectors from the participant units who are not performing any assigned operational tasks. All data collectors will be trained in data collection procedures.

JTF personnel will be trained in data collection procedures prior to the initial VRs. They will then recommend amendments to the procedures as needed. Prior to each field test, staff personnel will design and present training for augmentees and will participate in the training as well.

The JTF will use personnel from military units or from analysis organizations to augment data collection. Augmentees will need general training in test objectives and specific training for their function. They will be instructed about the required data and how it will be collected on the manual forms, VoiceIT systems, palmtop computers, or laptop computers. They will be instructed in the use of any equipment that they may need (such as headphones, radios, or computers).

A pre-test rehearsal will be conducted before each test to ensure that the data collectors understand their role and have the opportunity to experience the process and have questions answered. Additionally, the JUAV Data Manager will have the opportunity to identify potential deficiencies in data collection methodology and data forms and in coordination with host venue data collection and data analysis processes and procedures.

F.5.2.3 Data Collection Methods

The first data collection requirement is collecting data that are generated during a test event. The JTF will use automated and manual data collection sources and methods and also develop specialized data collection tools (e.g., post-mission questionnaires and interviews) to meet unique JUAV JT&E data requirements. Data will be collected through several media (e.g., electronic, audio, and video). The reliability and accuracy of data collection systems developed specifically for the JUAV JT&E will be demonstrated prior to test events. Instrumentation systems will also be calibrated prior to test events.

Manual and automated data collection techniques will be used to collect various forms of data (e.g., analog and digital). The following bullets describe the types of data to be collected during test events:

- Environmental conditions such as terrain, visibility, climate, and personnel capability and training will be collected during all test events.
- The post-mission briefs, interviews, and questionnaires are among the more important JT&E data sources. The purpose is to provide professional, operational SME data that support and explain integrated UAV performance results. The raw data will consist of written responses or ratings made with respect to specific questions about how a particular mission was prosecuted. These questionnaires will provide the proper focus on JUAV and the operational workarounds used to mitigate any problems encountered during the test missions.

Automated and manual data collection will vary among the tests. The JTF will attempt to automate data collection through the use of instrumentation to the maximum extent practical.

F.5.2.4 Quick-Look Analysis

Quick-look analyses will be conducted for each test period. Daily reports will be produced by the data collection organization. The JUAV Lead Analyst and the JUAV Data Manager will consolidate quick-look analyses and prepare remedies for any incomplete or inaccurate data. The primary purpose of quick-look analysis is to prevent problems occurring early in a test from adversely affecting the rest of the test.

F.5.2.5 Data Extraction and Data Entry

After the raw data are collected on various data collection media, data elements will be extracted and entered into an initial database. Data elements are the individual pieces of information that are used to compute measures and to conduct the exploratory analyses that provide in-depth understanding of JUAV mission effectiveness. Automated collection systems have the potential to provide more data than are required for JTF purposes. Therefore, it will be necessary to extract the data of interest from the larger data set. The process of extracting data elements can be automated, as when a computer program reviews data to extract time and location data for trials of interest, or it can be a manual process, as when a system's status is entered on a manual JUAV data collection form or taken from a post-mission brief form and entered into a database. As discussed earlier, some of the data collected in the field tests will be audio, video, digital, or in a paper format. It will be necessary to process these raw data to yield the data elements needed to support the JUAV analysis.

F.5.2.6 Initial Database Analyses

The initial database is the result of the data extraction and entry process. Several types of analysis will be conducted using data in the initial database. These include trial reconstruction, anomaly analysis, debrief analysis, and mission reconstruction.

F.5.2.6.1 Trial Reconstruction

Trial reconstruction is the process by which analysts (usually the data collectors from each of the major nodes) compare their data from manual forms, palmtop computers, and notes to produce for each event in the test trial a consensus of whether the event was successful and the time range when the event occurred.

F.5.2.6.2 Anomaly Analysis

Data anomalies can be found at different stages of the data flow process. Differences in data between sources may occur during mission reconstruction using the initial or raw database. Two or more different sources may show differences in not only the time an event occurred but also whether or not the event occurred.

Time differences will be noted and additional data sources will be applied to resolve and definitively determine the time. For example, if data from the UAV GCS showed that an event occurred at 13:42:37 and the JAOC shows the event occurring at 13:43:15, the mission reconstruction will note the 38-second discrepancy. Other data sources, such as audio tapes of communications paths or videotapes of operators will be used to determine the certified time the event occurred.

A more complicated anomaly analysis process would occur if two or more data sources conflicted on whether or not the event occurred. If the JAOC data show no weapon was released, but the F/A-18 data show that it was, analysts will compile the relevant data from these sources, compare it with audio and video, and if necessary, a board of SMEs will convene with the analysts to decide. Issues the board is unable to decide will be presented to JUAV JT&E leadership.

F.5.2.6.3 Debrief Analysis

Surveys will be used to collect much of the data required by the JUAV JT&E. Demographic questionnaire surveys will be completed by personnel assigned to each component of the architectures. Surveys will collect data on the participants, including Service, military occupational specialty, rank, acquired skills and currency, and familiarity with UAV integration. These data will be used in analyses and will focus particularly on the acquired skills and currency. Some of the dendritic data will be collected by using surveys. These data will include assessments by the participants as to whether trial

events were successfully completed and whether the UAV-target geometry was maintained during the engagement phase.

Analysis of the surveys will produce data elements, particularly those associated with the success of the mission and of executing the specific trial events. These data will be compared with other sources in determining success of the mission.

Survey analysis will also populate uncontrolled and primarily human factors data in the database. The focus will be on which skills had the more dramatic impact on mission (and trial event) success and completion times.

F.5.2.6.4 Mission Reconstruction Analysis

Each test trial will be examined in detail. Determinations will be made on whether an event occurred and the time the event occurred. Mission reconstruction will therefore recreate the test trial based on the data elements collected for the purpose of understanding potential variations in the data.

F.5.2.7 Data Entry Verification

Quality assurance will be conducted prior to entry into the intermediate database, which encompasses two important data management and analysis aspects. Quality assurance serves to verify that the collected data are complete and accurate. Corrupt data must not be permitted to enter the JUAV intermediate and final databases. The data quality and integrity check process will be established for all sources and will employ specific, well-defined criteria. The data quality and integrity checks provided by the data collection process can be automated or manual and will include checks for completeness and validation of collected data. For data sources involving audio recording and video imagery, quality checks will require an analyst to view or listen to the recording to identify the data content that can be derived from the data source. Environmental data will be checked for valid system status and completeness. Questionnaire and interview data will be reviewed during pre-test rehearsals to ensure that all items were answered and to maintain internal consistency (to the extent to which a respondent gave similar responses to items that assess the same factor). The extent of quality assurance checks will be defined in detail for each test event.

F.5.2.8 Data Reconciliation

Data reconciliation is the process by which the results of the initial database analyses are used to create an intermediate database. Reconstructed missions that have undergone data quality assurance checks, as well as the results of the debrief and anomaly analyses, will be verified and inserted into the intermediate database.

F.5.2.9 Data Fusion and Database Verification

Data fusion is the next requirement and is the process by which data from multiple sources are merged to yield a single data set. Software programs will be used to support automated data fusion for the JUAV JT&E.

After the fusion process, the next data collection requirement is to verify the data elements to ensure integrity and consistency with related data elements. An automated process will check the integrity of each data element to the extent possible. Correlation of trial source and time-related information, for instance, can be accomplished automatically. Data elements that have redundant collection sources or known relationships to other elements will also be manually examined and compared as part of the data verification process. The data element comparisons will be completed for every candidate trial. If data element values conflict with one another, the affected elements will be flagged as possible errors and reviewed by the test analyst team before being reported to the DQRT. The

DQRT will be chaired by the JUAV Lead Analyst and will include the JUAV Data Manager, the instrumentation engineer, the chiefs of the data analysis and data management teams, and one or more analyst teams as required. Once verified, the data will be loaded into the JUAV JT&E database in preparation for more detailed analysis and calculation of the measures.

F.5.2.10 Certification and Error Correction

Following the data verification, the DCC will review the integrity of the JUAV JT&E database. The DCC will be chaired by the JTD and will include the Service Deputies, the Technical Director, and the chiefs of the data analysis and data management teams. The data will be checked for consistency, completeness, and validity. If data values are not acceptable, or do not correlate with corresponding data values, the invalid test event data may be removed. No data may move beyond this intermediate step in the data cycle without being validated by the DCC. The JTD will act as the final certification authority for all data used and disseminated by the JTF.

The next data collection requirement is to correct erroneous data and replace them in the database. For instance, if the certification process questioned the validity of a particular timed event, the original data sources will be checked to reconstruct the times in question. This important step allows incongruities to be resolved in the database before analysis is conducted. All errors or suspected errors will be documented and remain a permanent part of the data set. At this point, the data are in a form amenable to analysis.

F.5.3 Special Considerations

The data handling process will be executed as explained in Section F.5.2. Additionally, there are some special considerations during the process.

F.5.3.1 Test Data Quality Control

Test data quality control is essential for a successful test. Processes including data quality control and assurance, data verification, data certification, and identification of data anomalies and their associated adjudication process are discussed in Section F.5.2 at the appropriate places in the data handling process.

F.5.3.2 Modeling and Simulation Considerations

The JTF is using M&S to rehearse in preparation of field tests. Data handling will flow similarly through the steps outlined in Section F.5.2. M&S will enable rehearsal of these steps. M&S may also allow refinement of data collection forms, database structures, and data collection control and analysis procedures. M&S data will not be entered into the main databases described in Section F.5.2 but will be inserted into copies of these databases created for rehearsal purposes. M&S data will always be kept segregated from data from live tests.

M&S data sources and instrumentation may vary somewhat from field tests. For example, in M&S, data collectors can observe tactical fighter operations from immediately behind the pilot in the VPF at IBAR or the BHIVE at APEX. Therefore, data collection for “airborne” platforms will be simpler in M&S than in the field. Care will be taken to identify these issues and ensure that rehearsal procedures at M&S will not detract from the ability to collect and handle data in the field. Data from VRs will not be part of the analysis database.

F.5.3.3 Data Collection Instrumentation and Calibration

Most analysis issues will require instrumentation systems to collect data needed to reconstruct data elements. Examples include telemetry, TSPI, video, and audio. Portable Audio Video Equipment Racks (PAVERs), with the functionality to integrate with each test venue, will capture audio, video, and UAV TSPI and synchronize these data with GPS time. TSPI information from each test venue's range telemetry system will be collected to support player location data elements. Reference Table F-4 for a specific list of test venue range telemetry systems. The instrumentation engineer will test and calibrate each data collection system prior to missions and verify recorded data are being labeled and cataloged for future review.

The instrumentation engineer will manage the instrumented data collection by performing functions similar to the subject matter analysts assigned to the tactical systems. This includes determining and implementing data collection methods, developing data reduction capabilities, establishing media requirements and data formats, and validating all data processing using sample data media. The instrumentation engineer will develop any required data collection forms, identify additional data collector or system operator (augmentee) requirements, and develop instructions for augmentees. The instrumentation engineer will develop sections for instrumentation data in the detailed DMAP for each test.

F.5.4 Joint Test Database

This section describes the structure for the JUAV database. The purpose of the database is to facilitate the analysis of data collected during the JT&E. The JUAV database will contain all data collected during the JT&E. Appropriate digital data (e.g., TSPI, questionnaires, voice recordings, and digital imagery) will reside on the JUAV database discussed in F.5.4.6. Other data such as HUD video, paper notes, and other non-digital data will also be part of the JUAV database. The responsibility for the quality, integrity, and security of the data is that of the JUAV Data Manager. The JUAV Data Librarian will support the JUAV Data Manager.

F.5.4.1 Data Library

To facilitate control and tracking of data, the JTF will implement a Data Library System (DLS) located in the JUAV office and at the test sites. The DLS will provide for automated inventory check-in, check-out, transfer-in, and transfer-out control procedures and printed documents such as labels, receipts, and reports. The JUAV DLS will receive, control, store, and provide retrieval of a variety of data generated and collected during the JT&E. The DLS will store the original data and data media, intermediate data products, all database files (including back-ups), and reference materials. The library system's check-in and check-out mechanism controls and inventories the media as they are moved between the various data collection and processing points. The DLS, and an appropriate subset of the DLS information, will be used during every JUAV test activity for producing required media labels and for tracking and controlling the data at the test sites. The JUAV Data Manager will be responsible for directing the operation of the DLS. The DLS will be automated to enable the JUAV Data Manager to assign data media control numbers, conduct automated inventory, accomplish check-in and check-out procedures, and retrieve individual data.

F.5.4.2 Data Collection Media Distribution and Control

The data media packages will be designed prior to deploying to the Risk Reduction Mini-Test and field test activities. Each data package will be packaged in appropriate containers (e.g., boxes, padded envelopes) and will consist of a unique set of labels and data collection media for a specific data collector. However, unforeseen test limitations or problems may make it necessary to develop data packages on demand in the field; therefore, the JUAV Data Manager will be able to generate data packages on short

notice and distribute the packages to the appropriate data collectors. The DLS personnel will be capable of revising and generating the data labels at field sites. Blank media will be available at each test activity for contingencies. The JUAV Data Manager will have an expedited means to purchase data media from commercial sources while deployed. The completed packages will be checked against the data media requirements (inventory sheet) and then prepared for distribution.

When the data packages are completed, the test site DLS personnel will keep a copy of the data package inventory sheet to ensure traceability of the data package. The DLS personnel must positively identify each data collector prior to distributing the data media packages. All control and accountability procedures will be strictly enforced. Site DLS personnel will ensure that the inventory levels of media and forms are maintained and that the correct media items are distributed.

Data collectors will check out the prepared data collection packages and verify the contents prior to the start of each data collection shift. They will compare the items in the data package to the items listed on the inventory sheet produced during generation of the data package to ensure that all the required materials are in the data package.

F.5.4.3 Data Entry and Extraction Procedures

Some data collection activities will require data to be collected on paper (e.g., interviews, questionnaires, observation checklists, logs, and reports, etc.). Other data may be manually extracted from audio or video sources. Data will be checked against acceptable formatting, units of measure, and ranges of values to screen for data entry errors. Double entry data procedures will be employed for all non-narrative data.

Data analysis teams will perform data extraction. Senior analysts will be essential for interpreting system-specific data. Data analysts will provide scientific regimen, focus the team on the task, and independently correlate the extracted data. Data with hard errors, such as parity errors, will be flagged as they are extracted and considered in the data analysis. The data collector notes will be available to help resolve the ambiguity. The data extraction task is tailored to each type of media. This process will be automated when practical (by using data replay tools) or it can be a manual process (as when a system status is taken from a post-mission brief form and entered into a database). As discussed earlier, some of the data obtained in the JUAV tests will be audio, video, digital, or paper format.

Reconstruction combines data from multiple sources to yield a single data set. Using the verified database, JTF analysts will conduct thorough mission and event reconstruction to understand the chronology for analysis events. All relevant data will be used such as tracking files, voice files, video files, questionnaires, and hard copies of the test notes. Digital data will be replayed using automated replay tools (such as JCAS developed COMBAT) to accelerate the process.

Designated analysts will identify analysis events and use the verified data to reconstruct chronology, associations, and parameters for their assigned tactical systems and objectives. Reconstruction involves human-aided fusion of verified data from all sources to determine the chronology and data elements for each event. Reconstruction will also review test conditions to ensure that data were collected under the correct conditions and are suitable for use in analysis.

F.5.4.4 Database Access Control

Database access will only be granted to authorized persons approved by the JUAV Data Manager. Once access has been granted, it will be controlled by those procedures discussed in Section F.5.4.7.

F.5.4.5 Database Backup Procedures

The database will be backed-up incrementally nightly and in its entirety weekly. The incremental tapes will be kept for one week and then recycled. The complete weekly tapes will be kept for 6 months before being reused. All raw data from field tests will be backed up on to CD-ROMs. Tapes and field test backup CD-ROMs will be stored in a different facility than the JUAV office.

F.5.4.6 Hardware and Software Overview

The JUAV database will be hosted on a database server connected into a simple 100BaseT Ethernet peer-to-peer network. This network will be comprised of desktop computers for each analyst requiring simultaneous access to the JUAV network. This will be a SECRET capable network and all computers on it will have removable disk drives. The database server will use Redundant Array of Independent Disks (RAID) 1 Mirroring, which provides 100% redundancy providing an exact copy or mirror of the primary drive. In the event of a disk failure, the remaining disk can be accessed or even moved to a new computer. Internet and e-mail service will be provided to JUAV members on the separate network operated by the JUAV JT&E. SIPRNET will also be provided to members on an additional Navy/Marine Corps Intranet (NMCI) operated network. No Sensitive Compartmented Information (SCI) data are envisioned to be required for the JUAV JT&E.

The database will be implemented using commercial database software, such as MS Access. It will be implemented on Microsoft Windows 2000 using the NT File System (NTFS). The NTFS was chosen over File Assist Table (32 bits) because of its security and reliability and it is the file structure chosen by NMCI for host organization support. Each analyst will have access to a Windows computer with applications such as MS Word, Access, and Excel. Other tools such as WAM or COMBAT and other statistical tools will be used as required.

F.5.4.7 Database Security

Database security will be accomplished through access control and physical security. The JUAV data analysis network is a stand-alone network with no connectivity via internet, modem, or LAN to any other network.

Access to the network can only be accomplished by logging into the network from a workstation located in the JUAV facility. Windows 2000 requires a unique name and password to log on to the computer. This process cannot be disabled. After successful user validation, the user is logged into the network and another level of access control is encountered. Using the features of the NTFS, the system administrator can assign control access to folders (directories) and individual files residing on the network. This will prevent files from being modified unintentionally by users. Windows 2000 also provides the ability to audit access and security-related actions. This will allow the system administrator to monitor the network for unauthorized access attempts.

F.5.5 Data Collection Pre-Test Rehearsals

The JTF will conduct pre-test rehearsals of the data collection process. These rehearsals will include “rock drills” to walk through the events needed to collect data. Data collection procedures will be modified as needed as a result of the rehearsals.

F.5.6 Data Security Procedures

Safeguarding data involves physical custody and security. Once media has been distributed to data collectors, they are responsible for it until the media is given to the data management team. The data collector is responsible for keeping non-JTF members from accessing media data. Classified data will be

safeguarded in the data collector's possession until the media are properly transmitted to the JUAV Data Manager.

Appropriate data media classified storage locations at the test activities will be detailed in the site test plans. Adequate conditions to prevent unauthorized persons from gaining access are outlined in DoD Directive 5200.1-R, DoD Information Security Program.

F.5.6.1 Shipment and Transfer of Test Data from Test Site

Test data returned from test activity libraries will be appropriately boxed to meet security requirements as outlined in Annex H and wrapped for shipment to the DLS in the JUAV office after completion of the quality check measures. All test media will be shipped by traceable shipping modes. Site DLS personnel are responsible for getting the material to the designated carrier as specified in the specific site test plan.

F.5.6.2 Courier Requirements

Couriers of JUAV data will be assigned such responsibilities as outlined in Annex H. Couriers will be knowledgeable about restrictions of hand-carrying classified data aboard commercial airlines that perform detailed random searches of passengers.

F.5.6.3 Coordination with Non-JT&E Data collection Sources

The JUAV Data Manager will coordinate with the organizations responsible for the non-JT&E data sources (e.g., NSAWC for Fallon TACTS data). This coordination will result in documented procedures to ensure non-JT&E data are safeguarded to appropriate levels. These procedures will be contained in the detailed DMAP for each test.

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Appendix F-1 Statistical Analysis Methodology

This appendix is a repeat of the methodology developed in the JUAV JFS. It describes the methodology that serves as a basis for the planned methodology of the JUAV JT&E.

Issue resolution will involve computation of measures and answering the issues. MOE and MOP will be computed by grouping appropriate data parameters by mission area and test conditions. Results of those computations will be analyzed to determine if differences are significant and consistent and if they really correlate to differences in procedures under test. Issues will be resolved by determining which test procedures achieved the highest percentage of mission success based on the stated mission objectives.

The dendritic methodology provides for systematic decomposition of issues to sub-issues and supporting measures to determine data requirements to answer the issues. The left side of Figure F-5 (planning phase) schematically illustrates the process of breaking down the problem statement into issues and measures and then measures into data elements. The bottom of Figure F-5 (execution phase) represents test conduct and data collection. The right side of Figure F-5 (analysis phase) illustrates synthesis where the measures are computed from data, data and computed measures are analyzed, evaluation is performed, results are generated, conclusions are drawn, and recommendations are made and reported. The original dendritic will be used throughout this phase to ensure that analysis stays focused on providing objective answers to the issues. The proposed process is straightforward, has been used in previous Service and Joint tests, and provides overall low technical risk.

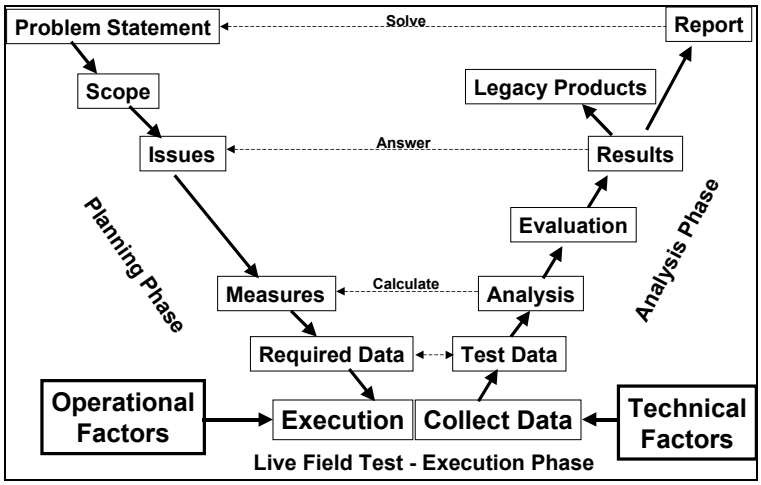

Figure F-5 Issue Resolution

Issue analysis consists of measure analysis and computation, issue resolution, exploratory analysis, and additional process analysis. Measure analysis consists of the activities required to develop data criteria and calculate the measures. Issue and measure resolution consists of the analysis necessary to resolve the issues and measures. The issue analysis process will follow these steps:

(1) Calculate the measures.

(2) Develop data presentations to assist analysis.

(3) Resolve the issues and measures.

(4) Perform evaluation of the analysis results.

(5) Formulate and report conclusions.

The JUAV JT&E concept is to conduct a multiphase test and analysis effort. During startup of the JUAV JT&E (FY02-FY03), the data analysis team will use a combination of systems analysis and operational analysis to assess how UAVs may be used as tactical support assets, the extent of procedural problems, and the state of current training. The data analysis team will use systems analysis techniques to characterize the relationships among the various C2 echelons as well as the interactions and interfaces among the JFCOM headquarters, Service components and agencies, and among the Service components themselves. The data analysis team will also aggregate the results at each level of the dendritic structure to form the basis for addressing the next higher level.

F-1.1 Calculate the JT&E Measures

After returning from the field test site to the JUAV office, the data management personnel will populate archival databases from the temporary field test databases according to the analysis plan. The JTF analysts will review data from their assigned locations to identify all periods of usable data. Then, the JUAV Lead Analyst will determine missions (or periods during missions) when data collection is sufficiently complete and correct it to support analysis objectives. For these periods, analysts will extract data not already processed from non-digital sources (such as manual logs, audio tapes, and video tapes) to finish populating the analysis database. Analysts will also reconstruct all JUAV JT&E events and establish other associated event parameters required for the measures. The data analysis team will then calculate the measures according to the dendritic.

F-1.2 Develop Data Presentations to Assist Analysis

Clear and understandable data presentations are essential to determine findings and identify trends. Analytic tools and products used by the data analysis team will include descriptive statistics, graphs, tables, and charts as required to demonstrate key results and differences between alternative test procedures.

F-1.3 Resolve the Issues and Measures

During the analysis and assessment phase of the JUAV JT&E, the data analysis team will analyze data and assess effects of the alternative tactical procedures. The same measures will be calculated for all three alternatives for the same mission conditions. Differences between measures will be tested to determine if they are statistically different.

Mission success and mission time data can be arrayed in contingency tables and Chi-Square tests used to test for independence between C2 architectures and outcomes. Table F-14 displays mission success outcomes in contingency table format where N, with a subscript, is the number of successful missions and M, with a subscript, is the number of unsuccessful missions.

Table F-14 Mission Success Outcomes in Contingency Table Format

	Mission Successful?		
	Yes	No	Totals
Alternative A	N_A	M_A	$N_A + M_A$
Alternative B	N_B	M_B	$N_B + M_B$
Alternative C	N_C	M_C	$N_C + M_C$
Totals	$N_A + N_B + N_C$	$M_A + M_B + M_C$	$N_A + N_B + N_C + M_A + M_B + M_C$

If mission success outcomes are independent of the alternative C2 architectures, then the expected frequencies of mission success outcomes are the products of the marginal totals divided by the grand total. The following is an example of the expected frequency of mission successes for the trials with Alternative A:

$$(N_A + N_B + N_C) \times (N_A + M_A) \;/\; (N_A + N_B + N_C + M_A + M_B + M_C)$$

If the success outcomes are independent of the C2 architectures, then the observed frequencies of mission success are likely to be close to the expected frequencies. For large samples, a statistic equal to the sum of squared differences between observed and expected frequencies in the contingency table divided by expected frequencies has a Chi-Square distribution (Mood, Graybill, and Boes, *Introduction to the Theory of Statistics*, p 440-459). The DOF for the distribution is the product of the number of C2 architectures less one and the number of categories for mission outcomes less one. The JTF intends to reject independence for values of the test statistic that have less than one in four chances of occurring, which corresponds to having a value greater than 2.77.

The JTF can analyze whether mission times are affected by C2 architecture in a similar fashion. The first step is to define time categories and sort the results into the categories. Time categories can be based on an operationally relevant time interval such as the time interval in which operators need, or want, to be able to accomplish the mission. Three time categories are then defined: the first for time intervals at least somewhat shorter than wanted, the second for time intervals about equal to what is wanted, and the third for times at least somewhat longer than is wanted. Using this technique, Table F-15 displays mission times in contingency table format where:

R, with a subscript, is the number of times in the category of at least somewhat shorter than wanted;

S, with a subscript, is the number of times in the category of about equal to what is wanted; and

T, with a subscript, is the number of times in the category of at least somewhat longer than wanted.

Table F-15 Mission Times in Contingency Table Format

	Mission Times			Totals
	Shorter than needed	About as needed	Longer than needed	
Alternative A	R_A	S_A	T_A	$R_A + S_A + T_A$
Alternative B	R_B	S_B	T_B	$R_B + S_B + T_B$
Alternative C	R_C	S_C	T_C	$R_C + S_C + T_C$
Totals	$R_A + R_B + R_C$	$S_A + S_B + S_C$	$T_A + T_B + T_C$	$R_A + R_B + R_C + S_A + S_B + S_C + T_A + T_B + T_C$

Analysis of mission times is very similar to the analysis of mission outcomes. If mission times are independent of the C2 architecture, then the observed frequencies of mission times in each category are likely to be close to the expected frequencies (the products of the marginal totals divided by the grand total). For large samples, a statistic equal to the sum of squared differences between observed and

expected frequencies divided by expected frequencies has a Chi-Square distribution. The DOF for the distribution is the product of the number of C2 architectures less one and the number of categories for mission times less one. Values of the statistic that have less than one in four chances of occurring, and for which the JTF will therefore reject independence, are values greater than 5.39.

This approach will be used to analyze the results for each of the distinctive missions being tested and for the parts of missions for which the relevant data are collected. The approach uses accepted statistical procedures to provide a basis for determining whether the C2 architectures affect capabilities for conducting time-critical missions and for describing whatever influence the C2 architectures are discovered to have.

There are considerations for small sample sizes. The general rule is that using the Chi-Square test with the statistic described above is appropriate if the expected frequencies in each cell are at least five. The JTF plans to run enough trials to obtain about 17 valid data points per test condition, but with any operational test, there is some risk that the desired sample size will not be realized. The contingency cell format proposed for analyzing mission outcomes has six cells so at least 30, and perhaps more than 30, trials would be needed to have expected frequencies of at least five in each cell. And the format proposed for analyzing mission time has nine cells, so at least 45, and perhaps more than 45, successful trials would be needed for analysis of mission times. While most statisticians regard the general rule as more restrictive than necessary, the JTF may violate the less restrictive rules that have been proposed. An example of the less restrictive rules is that the minimum expected frequency may be as small as $5r/s$ where s is the number of cells and r denotes the number of cells with expected frequencies less than five (Yarnold, *Journal of the American Statistical Association* 65 (1970) 864-886).

However, there are statistical techniques that can be used with small samples. The Fisher Exact method takes the observed row and column totals as given and then, assuming independence, calculates the probabilities of each possible outcome that would yield the same row and column total as were observed. This method then sums the probabilities of the case the JTF observed and all the cases that are less likely to have occurred. Then if the total probability of the observed result and those less likely is less than 0.25, the JTF reject independence.

Appendix F-2 Levels of Confidence for Statistical Separation

This appendix continues the analysis conducted in Section F.2.3.3. The analysis in that section determined that when comparing results from two test variables (such as C2 architectures), under the constraints that separations in probability distributions be operationally meaningful (i.e., with at least 20% difference in probability in the result) and with a confidence level of at least 75% (less than 25% chance of wrongly concluding there is a separation), 17 trials for each are needed in the worst case. Fewer trials might be possible in many cases.

The JTF computed tables for comparison when comparing results from two variables with up to 17 trials each. Five of these tables are included in this appendix. In each of these tables, the two test variables have the same number of trials (10, 12, 15, 16, or 17, respectively). In principle, tables can be generated for different numbers of trials for the two test variables, but in designing tests, it is important to have the same number of trials for each variable. For each table, the two axes are the number of successes for the respective test variable. The cell value is the level of confidence in making a decision that there is statistical separation between the results of the variables. This value is 1 minus the probability of a type I error (wrongly concluding that a statistical separation exists). This error is computed using the methodology in Section F-1. (Instead of using 3 x 2 or 3 x 3 contingency tables, the computations here use pair-wise comparison and use a 2 x 2 contingency table. These computations follow the principles developed in Appendix F-1.) Levels of confidence of 75% or greater are in bold. Levels of confidence below 75% are dimmed.

Table F-16 shows the levels of confidence from results from two variables, each with 10 trials. For example, if 4 successes occur in 10 trials for the first test variable, statistical separation occurs (using the JTF's criteria of 75% or more confidence) when the second test variable has either 0, 1, or at least 7 successes out of 10. When 7 trials out of 10 for the second test variable are successful, the JTF can conclude that the two distributions are statistically separated with 82% confidence. Four successes in 10 trials is 40%, 1 success in 10 is 10%, and 7 successes in 10 trials is 70%. This indicates that in this case, 10 trials for each test variable can show statistical separation at least 75% confidence for separations of 30% or more (40% - 10% or 70% - 40%). Table F-17 shows the confidence levels for 12 trials for each test variable. Table F-18 shows the confidence levels for 15 trials for each test variable. Table F-19 shows the confidence levels for 16 trials for each test variable. Table F-20 shows the confidence levels for 17 trials for each test variable.

One reason to produce tables of less than 17 trials per test variable is that these tables can help focus tests during test execution. For example, if 17 trials are budgeted for each test variable for a given arrangement of other variables, and after 10 trials for each the table shows separations with levels of confidence greater than about 75% or 80%, then separation could be concluded and the remaining 14 trials (7 from each architecture) could be dedicated to other aspects of the test.

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Table F-16 Level of Confidence that a Statistical Separation Exists in the Results (10 Trials)

		Number of Successes in 10 Trials for First Test Variable										
		0	1	2	3	4	5	6	7	8	9	10
Number of Successes in 10 Trials for Second Test Variable	0	0.0%	69.5%	**86.4%**	**94.0%**	**97.5%**	**99.0%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**
	1	69.5%	0.0%	46.9%	73.6%	**87.9%**	**94.9%**	**98.1%**	**99.4%**	**99.8%**	**100.0%**	**100.0%**
	2	**86.4%**	46.9%	0.0%	39.4%	67.1%	**84.0%**	**93.2%**	**97.5%**	**99.3%**	**99.8%**	**100.0%**
	3	**94.0%**	73.6%	39.4%	0.0%	36.1%	63.9%	**82.2%**	**92.6%**	**97.5%**	**99.4%**	**99.9%**
	4	**97.5%**	**87.9%**	67.1%	36.1%	0.0%	34.7%	62.9%	**82.2%**	**93.2%**	**98.1%**	**99.7%**
	5	**99.0%**	**94.9%**	**84.0%**	63.9%	34.7%	0.0%	34.7%	63.9%	**84.0%**	**94.9%**	**99.0%**
	6	**99.7%**	**98.1%**	**93.2%**	**82.2%**	62.9%	34.7%	0.0%	36.1%	67.1%	**87.9%**	**97.5%**
	7	**99.9%**	**99.4%**	**97.5%**	**92.6%**	**82.2%**	63.9%	36.1%	0.0%	39.4%	73.6%	**94.0%**
	8	**100.0%**	**99.8%**	**99.3%**	**97.5%**	**93.2%**	**84.0%**	67.1%	39.4%	0.0%	46.9%	**86.4%**
	9	**100.0%**	**100.0%**	**99.8%**	**99.4%**	**98.1%**	**94.9%**	**87.9%**	73.6%	46.9%	0.0%	69.5%
	10	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.0%**	**97.5%**	**94.0%**	**86.4%**	69.5%	0.0%

Table F-17 Level of Confidence that a Statistical Separation Exists in the Results (12 Trials)

		Number of Successes in 12 Trials for First Test Variable												
		0	1	2	3	4	5	6	7	8	9	10	11	12
Number of Successes in 12 Trials for Second Test Variable	0	0.0%	69.3%	**86.0%**	**93.6%**	**97.2%**	**98.8%**	**99.5%**	**99.8%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	1	69.3%	0.0%	46.3%	72.7%	**86.8%**	**94.1%**	**97.5%**	**99.1%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**
	2	**86.0%**	46.3%	0.0%	38.5%	65.4%	**82.2%**	**91.7%**	**96.5%**	**98.7%**	**99.6%**	**99.9%**	**100.0%**	**100.0%**
	3	**93.6%**	72.7%	38.5%	0.0%	34.7%	61.4%	**79.4%**	**90.2%**	**95.9%**	**98.6%**	**99.6%**	**99.9%**	**100.0%**
	4	**97.2%**	**86.8%**	65.4%	34.7%	0.0%	32.7%	59.2%	**78.1%**	**89.8%**	**95.9%**	**98.7%**	**99.7%**	**99.9%**
	5	**98.8%**	**94.1%**	**82.2%**	61.4%	32.7%	0.0%	31.8%	58.6%	**78.1%**	**90.2%**	**96.5%**	**99.1%**	**99.8%**
	6	**99.5%**	**97.5%**	**91.7%**	**79.4%**	59.2%	31.8%	0.0%	31.8%	59.2%	**79.4%**	**91.7%**	**97.5%**	**99.5%**
	7	**99.8%**	**99.1%**	**96.5%**	**90.2%**	**78.1%**	58.6%	31.8%	0.0%	32.7%	61.4%	**82.2%**	**94.1%**	**98.8%**
	8	**99.9%**	**99.7%**	**98.7%**	**95.9%**	**89.8%**	**78.1%**	59.2%	32.7%	0.0%	34.7%	65.4%	**86.8%**	**97.2%**
	9	**100.0%**	**99.9%**	**99.6%**	**98.6%**	**95.9%**	**90.2%**	**79.4%**	61.4%	34.7%	0.0%	38.5%	72.7%	**93.6%**
	10	**100.0%**	**100.0%**	**99.9%**	**99.6%**	**98.7%**	**96.5%**	**91.7%**	**82.2%**	65.4%	38.5%	0.0%	46.3%	**86.0%**
	11	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.1%**	**97.5%**	**94.1%**	**86.8%**	72.7%	46.3%	0.0%	69.3%
	12	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.8%**	**99.5%**	**98.8%**	**97.2%**	**93.6%**	**86.0%**	69.3%	0.0%

Table F-18 Level of Confidence that a Statistical Separation Exists in the Results (15 Trials)

		Number of Successes in 15 Trials for First Test Variable															
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of Successes in 15 Trials for Second Test Variable	0	0.0%	69.1%	**85.7%**	**93.2%**	**96.8%**	**98.6%**	**99.4%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	1	69.1%	0.0%	45.7%	71.7%	**85.8%**	**93.2%**	**96.9%**	**98.7%**	**99.5%**	**99.8%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	2	**85.7%**	45.7%	0.0%	37.6%	63.9%	**80.5%**	**90.1%**	**95.4%**	**98.0%**	**99.2%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
	3	**93.2%**	71.7%	37.6%	0.0%	33.4%	59.1%	**76.8%**	**87.9%**	**94.2%**	**97.5%**	**99.0%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**
	4	**96.8%**	**85.8%**	63.9%	33.4%	0.0%	31.0%	56.1%	74.4%	**86.4%**	**93.5%**	**97.2%**	**98.9%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**
	5	**98.6%**	**93.2%**	**80.5%**	59.1%	31.0%	0.0%	29.5%	54.4%	73.1%	**85.7%**	**93.2%**	**97.2%**	**99.0%**	**99.7%**	**99.9%**	**100.0%**
	6	**99.4%**	**96.9%**	**90.1%**	**76.8%**	56.1%	29.5%	0.0%	28.7%	53.6%	72.7%	**85.7%**	**93.5%**	**97.5%**	**99.2%**	**99.8%**	**100.0%**
	7	**99.7%**	**98.7%**	**95.4%**	**87.9%**	74.4%	54.4%	28.7%	0.0%	28.5%	53.6%	73.1%	**86.4%**	**94.2%**	**98.0%**	**99.5%**	**99.9%**
	8	**99.9%**	**99.5%**	**98.0%**	**94.2%**	**86.4%**	73.1%	53.6%	28.5%	0.0%	28.7%	54.4%	74.4%	**87.9%**	**95.4%**	**98.7%**	**99.7%**
	9	**100.0%**	**99.8%**	**99.2%**	**97.5%**	**93.5%**	**85.7%**	72.7%	53.6%	28.7%	0.0%	29.5%	56.1%	**76.8%**	**90.1%**	**96.9%**	**99.4%**
	10	**100.0%**	**99.9%**	**99.7%**	**99.0%**	**97.2%**	**93.2%**	**85.7%**	73.1%	54.4%	29.5%	0.0%	31.0%	59.1%	**80.5%**	**93.2%**	**98.6%**
	11	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**98.9%**	**97.2%**	**93.5%**	**86.4%**	74.4%	56.1%	31.0%	0.0%	33.4%	63.9%	**85.8%**	**96.8%**
	12	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.0%**	**97.5%**	**94.2%**	**87.9%**	**76.8%**	59.1%	33.4%	0.0%	37.6%	71.7%	**93.2%**
	13	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.2%**	**98.0%**	**95.4%**	**90.1%**	**80.5%**	63.9%	37.6%	0.0%	45.7%	**85.7%**
	14	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.8%**	**99.5%**	**98.7%**	**96.9%**	**93.2%**	**85.8%**	71.7%	45.7%	0.0%	69.1%
	15	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.4%**	**98.6%**	**96.8%**	**93.2%**	**85.7%**	69.1%	0.0%

Table F-19 Level of Confidence that a Statistical Separation Exists in the Results (16 Trials)

Number of Successes in 16 Trials for Second Test Variable	Number of Successes in 16 Trials for First Test Variable																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0.0%	69.0%	**85.6%**	**93.1%**	**96.7%**	**98.5%**	**99.3%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
1	69.0%	0.0%	45.6%	71.5%	**85.6%**	**93.0%**	**96.7%**	**98.6%**	**99.4%**	**99.8%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
2	**85.6%**	45.6%	0.0%	37.4%	63.5%	**80.0%**	**89.8%**	**95.1%**	**97.8%**	**99.1%**	**99.7%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
3	**93.1%**	71.5%	37.4%	0.0%	33.1%	58.6%	**76.2%**	**87.3%**	**93.7%**	**97.2%**	**98.8%**	**99.6%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
4	**96.7%**	**85.6%**	63.5%	33.1%	0.0%	30.6%	55.4%	73.6%	**85.6%**	**92.8%**	**96.7%**	**98.7%**	**99.5%**	**99.9%**	**100.0%**	**100.0%**	**100.0%**
5	**98.5%**	**93.0%**	**80.0%**	58.6%	30.6%	0.0%	29.0%	53.5%	72.0%	**84.6%**	**92.3%**	**96.6%**	**98.7%**	**99.6%**	**99.9%**	**100.0%**	**100.0%**
6	**99.3%**	**96.7%**	**89.8%**	**76.2%**	55.4%	29.0%	0.0%	28.1%	52.4%	71.2%	**84.3%**	**92.3%**	**96.7%**	**98.8%**	**99.7%**	**99.9%**	**100.0%**
7	**99.7%**	**98.6%**	**95.1%**	**87.3%**	73.6%	53.5%	28.1%	0.0%	27.7%	52.0%	71.2%	**84.6%**	**92.8%**	**97.2%**	**99.1%**	**99.8%**	**100.0%**
8	**99.9%**	**99.4%**	**97.8%**	**93.7%**	**85.6%**	72.0%	52.4%	27.7%	0.0%	27.7%	52.4%	72.0%	**85.6%**	**93.7%**	**97.8%**	**99.4%**	**99.9%**
9	**100.0%**	**99.8%**	**99.1%**	**97.2%**	**92.8%**	**84.6%**	71.2%	52.0%	27.7%	0.0%	28.1%	53.5%	73.6%	**87.3%**	**95.1%**	**98.6%**	**99.7%**
10	**100.0%**	**99.9%**	**99.7%**	**98.8%**	**96.7%**	**92.3%**	**84.3%**	71.2%	52.4%	28.1%	0.0%	29.0%	55.4%	**76.2%**	**89.8%**	**96.7%**	**99.3%**
11	**100.0%**	**100.0%**	**99.9%**	**99.6%**	**98.7%**	**96.6%**	**92.3%**	**84.6%**	72.0%	53.5%	29.0%	0.0%	30.6%	58.6%	**80.0%**	**93.0%**	**98.5%**
12	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.5%**	**98.7%**	**96.7%**	**92.8%**	**85.6%**	73.6%	55.4%	30.6%	0.0%	33.1%	63.5%	**85.6%**	**96.7%**
13	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.6%**	**98.8%**	**97.2%**	**93.7%**	**87.3%**	**76.2%**	58.6%	33.1%	0.0%	37.4%	71.5%	**93.1%**
14	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.1%**	**97.8%**	**95.1%**	**89.8%**	**80.0%**	63.5%	37.4%	0.0%	45.6%	**85.6%**
15	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.8%**	**99.4%**	**98.6%**	**96.7%**	**93.0%**	**85.6%**	71.5%	45.6%	0.0%	69.0%
16	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**99.9%**	**99.7%**	**99.3%**	**98.5%**	**96.7%**	**93.1%**	**85.6%**	69.0%	0.0%

Table F-20 Level of Confidence that a Statistical Separation Exists in the Results (17 Trials)

		Number of Successes in 17 Trials for First Test Variable																	
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Number of Successes in 17 Trials for Second Test Variable	0	0.0%	69.0%	85.5%	93.0%	96.7%	98.5%	99.3%	99.7%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1	69.0%	0.0%	45.5%	71.3%	85.4%	92.8%	96.6%	98.5%	99.3%	99.7%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	2	85.5%	45.5%	0.0%	37.2%	63.2%	79.7%	89.4%	94.8%	97.6%	99.0%	99.6%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	3	93.0%	71.3%	37.2%	0.0%	32.9%	58.1%	75.6%	86.8%	93.3%	96.9%	98.7%	99.5%	99.8%	99.9%	100.0%	100.0%	100.0%	100.0%
	4	96.7%	85.4%	63.2%	32.9%	0.0%	30.3%	54.8%	72.9%	84.9%	92.2%	96.3%	98.4%	99.4%	99.8%	99.9%	100.0%	100.0%	100.0%
	5	98.5%	92.8%	79.7%	58.1%	30.3%	0.0%	28.6%	52.7%	71.0%	83.7%	91.6%	96.1%	98.4%	99.4%	99.8%	100.0%	100.0%	100.0%
	6	99.3%	96.6%	89.4%	75.6%	54.8%	28.6%	0.0%	27.6%	51.4%	70.0%	83.1%	91.4%	96.1%	98.4%	99.5%	99.9%	100.0%	100.0%
	7	99.7%	98.5%	94.8%	86.8%	72.9%	52.7%	27.6%	0.0%	27.0%	50.8%	69.7%	83.1%	91.6%	96.3%	98.7%	99.6%	99.9%	100.0%
	8	99.9%	99.3%	97.6%	93.3%	84.9%	71.0%	51.4%	27.0%	0.0%	26.8%	50.8%	70.0%	83.7%	92.2%	96.9%	99.0%	99.7%	100.0%
	9	100.0%	99.7%	99.0%	96.9%	92.2%	83.7%	70.0%	50.8%	26.8%	0.0%	27.0%	51.4%	71.0%	84.9%	93.3%	97.6%	99.3%	99.9%
	10	100.0%	99.9%	99.6%	98.7%	96.3%	91.6%	83.1%	69.7%	50.8%	27.0%	0.0%	27.6%	52.7%	72.9%	86.8%	94.8%	98.5%	99.7%
	11	100.0%	100.0%	99.9%	99.5%	98.4%	96.1%	91.4%	83.1%	70.0%	51.4%	27.6%	0.0%	28.6%	54.8%	75.6%	89.4%	96.6%	99.3%
	12	100.0%	100.0%	100.0%	99.8%	99.4%	98.4%	96.1%	91.6%	83.7%	71.0%	52.7%	28.6%	0.0%	30.3%	58.1%	79.7%	92.8%	98.5%
	13	100.0%	100.0%	100.0%	99.9%	99.8%	99.4%	98.4%	96.3%	92.2%	84.9%	72.9%	54.8%	30.3%	0.0%	32.9%	63.2%	85.4%	96.7%
	14	100.0%	100.0%	100.0%	100.0%	99.9%	99.8%	99.5%	98.7%	96.9%	93.3%	86.8%	75.6%	58.1%	32.9%	0.0%	37.2%	71.3%	93.0%
	15	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.6%	99.0%	97.6%	94.8%	89.4%	79.7%	63.2%	37.2%	0.0%	45.5%	85.5%
	16	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.7%	99.3%	98.5%	96.6%	92.8%	85.4%	71.3%	45.5%	0.0%	69.0%
	17	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.7%	99.3%	98.5%	96.7%	93.0%	85.5%	69.0%	0.0%

ANNEX G COMMAND AND CONTROL ARCHITECTURES

G.1 INTRODUCTION

The JTF will test and evaluate potential JTTP by evaluating the impact of alternative C2 architectures on JUAV mission accomplishment during TSO. The JTF will use the three alternative C2 architectures developed in the JFS while leaving open the option to develop additional architectures if needed. The architectures represent different levels of centralized and decentralized operations and will be compared to determine what may be gained or lost by pushing decision-making forward under specific circumstances. The architectures and supporting JTTP will be assessed independently to determine which JTTP will optimize the implementation and functionality of each C2 architecture. Specific JTTP will change for each C2 architecture. All C2 architectures will contain the same set of basic elements as listed below:

- A Joint C2 node, such as a JAOC
- A forward Tactical C2 node, such as an E-2, an E-3, or a FAC-A
- A GCS for the UAV
- One or more WDPs or RPs

G.2 JUAV C2 ARCHITECTURE COMPONENTS

The JUAV C2 architecture components are the common elements and nodes that the JUAV JTF will apply to the three alternative architectures and to any architectural variations that evolve during testing. These components, displayed in Figure G-1, allow the JTF to focus on the specific skills and experiences associated with each node. The components form a framework for the JTF to concentrate on the JTTP (when they exist) for each of the nodes and areas of responsibility.

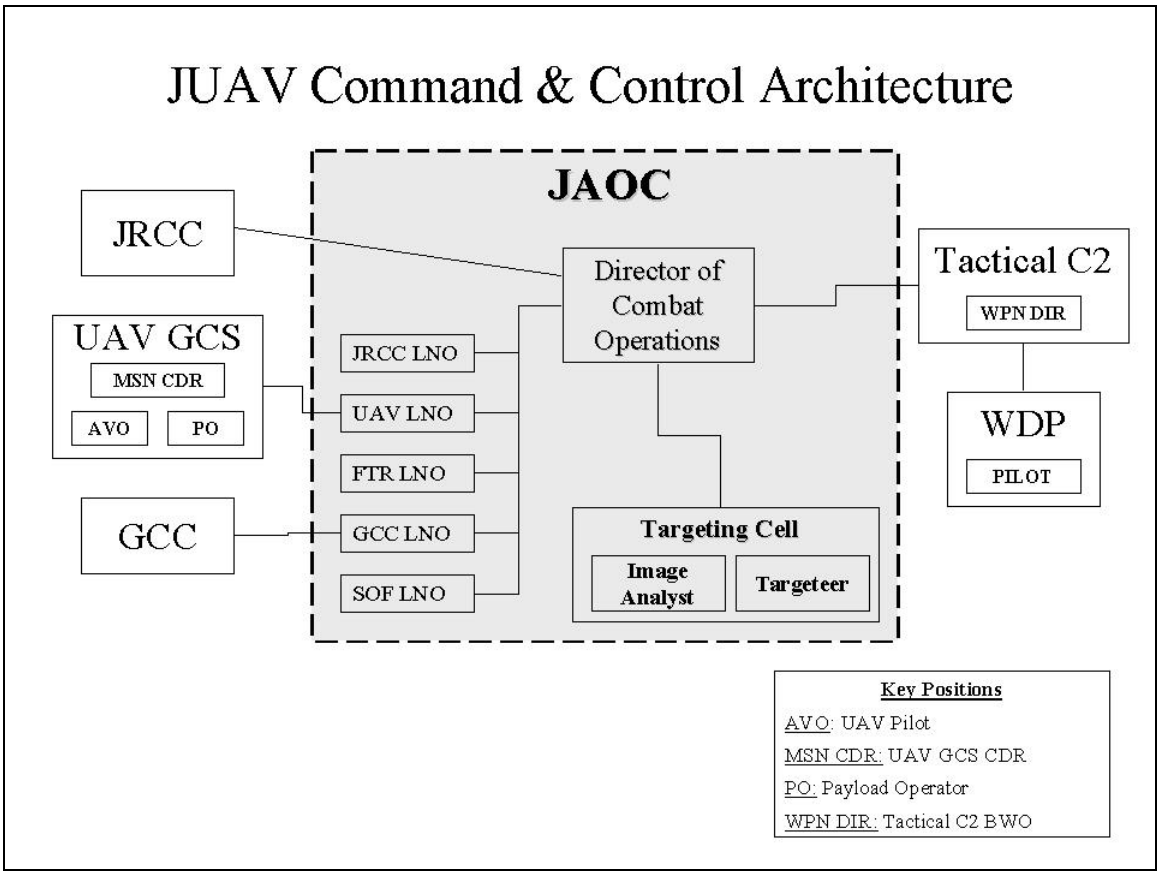

Figure G-1 JUAV C2 Architecture Components

G.3 THE BATTLE WATCH OFFICER

An important distinguishing feature of the different architectures is the location of the "Battle Watch Officer (BWO)," a generic term for the person who performs the BWF. The BWF are the skills, experience, and situational awareness, which are required for the person who has decision-making authority with respect to target engagements on a tactical level. Different Services use different titles and nomenclature for the person performing the BWF, and the JTF has decided to use a generic title, BWO, to support all scenarios. In addition to performing normal BWF, the BWO has the following responsibilities:

- Asset Management
- Engagement Priorities
- Airspace Management
- Airspace Integration
- Engagement Decisions

For JUAV JT&E purposes, only the last two areas of responsibility (those in the box) are transferred from the Joint C2 node forward to the Tactical C2 node (Architecture B) or the GCS (Architecture C). The remaining areas are retained at the Joint C2 node.

Joint Publication 1-02 defines airspace management as "the coordination, integration, and regulation of the use of airspace of defined dimensions." Airspace integration is therefore part of airspace management. For JUAV JT&E purposes, airspace integration is defined as actions conducted to ensure that multiple aircraft or weapons operate safely in a confined airspace in order to accomplish a common mission or task. This includes, for example, UAV laser designation of targets for a WDP or a GCS crewman talking an aircraft onto a target. In both cases, the UAV and the WDP need to operate in the target area to accomplish their common mission and need to do so safely. The Joint C2 node retains general responsibility for airspace integration of its assigned battlespace but routinely delegates local airspace integration to, for example, flights of fighter or attack aircraft. Airspace integration does not include airspace coordination (issuance of the airspace coordination order, establishing frequencies for communications, defining specific airspace procedures, etc.) or airspace regulation (ensuring and enforcing written rules for dividing-up the airspace and its use). Regulation and coordination will not be addressed in this JT&E.

The BWF assigned to the different nodes in each architecture are not necessarily generally applied across the theater but cover engagement decision and airspace integration for the operational integration of the UAV in the tactical situation.

The JTF makes two key assumptions about the BWO: first, the Joint Force Commander has placed the UAV in a tactical role and at the disposal of the BWO, and second, the BWO has been provided an approved target list to engage and the targets in the test are on that list.

G.4 ALTERNATIVE C2 ARCHITECTURE A

Alternative C2 Architecture A is defined by having the C2 node (JAOC or equivalent) act as the BWO. The GCS is in contact with the Joint C2 node. The Joint C2 node is also in contact with the forward Tactical C2 node, which in turn is in contact with the WDPs. Target acquisition is conducted by UAV video tracking the target. The video is data-linked back to the targeting cell in the Joint C2 node for processing. Target identification and target coordinate determination occurs. Target identification is passed to the BWO in the Joint C2 node. The BWO allocates a WDP. Airspace integration procedures are employed, with the UAV continuing to provide video of the target, while the WDP engages the target. Figure G-2 depicts the C2 relationships established for Architecture A.

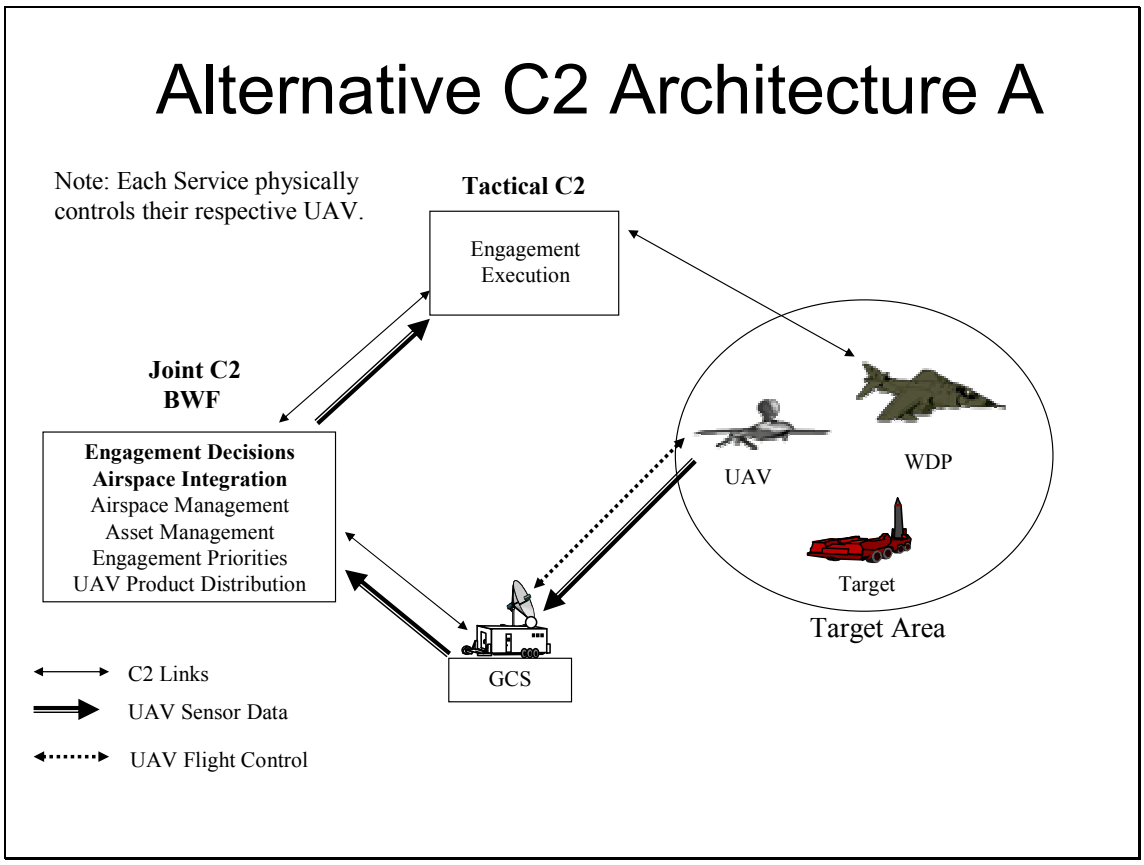

Figure G-2 Alternative C2 Architecture A

G.5 ALTERNATIVE C2 ARCHITECTURE B

Alternative C2 Architecture B is defined by having the forward Tactical C2 node act as the BWO at least for UAV integration into the tactical situation. This requires establishing communication between the forward Tactical C2 node and the GCS. The UAV acquires the target with video, which is transmitted to the BWO and the Joint C2 node. The BWO determines the target identification and its coordinates. The Joint C2 node retains the ability to direct the BWO or overrule as needed. The BWO allocates a WDP. Airspace integration procedures are employed, with the UAV continuing to provide video of the target, while the WDP engages the target.

The Tactical C2 node directly controls the WDP assigned to respond to the target area serviced by the UAV. In this architecture, as in Alternative C2 Architecture C, the BWO does not necessarily have engagement authority over the entire battlespace, but the BWO is charged with engagement authority over a limited portion of that space.

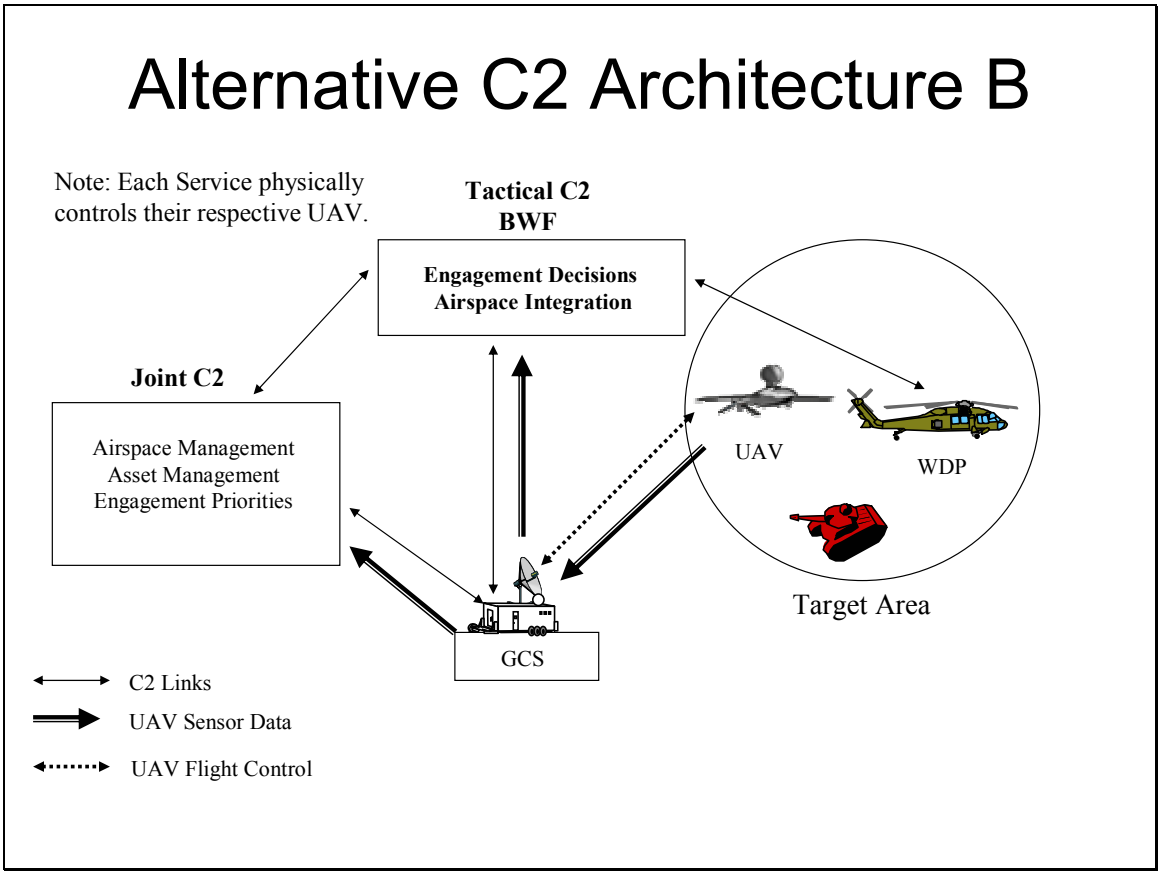

Figure G-3 Alternative C2 Architecture B

G.6 ALTERNATIVE C2 ARCHITECTURE C

Alternative C2 Architecture C (Figure G-4) is defined by having the GCS act as the BWO for operations that integrate the UAV into the tactical situation. This architecture combines the forward Tactical C2 node and the GCS into a single entity. A similar tactical flow occurs. The UAV acquires the target in its video. The target identification and coordinate determination are conducted at the GCS. The BWO receives the target identity directly and allocates the WDP. Airspace integration procedures are employed while the WDP engages the target and is supported by the UAV. This configuration provides tightly coupled C2 of both the UAV and the WDP assigned to respond to the target area serviced by the UAV. The Joint C2 node is informed and may influence the action.

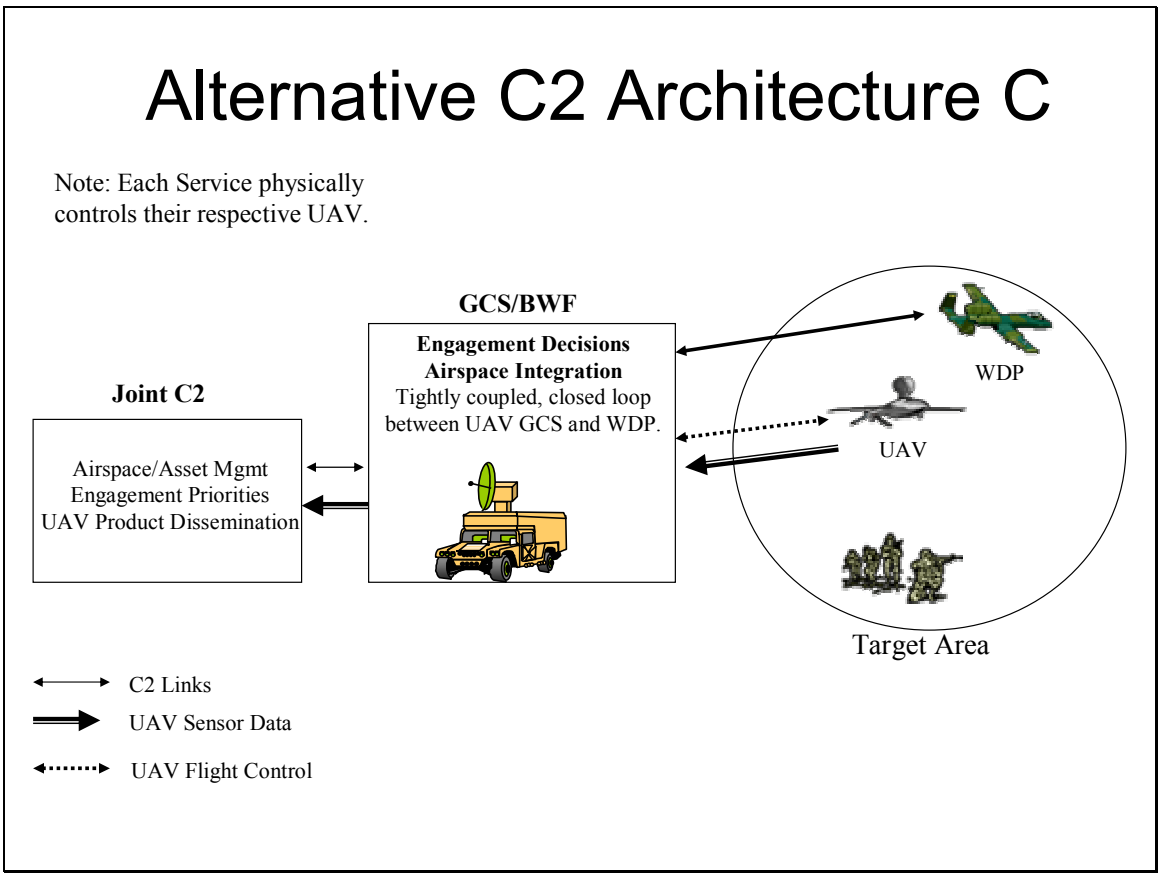

Figure G-4 Alternative C2 Architecture C

G.7 OTHER POSSIBLE ARCHITECTURES

C2 Architectures A, B, and C represent three basic configurations that depend on the node exercising BWF for UAV integration into the tactical situation. Each will have variations in terms of communications links and critical paths.

In the process of the JT&E, the JTF will consider other architectures should they appear. For example, if two variants of Architecture B emerge as different and significant, the JTF reserves the option of defining one as a new Architecture D for test purposes. Therefore, the JTF is focusing on three quite different architectures and are keeping open the possibility of others.

The JTF will build on the alternatives to address nuances that may result from various mission needs, UAV payloads, weapon systems, weapons, weapon delivery methodologies, communications systems and platforms, control relationships, and command structures. The field tests will exercise the proposed alternatives under realistic operational conditions and will generate data to evaluate the proposed JTTP inputs. The tests will be conducted in a DoD-approved scenario and with DIA-approved threat data, options for various levels of "Blue" response, DoD-approved ROE, and objectives for both "Blue" and threat forces.

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ANNEX H SECURITY PLAN

This security plan describes basic security policies that must be adhered to by all government agencies, organizations, contractors, and individuals assigned to the JUAV JT&E. The JTF will safeguard all classified information in accordance with DoD Directive 5200.1-R, *DoD Information Security Program*. This plan does not cover handling, control, storage, or discussion of SCI or Special Access Required information. The JTF will follow the appropriate guidance as required for those programs. This plan discusses all aspects of information security as applicable to the JUAV JT&E and lists the references that govern security matters.

H.1 CONFLICT RESOLUTION

The JUAV Security Manager (SM), in coordination with the JTD, will resolve conflicts between this security plan and other security directives. The most restrictive requirement will prevail until the matter is resolved. The JTF will protect government interests and the security of the project from compromise.

H.2 RESPONSIBILITIES

Table H-1 outlines the principal security responsibilities of the JTD and the SM.

Table H-1 JTD and SM Responsibilities

Title	Responsibilities
Joint Test Director (JTD)	The JTD directs all programmatic, government, and contractor activities associated with the JT&E. The JTD appoints in writing the: Security Manager Alternate Security Manager OPSEC Officer COMSEC Point of Contact (POC)
Security Manager (SM)	The SM: Provides advice and assistance to the JTD. Appoints a security container custodian for each container. Ensures security requirements are implemented and followed. Conducts a JUAV self-inspection at a minimum of once a year. Establishes and administers a continuing security education program.

The JTD has delegated day-to-day responsibility for JUAV security management to the SM. Interested parties should appropriately classify and address all inquiries concerning interpretation of Table H-1 to the following:

JUAV Security Manager

4755 Pasture Road, Bldg 304

NAS Fallon, NV 89496-5000

Phone: DSN 890-4683 COMM (775) 426-4683

H.3 SECURITY OF CLASSIFIED INFORMATION

Access to classified or sensitive JUAV information will be restricted to those individuals who have a verified security clearance on file and a signed Standard Form (SF) 312. All JUAV personnel must be knowledgeable of the information to perform their duties in accordance with DoD "need-to-know" policies. The JTF will not disclose information to an individual that is not required for the performance of the individual's job.

H.3.1 Media Classification

The JTD is the JUAV JT&E security classification authority. Materials may also be classified by original classification authorities or by derivative authority. Media provided by other organizations in support of JUAV JT&E testing are classified in accordance with the originating organization's applicable security classification guides and regulations. The SM is responsible for reviewing classified documents or media items generated by the JTF for appropriate classification levels. The JUAV JT&E Security Classification Guide (SCG) will be the guidance for conducting and documenting all briefings, reports, and discussions.

H.3.2 Accountability and Storage of Classified Media

DoD and contractor organizations will handle classified and sensitive materials in accordance with DoD Directive 5200.1-R. Table H-2 provides additional instructions.

Table H-2 Accountability and Storage Instructions

Marking
The marking of classified documents warns the holder about the classification of information involved and indicates the degree of protection required. Holders must mark all documents in accordance with DoD Directive 5200.1-R or DoD Directive 5200.1-PH, *A Guide for Marking Classified Documents.* For guidance on marking Working Papers, reference DoD Directive 5200.1-R, Paragraph 6-101.
Storage
The JTF will store classified material in a General Services Administration (GSA)-approved security container, a secure storage room, or vault. The JTF will not store high value and other items susceptible to theft in a container with classified material. The SM will establish procedures implementing guidelines on security containers. Custodians will change container combinations in accordance with DoD Directive 5200.1-R, Paragraph 6-404. The SF 700, posted inside the locking drawer, will contain the names of the container custodian and any alternates. The SF 702, posted on the outside of each security container, will indicate each time the container is opened and closed. The SM will inspect the use of these forms for compliance with applicable guidelines.

Freedom of Information Act (FOIA) Requests
The JUAV FOIA official, appointed by the JTD, will process all FOIA requests strictly in accordance with DoD Directive 5400.7-R, *DoD Freedom of Information Act Program*.
Transmission
The JTF may transmit classified information only in the manner described in Chapter 7 of DoD Directive 5200.1-R. Receipts are required when mailing SECRET material. A receipt is not required when there is a hand-to-hand transfer between US cleared personnel and the recipient verbally acknowledges responsibility for the SECRET information. CONFIDENTIAL information does not require a receipt unless the originator requests it. The JTD will appoint personnel, in writing, who are authorized to receive certified and registered mail. The JTF will handle all unopened registered, certified, and first-class mail and Fed Ex and Emory Air Freight Service packages as classified information at the SECRET level.
Hand-carrying Classified On and Off Base
All personnel hand-carrying classified material outside their work area must have received prior approval, authorization, and a courier briefing. Any time government employees hand-carry classified material within the local area, they must have on their person a DD Form 2501, Courier Authorization Card. Contractor personnel who hand-carry classified material must have been appointed, in writing, as a Classified Material Courier by the contractor. If the individual will be going through a non-DoD checkpoint or flying on a commercial plane, he or she must also have a Courier Authorization Letter and an Exemption Notice. The SM will keep a detailed list of all material being hand-carried from the facility.
Reproduction of Classified Material
All authorized personnel assigned to JUAV may reproduce classified material. The SM will ensure each JUAV copier carries an annotation of whether it is approved for reproduction of classified material. Any JTF member who reproduces classified material will: For a NATO document, annotate the original document to reflect the number of copies made and the recipient to which each copy is distributed. The individual copies must be annotated with the copy number (e.g., Copy 1 of 3, Copy 2 of 3, etc.). Ensure the copier used carries an annotation indicating that it is approved for reproduction of classified material. Run at least two unclassified sheets of paper through the copier after reproducing classified material and destroy the sheets by a method approved for destruction of the original classified material.
Destruction of Classified Material
When it is no longer needed, JUAV personnel will dispose of all classified information by shredding the material using the JUAV shredder after notifying the SM who will remove it from the JUAV classified materials log with the date it was removed from inventory and its disposition. Only one person is required to witness the destruction of SECRET or CONFIDENTIAL material. The destroyer must be an appropriately cleared employee. The destroyer must be briefed in destruction procedures and possess a full understanding of his or her responsibilities. No record of destruction or destruction certificate is required when SECRET or CONFIDENTIAL material is destroyed.

For Official Use Only (FOUO)
FOUO is not a security classification. During working hours, JUAV personnel will store FOUO out-of-sight if the information is accessible to persons who do not have a need for the information. During non-working hours, JUAV personnel will store FOUO material in a locked office, file cabinet, desk, or bookcase. Unauthorized disclosure of FOUO information does not constitute a security violation, but the releasing agency should be informed of any unauthorized disclosure. The unauthorized disclosure of FOUO information, protected by the Privacy Act, may result in criminal sanctions. Shred or burn FOUO material when no longer needed.
Public Release
Public release of classified and unclassified information is not authorized without the direct written authority of the JTD in coordination with the JT&E Program Office. Although information may be unclassified, it should not be automatically released to the public. Approval for public release does not satisfy the export licensing requirements of the Departments of State and Commerce. Contractors are not authorized to release information to the public.

H.3.3 Emergency Protection of Classified Material

In case of fires and natural disasters, if time permits, JUAV staff will store classified material in any available security container within the immediate work area. Personnel will not risk injury or the loss of life to secure classified material. If classified material cannot be secured, the holder will secure the classified material on his or her person and evacuate the affected area immediately. The holder will keep the classified material with him or her until an approved container can be found. Under no circumstance will the holder leave classified material unattended or transport it to the holder's living quarters. Immediately following the emergency, personnel will return to their work areas and check for any unsecured classified information.

H.3.4 Security Incidents

Any person who has knowledge of a suspected security incident must immediately report such facts to the JTD or SM. The person discovering a suspected incident is responsible for protecting all classified material involved until it is properly safeguarded. The JTD or the SM will assess whether an incident has occurred and who was the likely person responsible. Upon determination that an incident has occurred, the JTD will appoint a neutral party, of equal or higher rank to the person responsible, to conduct a preliminary inquiry in accordance with DoD Directive 5200.1-R, Chapter 1, Section 5.

H.3.5 Courier Responsibilities

The JTD or a delegated representative authorizes, in writing, individual official couriers to transport classified JUAV JT&E materials. The SM will designate military and DoD civilian couriers in writing and brief them on their responsibilities. Contractor couriers will be designated in writing by their parent company. Classified materials are processed in accordance with the JUAV JT&E security plan and local directives. Courier letters, contractor authorization cards, or DD Form 2501 (DoD Courier Authorization Card) are required for each individual designated to hand carry classified documents. Before transporting classified material aboard a commercial carrier, the following criteria must be met:

(1) A rare and unusual situation must exist.

(2) The necessary classified documents are not available at the traveler's destination.

(3) No other method of transmission meets the existing requirement in a timely manner.

H.4 PHYSICAL SECURITY

The JUAV SM is responsible for coordinating all physical security requirements. Classified material will be stored in approved security containers.

In accordance with DoD directives, the SM will establish and administer a continuing security education program to include initial and annual refresher briefings for all JUAV personnel. The department heads have the responsibility to make sure employees are aware of and understand the security requirements to accomplish their jobs. Contractors will also receive security training from the JUAV SM.

H.4.1 Restricted-Area Security

The JUAV closed storage area is located in the JUAV conference room in Building 304 at NASF. This room is an authorized secure area for storage of collateral classified information up to and including SECRET. The JUAV classified computers will be located in this area. The room door must be shut and locked when the area is left unattended during duty hours.

H.4.2 Personnel Security

The SM will process and handle all collateral personnel security matters in accordance with DoD Directive 5200.2-R, *DoD Personnel Security Program*.

The SM will keep an updated list of all JUAV contractors and military and civilian government employees. This list will include the following information on each individual:

- Full name
- Social Security Number
- Date and place of birth
- Type of investigation and date
- Clearance level
- Date clearance granted and granting agency

It is each JUAV member's responsibility to notify the SM or JTD when unfavorable information is revealed that could have a direct impact upon an individual's security clearance. The JTD will review, evaluate, and consider the disqualifying factors as outlined in DoD Directive 5200.2-R, *DoD Personnel Security Program, Chapter VIII and Appendix 1*. If the JTD determines it appropriate, he will direct a report be sent to the appropriate DoD or contractor security clearance center. The JTD will suspend the individual's access to classified information until the incident has been favorably adjudicated. If the individual has an SCI clearance, the JTF will send the report to the JT&E Special Security Office (SSO) located at Kirtland AFB, NM.

H.4.3 Incoming and Outgoing Visits

The JTD or the SM approves all visits by government and contractor employees. All contractors permanently or temporarily assigned to the JUAV JT&E must have a visit request on file with the JUAV office. Each visit request must include the following:

- Full name
- Title
- Date and place of birth
- Citizenship
- Type of investigation and date
- Clearance
- Date granted and granting agency
- The reason for the visit
- Dates of the visit, which may be up to one year
- Name and telephone number of the person being visited

Contractor visit requests must meet the requirements of DoD Directive 5220.22-M, *Industrial Security Manual*. The following is a list of DoD requirements:

(1) Each visit must be pre-announced by mail or facsimile.

(2) Each visit request must be on company letterhead and a government or company official must sign it.

(3) The individual on the visit request cannot sign his or her own request.

(4) Hand-carried visit requests are not acceptable.

The SM will keep a copy of both incoming and outgoing visit requests for at least 12 months after the request has become invalid. The Security Office is the sole focal point for receiving, transmitting, and filing visit requests. Personnel should contact the SM at least ten duty days prior to going TDY. The SM will confirm that a visit request is on file and is valid, or a new one will be sent. The JTD and his appointees are authorized to sign visit requests. Contractor employees will go through their Facility Security Officer (FSO) when visiting another contractor's facility. Subcontractors must first go through their prime contractor.

H.5 OPERATIONS SECURITY

Operations Security (OPSEC) is the process of denying adversaries information about friendly capabilities and intentions by identifying, controlling, and protecting indicators associated with the planning and conducting of military operations and other activities. OPSEC is directed toward the protection of unclassified intelligence indicators to preserve the security integrity of programs, projects, and evaluations.

H.5.1 OPSEC Training

All JUAV personnel will be sensitive to OPSEC issues. The SM will assess the need for any overall JUAV OPSEC procedures and will make appropriate recommendations to the JTD. The JTD will determine which OPSEC procedures to implement. Every JUAV test will be assessed to determine the need for and establish any required OPSEC procedures peculiar to that test. The SM will provide assistance as needed.

In accordance with DoD directives, the SM will establish and administer an OPSEC education program to include initial and annual refresher briefings for all JUAV personnel. The department heads

have the responsibility to make sure employees are aware of and understand the security requirements to accomplish their jobs. Contractors will also receive security training from the JUAV SM.

H.5.2 Foreign Disclosure

Personnel assigned to the JUAV JT&E program shall not disclose classified information to foreign persons unless the release of the information is authorized, in writing, by the Government Agency having classification jurisdiction over the information involved. Any disclosure of such information must also be consistent with applicable U.S. laws and regulations.

All personnel must report personal travel to designated countries in advance. Personnel traveling overseas must receive a foreign travel briefing by the SM unless they are traveling to a high threat area. Individuals traveling to a high threat area will be briefed prior to travel and debriefed upon completion of travel by the NSAWC SM.

H.5.3 Essential Elements of Friendly Information

Information that may potentially be available to an adversary is listed as Essential Elements of Friendly Information (EEFI). Often, such information is generally unclassified; however, it is sensitive information that should be safeguarded.

EEFI are those items of sensitive information that are vulnerable to enemy exploitation. Personnel must be aware of specific information that could or would potentially be damaging to the mission if discussed outside of secure areas or by non-secure means. Information that JUAV JT&E personnel need to protect to avoid adversary collection includes, but is not limited to, planning and analysis, operating limitations, battlefield procedures and equipment, units participating in testing, numbers and names of personnel assigned to JUAV, branches of Service, information on visiting personnel or personnel going on temporary duty, security to encompass personnel security clearances, facility capabilities or limitations, emergency procedures, and any computer or other communications equipment to include upgrades of such equipment.

H.6 COMMUNICATIONS SECURITY

The Communications Security (COMSEC) account for NASF is overseen by NSAWC. Automated media and administrative equipment used by the JUAV JT&E to process classified information must comply with emission security requirements. The JUAV SM will be responsible for coordinating COMSEC requirements with NSAWC. Additionally, it is the responsibility of each JUAV JT&E member to be aware of the use of “open” telephone lines and unsecured computers.

H.6.1 Secure Telephone Unit III

JUAV STU III accountability resides with the NSAWC COMSEC account. NSAWC is responsible for conducting semiannual COMSEC inspections. The JUAV COMSEC POC is responsible for controlling the JUAV STU III and its key. All JUAV personnel will comply with the following guidelines for using a STU III:

(1) Ensure the phone is in the secure mode prior to discussing classified or sensitive information over the phone.
(2) Talk only to the level displayed on the phone (even if both parties have a higher clearance).
(3) Remove the key after use.
(4) Do not leave the key in the phone while it is unattended. (The phone is classified to the level it has been keyed when it is unattended.)

(5) Do not allow non-cleared individuals to handle the key or to use the phone when the key is inserted.
(6) Ensure all personnel in the area are cleared to the level of discussion and have the need to know when talking in the secure mode.

H.6.2 Facsimile of Classified Information

All JUAV personnel will comply with the following guidelines for facsimile use of the classified information STU:

(1) Use only a facsimile machine matched with a converter interface connected to a STU III.
(2) Ensure the STU III is in the secure mode before the process starts.
(3) Send a receipt with the classified document for the recipient to facsimile or mail back acknowledging the receipt of the document for SECRET information. A receipt is not required for CONFIDENTIAL information.

H.7 REFERENCES

The following is a partial list of references pertinent to the JUAV JT&E security program:

- Executive Order 12333, *United States Intelligence Activities*
- Executive Order 12958, *National Security Information*
- National Security Decision Directive #298, *Operations Security*
- DoD Directive 5000.1, *Defense Acquisition*
- DoD Directive 5200.1-I, *DoD Index of Security Classification Guides*
- DoD Directive 5200.1-PH, *A Guide for Marking Classified Documents*
- DoD Directive 5200.1-R, *DoD Information Security Program*
- DoD Directive 5200.2-R, *DoD Personnel Security Program*
- DoD Directive 5200.12, *Policy on the Conduct of Meetings Involving Access to Classified Information*
- DoD Directive 5205.2, *DoD Operations Security Program*
- DoD Directive 5220.22-M, *Industrial Security Manual*
- DoD Directive 5400.7-R, *DoD Freedom of Information Act Program*
- DoD Directive C-5230.23, *Intelligence Disclosure Policy*
- DoD Manual 5000.2-M, *Defense Acquisition Management Documentation and Reports*
- JCS Publication 3-54, *Joint Doctrine for Operations Security*
- National Industrial Security Program Operating Manual (NISPOM)

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