ABSTRACT

The Joint Theater Level Simulation (JTLS®) is an interactive, computer-based, multi-sided wargaming system that models combined joint and coalition resource air, land, naval, and Non-Governmental Organization (NGO) environments.

The JTLS Executive Overview provides a survey of JTLS programmatic history, software, standard hardware, and functional capabilities.

The JTLS system consists of six major programs and numerous smaller support programs that inter-operate to prepare the scenario, run the simulation, and analyze the results. Designed as a tool for use in the development and analysis of operations, or operational and contingency plans, the simulation is theater-independent and does not require a knowledge of programming to execute. JTLS can operate on one or several computers, either at single or multiple distributed sites, depending on the training or analysis environment and size of the scenario.

JTLS features include Lanchester attrition algorithms, detailed logistic modeling, and explicit air, ground, and naval force movement. The JTLS system includes software designed to aid in scenario database preparation and verification; entering simulation orders; and obtaining scenario situational information from graphical map displays, messages, and status boards.

This publication is updated and revised as required for each Major or Maintenance version release of the JTLS model. Corrections, additions, or recommendations for improvement must reference specific sections, pages, and paragraphs with appropriate justification and be forwarded to:

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APPENDIX B. JTLS OPERATING EQUIPMENT ........................................................................ B-1
EXECUTIVE SUMMARY

ES.1 Introduction
The Joint Theater Level Simulation (JTLS®) is an interactive, Internet-enabled, computer based simulation that models multi-sided air, ground, and naval civil-military operations with logistical, Special Operation Force (SOF), and intelligence support. JTLS development began in 1983 as a project funded by the U.S. Readiness Command, the U.S. Army Concepts Analysis Agency, and the U.S. Army War College. The simulation was originally designed as a tool for development and analysis of joint and combined (coalition) operations plans. Today, JTLS is frequently used as a training support model that is theater-independent and does not require a knowledge of programming to operate effectively.

The primary focus of the JTLS system is conventional joint and combined operations at the Operational Level of War as defined by the Joint Staff’s Universal Joint Task List. JTLS explicitly models air, land, sea, amphibious, and SOF operations. The simulation supports limited nuclear and chemical effects, low-intensity conflict, pre-conflict operations, and support of Humanitarian Assistance and Disaster Relief (HA/DR) operations.

ES.2 Force Composition
All processes are designed to support doctrine-neutral implementation for maximum flexibility. The simulation represents units and targets as basic entities. The user-configurable database defines unit types and sizes, combat systems, supply categories, and militarily significant targets to be represented. Small units (High Resolution Units, or HRUs) and target systems complement the more aggregated unit structure. Each scenario database can be developed to represent the requisite detail for systems of interest within this unit structure.

The complete spectrum of multi-sided coalition air, land, sea, and SOF forces can be represented. The model also supports the representation of civilian and non-combatant forces within sectors of interest. A maximum of ten Force Sides can be represented, and each Side can be divided further into an unlimited number of Factions. A Faction’s Side allegiance is dynamically changeable during scenario execution. Side relationships are asymmetric and can also be dynamically modified. Side names, Faction names, and the symbols used to display the assets belonging to a Side are user-configurable within the database.

ES.3 Basic Operations
Air-to-air operations can include individual missions and/or aggregate, multi-sided mission packages. Air engagements are adjudicated stochastically at the object level, using probability of engagement (pE), probability of hit (pH) and probability of kill (pK) factors defined in the database. Repair time for damaged aircraft, as well as routine maintenance downtime, are represented.

Surface-to-air defense operations are represented at the object level using pE and pK data. Integrated air defense systems linking air defense sites, communications centers, radar sites and AWACS aircraft are represented. Adjudication is stochastic.

Air-to-ground weapons, surface-to-surface missiles (ballistic and cruise), and artillery (including naval gunfire support) operations are modeled at the object level. Adjudication algorithms use pH and pK for precision-guided munitions and target density functions for area weapon coverage. Adjudication of precision-guided munitions is stochastic while area weapon results are deterministic.
The land warfare module uses Lanchester attrition methodology to aggregate the effects of direct fire weapons and direct support systems not engaged in explicit fire support operations. Adjudication is deterministic.

Naval representations include ship based cruise and ballistic missiles, torpedoes, mine and counter-mine operations, submarine and antisubmarine operations, naval gunfire, sea based air (fixed wing, helicopter and UAV), supply sealift, and coalition amphibious operations.

ES.4 Input
JTLS recognizes relevant terrain, weapons, movement, attrition tables, unit characteristics, and Time-Phased Force Deployment Data (TPFDD) information as input. No data elements are hard-coded; therefore, creating a completely new database is complex and time-consuming. A Standard Database that includes several reusable modules is delivered with the JTLS software suite. Estimated time to develop a new database is six to eight months, but development for a scenario that uses the delivered database is approximately four weeks, depending on the availability of Order of Battle (OB) information. Easy to use database development and modification tools are part of the JTLS delivery suite.

Terrain is an extremely important aspect of the database. Only basic terrain features are required to support the simulation at the Operational Level of War. JTLS represents terrain as a grid of hexagons. Each hexagon is typically one kilometer to seven kilometers wide and aggregates regional terrain and environmental characteristics, such as trafficability, elevation, and chemical or nuclear contamination. Roads, rivers, pipelines, and railroads are represented as network overlays on the hexagon terrain.

Point targets modify trafficability by providing targetable enhancements to the baseline terrain conditions. For example, bridges, tunnels, and interdiction points can be explicitly represented and targeted. Destruction of these targets affects the underlying terrain representation. Similarly, pumping stations and rail yards can be explicitly represented and targeted. Their destruction affects the underlying capabilities of the associated pipeline and rail networks.

ES.5 User Participation
The main JTLS operational interface is the Web Hosted Interface Program (WHIP®). It allows visual interaction with the simulation in the form of order input and graphical image and data displays. The WHIP has been constructed to conform to IEEE Internationalization Standards (i18n), allowing users to deploy and utilize the interface in their native language.

JTLS operators can use order entry panels displayed on the WHIP screen, a spreadsheet of similarly formatted orders, or a standard Decision Support System (DSS) translation program delivered with JTLS. For example, the JTLS Air Tasking Order Translator (ATOT) accomplishes automatic input of Air Tasking Orders (ATOs) from either the U.S. Theater Battle Management Core Systems (TBMC), the NATO Integrated Command and Control (ICC), or the Northern European Command - Command and Control Information System (NECCIS).

ES.6 Output
Each Player and Controller WHIP workstation provides a graphical display of aggregated land units, individual air missions, surface and subsurface ships, and more detailed entity level High Resolution Units (HRUs). Users obtain current status information about force mission, posture, and capabilities from an interactive, real-time Information Management Tool (IMT) component that provides user-configurable, spreadsheet-formatted data displays.
JTLS users receive messages and reports about the movement, attrition, and logistics status of their own forces, as well as intelligence summaries and capabilities of opposing forces. Users at each workstation can elect to view simulation messages in plain language or U.S. Message Text Format (USMTF). Message outputs may be sent electronically to standard Simple Message Text Protocol (SMTP) electronic mail workstations. Data feeds to C4I systems such as the Global Command Control System (GCCS), Joint Operational Tracking System (JOTS), and Joint Military Command Information System (JMCIS), have been successfully implemented and are frequently used during training exercises to populate real-world Common Operational Picture (COP) displays.

A graphical replay capability that depicts scenario events during user-selectable time intervals is supported and allows retrieval and summarization of After Action Review (AAR) statistics.

ES.7 Time Processing

JTLS users specify the desired ratio of elapsed exercise time to elapsed real time. The maximum feasible ratio depends upon the simulation's hardware platform, scenario size, and current game intensity. Although the capability to maintain a game ratio of at least 6 to 1 is a design objective, ratios of 20 to 1 or more can currently be maintained for large, conflict-intensive scenarios.

ES.8 Limitations

JTLS modeling assumptions limit its usefulness when aggregated ground units are represented below the company level. However, HRUs are designed to represent very small units such as individual traffic control units, reconnaissance patrols, lifeboats, and special forces teams.

ES.9 Hardware and Software

The JTLS Equipment List included as Appendix B to this document provides a summary description of supported hardware system configurations. JTLS execution can be on a single Linux laptop for small scenarios. A more robust suite is required for large exercises. The main JTLS programs require a Linux operating system, however individual player workstations can be hosted on Windows clients.

ES.10 HLA Compliance

JTLS is High Level Architecture (HLA) compliant and has been successfully integrated with other simulations to provide expanded resolution capabilities in a joint training environment.

- The Joint Multi-Resolution Model (JMARM) is a federation of JTLS and the Joint Conflict and Tactical Simulation (JCATS) and is developed and managed by Lawrence Livermore National Laboratory (LLNL).
- The NATO Education and Training Network (NETN) is currently an experimental federation that includes JTLS and the Virtual Battle Space 2 (VBS2) first-person shooter model.

ES.11 Documentation

A complete documentation suite consisting of 20 manuals and user guides is included with each JTLS release.
1.0 INTRODUCTION

The Joint Theater Level Simulation (JTLS®) is an interactive, computer-assisted simulation that models multi-sided air, ground, naval, and NGO environments, with logistical, Special Operation Force (SOF), and intelligence support. Developed originally as a component of the Joint Chiefs of Staff (JCS) sponsored Modern Aids to Planning Program (MAPP), JTLS was originally designed as a tool for use in the analysis of joint and combined and coalition operation plans. It is frequently used as a training support model. JTLS is theater-independent and does not require a knowledge of programming.

1.1 PURPOSE

The JTLS Executive Overview provides a general description of the standard hardware, standard software, and functional capabilities of the JTLS system. A complete suite of documentation, outlined in Table 1.1, is provided with the release of each version of JTLS.

1.2 GENERAL OVERVIEW

1.2.1 Date Implemented

JTLS development began in 1983 as a project funded by the U.S. Readiness Command, U.S. Army Concepts Analysis Agency, and the U.S. Army War College. The simulation has had continual functional and system upgrades since that time.

1.2.2 Description

1.2.2.1 Scope of Operations

The focus is on conventional joint and combined operations at the Operational Level of War as defined by the Joint Staff’s Universal Joint Task List (UJTL). JTLS explicitly models air, land, sea, amphibious, and SOF operations. The simulation supports limited nuclear and chemical effects, low intensity conflict, and pre-conflict operations.

1.2.2.2 Terrain

The Defense Mapping Agency’s Compressed ARC Digitized Raster Graphics (CADRG) maps and terrain data permit the simulation to be used worldwide. The Terrain Generation Service (TGS) can be used to build hexagon-based terrain files to support JTLS. JTLS algorithms assume a hexagon grid is overlaid on a Lambert conformal conic map projection. This projection may lead to undesirable distortion if the map area exceeds a rectangular area larger than 2000 NM on each side.

1.2.2.3 Environment

Hexagon (hex) based terrain aggregates regional terrain and environmental characteristics: trafficability, elevation, chemical contamination, and nuclear contamination. Roads map hex center to center. Pipelines and railroads are mapped via independent node-to-node networks. Rivers and shorelines map to hex borders.

Point targets modify trafficability by providing targetable enhancements to the baseline terrain conditions. Bridges, tunnels, and interdiction points can be explicitly represented and targeted. Destruction of the targets affects the underlying terrain representation. Likewise, pumping
stations and rail yards are explicitly represented and targeted. Their destruction affects the underlying capabilities of the associated pipeline and rail networks.

1.2.2.4  Force Composition

Multi-sided coalition air, land, sea, and SOF resources can be represented. JTLS also supports the representation of civilian and non-combatant resources within sectors of interest.

A maximum of ten Force Sides can be represented. Each Side can be divided further into an unlimited number of Factions. A Faction’s Side allegiance is dynamically changeable during simulation play. Side relationships are asymmetric and also can be changed during simulation execution.

Side names, Faction names, and the color used to display the resources belonging to a Side are user-configurable via the database.

1.2.2.5  Level of Detail

All processes are designed toward doctrine-neutral implementation for maximum flexibility. Units and targets are the basic entities represented in JTLS. The user-configurable database defines unit types and sizes, combat systems, supply categories, and the targets to be represented. The high resolution target systems complement the more aggregated unit structure. Units are represented at either an aggregate level of resolution or a high level of resolution. The database can be developed to represent, within the aggregated unit structure, the requisite detail for systems of interest. Therefore, multi-level resolution is the norm.

Air-to-air operations can be controlled as single aircraft and/or as aggregate, multi-sided mission Packages. Adjudication is at the item level and uses probability of engagement (pE), probability of hit (pH), and probability of kill (pK) factors for each mission element. Adjudication is stochastic.

Aircraft damage and subsequent repair operations, as well as routine aircraft post-flight maintenance downtime, are represented.

Surface-to-air operations are simulated at the item level and use pE and pK factors for each mission. Integrated air defense systems linking air defense sites, communications centers, radar sites and AWACS aircraft are represented. Adjudication is stochastic.

Air-to-ground, surface-to-surface missiles, and artillery (including naval gunfire support) operations are simulated at the item level; they use pH and pK for precision-guided munitions, and target density functions for area weapon coverage. Adjudication of precision-guided munitions is stochastic, and area weapon results are deterministic.

The land warfare module uses Lanchester methodology to aggregate the effects of direct fire weapons and direct support systems not engaged in explicit fire support operations. Adjudication is deterministic.

Naval representations include ship based cruise and ballistic missiles, torpedoes, mine and counter-mine operations, submarine and antisubmarine operations, naval gunfire, sea based air (fixed wing, helicopter and UAV), supply sealift, and coalition amphibious operations.
1.2.2.6 Input

JTLS recognizes relevant terrain, weapons, movement, attrition tables, unit characteristics, and Time-Phased Force Deployment Data (TPFDD) information as input. There are no hard-coded data items; therefore, the creation of a database is complex and time-consuming when starting from scratch. JTLS is distributed with a Standard Database that includes many reusable modules. Development time for a new database is six to eight months.

1.2.2.7 User Participation

JTLS is an interactive simulation and requires user decisions to manage the processes and entities. Interaction with the simulation is via the Web Hosted Interface Program (WHIP®) for order entry and simulation graphics. Automatic entry of an Air Tasking Order (ATO) is accomplished via the JTLS ATO Translator (ATOT).

1.2.2.8 Output

Each user WHIP workstation includes a graphical display of aggregate land units, air missions, surface and subsurface ships, and High Resolution Units (HRUs). The user also has access to an interactive, real-time Information Management Tool (IMT). The IMT provides user configurable spreadsheet-style displays from which current status information on resource mission, posture, and capabilities may be obtained.

JTLS users receive messages and reports concerning the movement, attrition, and logistics status of their own resources, as well as intelligence summaries and capabilities of opposing resources. The user at each workstation can select to view messages in plain language or U.S. Message Text Format (USMTF). Message outputs may be sent electronically to standard Simple Message Text Protocol (SMTP) electronic mail workstations. Electronic feeds to Command, Control, Communications, Computers, and Intelligence (C4I) systems, such as the Global Command Control System (GCCS), Joint Operational Tracking System (JOTS), and Joint Military Command Information System (JMCIS), have been demonstrated, and are frequently used during training exercises to feed real-world Common Operational Picture (COP) displays.

Graphics replay at a user-selectable time interval is supported.

1.2.2.9 Time Processing

JTLS users specify the desired ratio of elapsed exercise time to elapsed real time. The maximum feasible ratio depends upon the simulation's hardware platform, scenario size, and current game intensity. Although the capability to maintain a game ratio of at least 6 to 1 is a design objective, ratios of 20 to 1 or more can currently be maintained for large, conflict-intensive scenarios.

1.2.3 Limitations

JTLS modeling assumptions limit its usefulness when aggregated ground units are represented below the company level. However, HRUs are designed to represent very small units such as individual traffic control units, reconnaissance patrols, lifeboats, and special forces teams.

1.2.4 Hardware and Software
1.2.4.1 Servers and Workstations
The JTLS suite is designed to operate on a Red Hat Linux (TM) platform. The JTLS Web Hosted Interface Program (WHIP®) can be executed on any compatible Java (TM) system, such as Red Hat Linux, CentOS Linux (TM), or Microsoft Windows (TM) platforms. Minimum operating system requirements are specified in APPENDIX B. JTLS OPERATING EQUIPMENT.

1.2.4.1 Peripherals

The system requires at least one laser printer, though several are recommended for use during exercises. Tape or CD drives are needed for backups, archiving, and file transfers.

1.2.4.2 Programming Languages

JTLS requires a Linux operating system that includes X-Windows. A SIMSCRIPT II.5 to C translator for the target platform and a C compiler are required for source code users. The JTLS Database Development System (DDS), an application of the Oracle Server (TM) relational database management system, is required for database preparation.

1.2.5 Planned Improvements and Modifications

A Configuration Control Board (CCB), managed by the U.S. Joint Staff (JCS), establishes priorities for simulation development and improvement. The CCB is comprised of representatives from the COCOMs. The following areas have been identified as high-priority improvement projects for JTLS by the CCB:

- Enhance the representation of network systems (Command, Control, Communications, and Intelligence (C3I) as well as road, rail, and intelligence networks).
- Maintain HLA compliance.
- Alter the simulation to represent tessellating, multi-resolution terrain.
- Upgrade and refine capability to link to fielded C4I systems, such as the Tactical Digital Interface Link (TADIL) and Contingency Tactical Air Planning System (CTAPS).
- Other functional requirements are specified by the CCB.

1.2.6 Users

JTLS users include: US Joint Staff, Warrior Preparation Center, USCENTCOM, USEUCOM, USSOCOM, USSOUTHCOM, USPACOM, NATO (CI Agency, JWC, JFTC), and the Naval Postgraduate School. Other international users include these government defense agencies and contractors:

- Australia - Joint Warfare Doctrine and Training Centre (JWDTC)
- France - Ecole de Guerre
- Greece - Hellenic National Defense General Staff (HNDGS)
- Italy - Italian Joint Operational Simulation Center (CIMSO)
- Japan - Mitsubishi Electric Corporation (MELCO)
- Korea - Republic of Korea, Air Force Air University (ROK-AF)
- Malaysia - Malaysian Armed Forces (MAF)
- Norway - Norwegian Joint Headquarters (NJHQ)
- Pakistan - National Defense University (NDU)
- Poland - National Simulation & War Game Centre (NS&WGC)
- Saudi Arabia - Royal Saudi Land Forces, Command Staff College (RSLF CSC)
- Slovenia - Center for Operational Research and Simulations (CORSA)
November 2013

- Taiwan – Joint Exercise and Training Center (JETC)
- Thailand – Royal Thai Supreme Command (RTSC)
- Turkey – Turkish War Colleges, Wargame & Simulation Center (WGSC)
- United Arab Emirates – Joint Command & Staff College (JCSC)

1.3 SECURITY
The JTLS system, as delivered, is unclassified. Data used in the preparation and maintenance of a specific scenario database are also unclassified.

1.4 DOCUMENTATION
A substantial documentation suite is included with each JTLS release. Table 1.1 summarizes the content of each volume of the suite. The JTLS Design Plan, which describes the functional enhancements and database changes implemented for a Major JTLS software and Standard Database release, is published separately.

**Table 1.1 JTLS Documentation Suite**

<table>
<thead>
<tr>
<th>JTLS DOCUMENT TITLE</th>
<th>CONTENT DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTLS Analyst Guide</td>
<td>Describes the design, logic, and internal algorithms of the JTLS Combat Events Program (CEP), from the perspective of the simulation designer.</td>
</tr>
<tr>
<td>JTLS ATOT User Guide</td>
<td>Describes the design, logic, functions, and use of the JTLS Air Tasking Order Translator (ATOT).</td>
</tr>
<tr>
<td>JTLS C4I Interface Manual</td>
<td>Overview and operator manual that describes the functional capabilities of JTLS external interface programs that feed C4I systems.</td>
</tr>
<tr>
<td>JTLS Controller Guide</td>
<td>Describes the role of the Controller in monitoring the game and the use of JTLS Controller orders.</td>
</tr>
<tr>
<td>JTLS Data Requirements Manual</td>
<td>Describes data elements and structures required by JTLS software and algorithms.</td>
</tr>
<tr>
<td>JTLS DDS User Guide</td>
<td>Describes how to use the JTLS Database Development System (DDS) to build, modify, verify, or query JTLS databases.</td>
</tr>
<tr>
<td>JTLS Director Guide</td>
<td>Describes the JTLS Director’s role of scheduling resources, locating and assembling data, training, and security.</td>
</tr>
<tr>
<td>JTLS ELS User Guide</td>
<td>Provides information and instructions for using the Entity Level Simulation (ELS), including initialization requirements, template building, configuring and executing the ELS.</td>
</tr>
<tr>
<td>JTLS Executive Overview</td>
<td>Provides a survey of the JTLS hardware, software, and functions.</td>
</tr>
<tr>
<td>JTLS Federation User Guide</td>
<td>Describes the use of JTLS usage within federations such as JMRM, MUSE, and JLVC.</td>
</tr>
<tr>
<td>JTLS Installation Manual</td>
<td>Describes procedures for installing JTLS on various hardware and operating systems and setting system parameters.</td>
</tr>
<tr>
<td>JTLS DOCUMENT TITLE</td>
<td>CONTENT DESCRIPTION</td>
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</tr>
<tr>
<td>JTLS Player Guide</td>
<td>Describes the role of the Player and the use of Player orders to interact with JTLS.</td>
</tr>
<tr>
<td>JTLS PPS User Guide</td>
<td>Provides information and instructions for using the JTLS Postprocessor System (PPS).</td>
</tr>
<tr>
<td>JTLS Software Maintenance Manual</td>
<td>Provides information pertaining to upgrades and maintenance of the JTLS system, and is intended to be used as a reference.</td>
</tr>
<tr>
<td>JTLS Standard Database Description</td>
<td>Describes general JTLS database characteristics and specific data, including resource Sides, Factions, Unit and Target data, unit prototypes, weapons, logistics, lethality data, and functional prototypes.</td>
</tr>
<tr>
<td>JTLS Technical Coordinator Guide</td>
<td>Provides information needed for the JTLS Technical Coordinator while starting and maintaining the game and providing system expertise.</td>
</tr>
<tr>
<td>JTLS Version Description Document</td>
<td>Describes upgrades and code corrections associated with each JTLS release.</td>
</tr>
<tr>
<td>JTLS WHIP Training Manual</td>
<td>Provides user instructions to operate the Web Hosted Interface Program (WHIP®) and its associated components: the Map Display, Filters, Order Panels, Message Browser, Information Management Tool (IMT), and Online Player Manual (OPM).</td>
</tr>
</tbody>
</table>
2.0 JTLS SYSTEM OVERVIEW

The Joint Theater Level Simulation (JTLS®) system is an interactive, multi-sided analytical tool that models a joint air, land, and naval warfare environment. This theater-level model is designed for use in the following areas:

- analysis, development, and evaluation of contingency plans and joint tactics;
- evaluation of alternative military strategies; and
- analysis of combat unit structure with respect to assigned combat systems.

The model is also useful as the situation driver and combat evaluation tool for joint and international staff exercises.

This chapter provides an overview of the wargaming process, then summarizes the required JTLS operating equipment suite. Finally, it presents brief descriptions of each of the JTLS programs, both the major system components, such as the Combat Events Program (CEP), and the support tools, such as the Terrain Modification Utility (TMU).

2.1 THE WARGAMING PROCESS

The design and execution of the wargaming process is tied to the purpose and scope of the endeavor. Exercise or analytical objectives and resources will drive design decisions. One of four general designs is typically used:

- Seminar Wargame or Analysis
- Open Support
- Hidden Support
- Distributed Output

The Seminar Wargame design employs a small cadre of gamers to operate the model and report results to key decision-makers. An experienced gaming cell inputs order sets—to implement a branch of a campaign plan—then runs the game at high speed in a “batch mode” until a pre-defined branch point is reached or a specified time interval has elapsed. The gaming cell then provides operational results to the seminar director to support the decision-making process. Once key decisions are made, the cycle continues with a new set of orders being input into the model. This approach requires only a few gamers; however, they must be well-trained in all aspects of the model and must maintain expertise in a variety of warfare function areas.

An Open Support design places the key decision-makers—members of the target training audience—within the simulation facility. These decision-makers and/or their representatives may
enter orders directly into the game or retrieve data from the model. In this mode, the model is completely open to the target training audience. This design is advantageous because it does not require many “overhead” personnel to support model inputs. However, the target training audience can become too involved in simulation details at the expense of their focus on training objectives and their decision-making process. Additionally, simplifications made during the modeling process or errors entered by game Players can detract from the desired realism.

The Hidden Support design attempts to overcome the realism constraints by placing a response cell between the simulation facility, where the game is operated, and the training audience. The training audience develops operation orders in their standard format, and ignores model constraints or special requirements. A subordinate response cell then processes these operational level orders into game-level directives. During execution, the response cell monitors reports produced by the model and may monitor simulation outputs over organic command and control systems. The response cell reviews all output to ensure errors are corrected before data are transmitted to the training audience. In this manner, the simulation is hidden from the training audience. However, this scheme requires “overhead” personnel to operate the JTLS workstations and additional personnel to establish and maintain the response cells.

A Distributed Output design attempts to combine aspects of the Open and Hidden designs to interface the model with established Command, Control, Communications, Computer and Intelligence (C4I) systems. This design permits key decision-makers to send orders and monitor results over their organic, wartime command, and control systems. Their orders are processed into game directives by a response cell (as in the hidden support design). However, output from the model is broadcast directly to elements of the training audience over their organic C3I. For example, the Air Operations Center (AOC) may establish a Tactical Digital Interface Link (TADIL) from the JTLS model to an organic battlespace management system. Additionally, U.S. Message Text Format (USMTF) messages can be transmitted from the game over a local area network (LAN) to an interface with Theater communications systems. When coupled with order input modules like the Air Tasking Order Translator (ATO-T), this design structure will provide powerful and flexible support for training exercises. The problem with this structure is that every national military has different C4I systems and therefore different requirements to directly interface JTLS with those national systems. JTLS, as a funded US Department of Defense model, is used in this manner to interface with US C4I systems. Any other users would need to develop their own interface with their own military C4I systems.

All of these designs are supported by five key staff positions: the Exercise Director, the Senior Controller/Exercise Controller, the Technical Coordinator, the Computer Systems Manager, and the Players. The functions of each position are summarized below:

- The **Exercise Director** plans and administers the wargaming exercise.
- The **Senior Controller/Exercise Controller** monitors the progress of the campaign and uses JTLS model tools to shape the electronic battlespace to meet operational requirements or training objectives as specified by the Exercise Director.
• The Technical Coordinator (or Tech Control) starts and stops the game, monitors all computer resources needed for the simulation, and provides technical support for the JTLS game.

• The Computer Systems Manager configures the computers and coordinates system software changes and hardware maintenance.

• The Players input game orders and monitor the status of assigned forces. Players may have command authority over all forces on their side, or can be limited in who they may command or in the type of functions they may perform. JTLS requires at least one Player per Force Side. There are generally six distinct types of Players. However, JTLS provides the exercise planning staff the capability to develop other specific Player types that combine any or all of the six Player types. This is done by creating specific Player order menu definition files tailored to exercise requirements. For example, a particular exercise might require a Player who had access to some of the Air-related orders as well as selected LOGISTICS and INTEL orders. The six commonly-used Player types are briefly described below:

• A Commander can perform all Player functions.

• A Ground Player can issue directives required to manage the scenario’s ground forces only.

• An Air Player can issue Air Mission directives only.

• A Naval Player has access only to those orders which are required to fully manage all naval and amphibious capabilities modeled in JTLS.

• An Intelligence Player issues orders only to intelligence collection assets, processes information gathered by organic resources, and passes information to other interested Players.

• The Logistics Player is limited to establishing stockage objectives, directing resupply operations, and controlling convoys and supply networks.

2.2 JTLS OPERATING EQUIPMENT

JTLS consists of several component programs that are closely related and integrated into a system that allows users to create the required databases, execute the game, and analyze the results.

The Combat Events Program (CEP) and its support programs, the JTLS Object Distribution Authority (JODA) data server, and the Web Enabled JTLS services (Apache data server, XMS, SYNAPSE, OMA, and JXSR) are designed for execution on 64-bit Linux-based platforms. The Web Hosted Interface Program (WHIP) is the graphical user interface for JTLS. Multiple individually executing WHIPs, possibly located at remote sites, accommodate JTLS exercise players. WHIPs
are executed on Microsoft Windows (™) or Linux-based workstations that utilize the AMD/Intel
AMD64/EM64T architecture. Support for Solaris UNIX server and client configurations has been
discontinued.

Equipment required to execute the core components of JTLS—the CEP, Web Services, and WHIP—
is configured according to intended use of the model within an analysis, user training, or exercise
environment. JTLS can be executed on an optimized microcomputer or a suite of servers. An
analyst who desires to execute operational vignettes for research purposes can utilize a single
Linux desktop or laptop computer. A single computer may also be used to execute the model for
small groups of simulation trainees; larger groups require a network configuration similar to the
specifications described in Appendix B of the *JTLS Executive Overview*. Other critical elements,
such as exercise, analysis, or training environment, or scenario size and complexity, must be
considered while planning an optimal JTLS installation.

### 2.3 JTLS SYSTEM STRUCTURE

The Web Enabled JTLS (WEJ) structure and the relationships among its major programs are
depicted in Figure 2.1. This diagram depicts all major JTLS components, subsystems and support
tools, including the related data files that are accessed or created. Brief summaries of the
essential functions of each subsystem are provided in the remaining sections of this chapter.
This overview does not describe all components and their relationships in detail. Refer to the
*JTLS Technical Coordinator Guide* and other JTLS User Guides that pertain to individual
components for detailed descriptions of data files and programs. Each JTLS release includes all
executables compiled for the supported systems.

The Red Hat Linux (™) and Microsoft Windows operating systems are currently supported. All JTLS
components are currently compiled to execute on any platform that supports Red Hat Enterprise
Linux. The Web Hosted Interface Program is a Java (™) application that is operating system and
platform independent and may be hosted on either a Windows or Linux environment. Previous
support for the Sun Microsystems Sparc/Solaris Platform was discontinued in 2008.
2.4 SCENARIO PREPARATION TOOLS

2.4.1 Database Development System (DDS)

The JTLS Database Development System (DDS) is the primary JTLS database development and modification tool used to build a new database, modify an existing database, or query an existing database for filtered information. The DDS is an application of the Oracle Server(TM), a relational database management system. The DDS has been re-implemented to an alternative open-source platform that is deployed through the Oracle GlassFish(TM) J2EE-compliant server. A Client
interface was developed using Java™. This system interacts with the certified Oracle database server.

The ASCII data files that define the initialization database for a selected scenario are uploaded to fill a set of Oracle tables designed to be compatible with the JTLS database structure. The DDS user accesses these tables to modify or query the data they contain. When modifications are complete, the data are downloaded to create a new set of JTLS initialization data files for that scenario.

The DDS is started by first selecting Option 1, Prepare or Alter a Scenario Database, from the JTLS Main Menu. Then, from the resulting JTLS Database Preparation Menu, Option 1, Access the Database Development System Menu, is selected.

2.4.2 Scenario Verification Program (SVP)

The SVP is a primary component of the SIP that is implemented to verify that data entered for a specified scenario are internally compatible and consistent among variables. The SIP reads the scenario database files that are used by the CEP, and holds the data in the same data structures used by the model during game execution. This process makes all necessary consistency checking efficient and accurate. For example, it ensures that naval units are placed on water-terrain hexagons and that ground units are placed on ground-terrain hexagons. The output from this program lists the errors and possible inconsistencies present in the data. The SVP is started by selecting Option 2, Verify an Existing Scenario Database, from the JTLS Main Menu.

2.4.3 Online Players Manual (OPM)

The OPM provides access to a series of HTML files that contain formatted scenario initialization data. An OPM can be generated from either the game start data, or from the data associated with a checkpoint. Players can use a compatible Web browser to access this information and a workstation mouse to easily navigate the HTML pages. These files display static information from their source data and are not continuously updated as the game progresses.

2.4.4 Lanchester Development Tool (LDT)

This program assists in the implementation of Lanchester coefficients, which are used to assess the results of force-on-force land combat in JTLS. The user inputs the desired outcome of a battle of a specified duration, and the LDT generates a table of appropriate Lanchester coefficients. The LDT also provides a verification function which allows the user to view in tabular format the results of a long-term battle between two or more units. The Lanchester coefficient data in JTLS has been painstakingly developed and rigorously calibrated through many exercises and test events. There should be no compelling reason to modify the coefficients. The LDT is not depicted in Figure 2.1.
2.5 SYSTEM SETUP AND INITIALIZATION PROGRAMS

These programs are used to prepare JTLS to execute a specific scenario.

2.5.1 Scenario Initialization Program (SIP)

The SIP is a suite of tools that must be executed to prepare a scenario that has not been run previously for game start. One of its primary functions, scenario verification, is previously described in Section 2.4.2. Other SIP functions include:

- Determining that all the data files defining the scenario exist;
- Creating the proper directory structure to hold game runtime data files;
- Copying all scenario initialization data files into the game directory;
- Creating data files needed by other JTLS processes, such as WHIP order definition files, and menu definition files; and
- Verifying playing surface map file selection.

The SIP must be re-run for a scenario when:

- initialization data have changed;
- definitions in the static vocabulary file have changed;
- a new version of the WHIP is installed; or
- the order definition file has changed.

The Alter Database components of the SIP are specialized programs that allow users to rapidly modify or create new JTLS scenario initialization data files. These files are used by the JTLS model and other support programs, such as the Entity Level Simulation, and external models, such as JCATS. The Automatic Supply Calculation process is intended to assist database builders by replacing many of the tedious calculations required to determine the appropriate quantities for various categories of supply each Unit Prototype should have.

2.5.2 Interface Configuration Program (ICP)

The ICP is an interactive program that allows the user to define the specifications for each game process that can be started for a particular scenario: OVT (Order Verification Tool), ATOT (Air Tasking Order Translator), SDR (Scenario Data Repository) clients, Glassfish (J2EE Application Server for the DDS), KOIs (KML Operational Interface), Apache (HTTP Web Server), the CEP, JODAs and the other Web Service Programs, Replay Servers, WHIPs, and the MDP (Message Delivery Program). The ICP uses a Graphical User Interface (GUI) to allow the user to edit the
default process configuration. The data required to define a process in the game configuration
differ according to the type of process. Process definitions include process name, startup
password, parent process, execution host, Force Side, and others.

The ICP is typically run before game start to adjust the configuration to exercise requirements,
but can be used while JTLS is executing. For example, the ICP would be run to define a new WHIP
to be added to the pre-start system configuration and brought on line.

2.6 COMBAT EVENTS PROGRAM

The Combat Events Program (CEP) is the combat model and central component of the JTLS
system. This program determines all of the actions and interactions among the air, land, and
naval forces defined and modeled for the specific scenario being run. The CEP creates,
maintains, and reports the current status of the warfare environment being modeled. The CEP
can model a maximum of ten sides or coalitions in any given scenario. Each side can specify its
combat relationship (Friendly, Enemy, Suspect, or Neutral) with each of the other represented
sides. Only one CEP is allowed to execute for a specific scenario on any individual machine or
network during JTLS execution.

The CEP communicates with the Primary JODA process via a TCP/IP socket connection. The
Primary JODA receives an initial data download and periodic updates from the CEP, and, in turn,
communicates with the WHIPs, Secondary JODAs, and other client programs that are assigned to
it. Each JODA maintains its own current game database and communicates with the programs
immediately below it in the information tree structure.

Player inputs to the game are in the form of orders entered at a WHIP and transmitted to the CEP
for processing, up the tree through the Primary JODA. Players receive game information from the
CEP, via the Primary JODA down the tree, in the form of WHIP graphics updates, formatted
messages, IMT tabular data display updates, and updates to WHIP child processes such as the
SITREP tool, the ATO Viewer, and the Command and Logistics Hierarchy displays.

2.7 WEB SERVICES

The Web Enabled JTLS design is intended to reduce the cost of conducting a simulation-
supported joint training event, and to minimize the use of personnel and equipment. Operators
using a Web-based connection, or an existing wide area network (WAN) and local area network
(LAN), can log on to the simulation via a Web browser on a personal computer, and operate the
player interfaces from this PC. This design significantly reduces both the cost and the turn-
around time of a joint training event. Most exercise facilities have existing WANs and LANs that
allow Combatant Commands and Supporting Commands access to simulations based at a home
station to support a joint training audience.

The infrastructure implements four integrated Web Services that interact with the WHIP through
the Apache HTTP Web server. The CEP transmits simulation data to these Web Services through
the JTLS Object Distribution Authority (JODA), which provides these data to client programs on a
persistent socket connection. The JXSR, XMS, SYNAPSE, and OMA Web Services communicate with the JODA, which functions as an ambassador between the CEP and the Apache.

All Web Services are designed to execute on Linux-based systems that utilize Pentium IV (or better) platforms and RedHat Linux operating systems. Game support for the Sparc/Solaris platform has been discontinued.

2.7.1 JTLS Object Distribution Authority (JODA)

One JODA connects directly to the CEP and distributes data to the Web Services programs or other registered JTLS Data System (JDS) client programs. It is designated the single Primary JODA. Additional Secondary JODAs can be configured to accommodate certain types of support program clients. These secondary JODAs do not connect to the CEP, but to the Primary JODA.

2.7.2 Apache Web Server

The Apache is a modular, open source, HTTP-compliant Web server configured to manage one or more JTLS scenarios for a specific host and port. The Apache Web Server implements several modules that interface with the Web Services to provide the simulation data. The services include the JTLS XML Serial Repository (JXSR), the XML Message Service (XMS), the Order Management Authority (OMA), and the Synchronized Attribute Preferences Server (SYNAPSE). These services receive the simulation data from the Combat Events Program (CEP) via the JODA. The data are pushed to the Web Services (JXSR, XMS, OMA, and SYNAPSE), then become available upon request by each operator’s Web Hosted Interface Program (WHIP) through the Apache Web Server.

2.7.3 JTLS XML Serial Repository (JXSR)

The JXSR program obtains data from a JODA and passes it in XML format to the WHIP through the Apache Web Server. A JXSR is dedicated to providing object information. Potential requests include IMT data, SITREP data, and permitted object names for order entry. To properly distribute the processing load, additional JXSRs can be configured to run on separate hosts. Each JXSR is independent and maintains a connection only with the JODA.

2.7.4 XML Message Service (XMS)

The XMS connects to the JODA to monitor messages written to the file system, and provides four basic JTLS message indexing services to WEJ clients: searching, sorting and listing based on criteria provided by the client, data-only extraction, and formatting. The Message Browser component of the WHIP makes requests, via the Apache server, to the XMS and the XMS responds by delivering message summaries (file name, message type, and subject).

2.7.5 Order Management Authority (OMA)

The OMA provides an order verification and forwarding service to the WHIP. This ensures that the orders originating from WHIPs are verified for structural accuracy (not tactical appropriateness)
prior to sending them to the CEP. If an order fails verification, feedback is provided by the OMA to the WHIP operator specifying the nature of the problem with it.

2.7.6 Synchronized Attribute Preferences Server (SYNAPSE)

The SYNAPSE provides a user data sharing service in a central location and allows a WHIP configuration to be independent of the local workstation. This Web Service allows the WHIP operator to start their WHIP on any workstation and recover all their user preferences. The SYNAPSE is also responsible for the sharing of orders and drawings among WHIPS.

2.7.7 Web Services Manager (WSM)

The WSM allows the user to individually start, monitor, and shut down the Apache server, primary and secondary JODAs, and/or any of the Web Services (JXSR, XMS, OMA, and SYNAPSE) Web Services for a specific scenario. The window displays a tree interface that includes operating status buttons organized according to the component connectivity. For technical control monitoring, detailed operating status information can be displayed for each Web Service. For example, selecting the JODA service provides command buttons which query and display its operating status, available objects, sockets, peers, and other configuration information in a list format. The WSM is started by selecting Option 6, Launch Web Services Manager, from the JTLS Main Menu.

2.8 PLAYER INTERFACE PROGRAMS

2.8.1 Web Hosted Interface Program (WHIP)

The Web Hosted Interface Program (WHIP) is an integrated Java-based GUI that is downloaded to each JTLS client workstation via Java WebStart, and allows clients to interact with JTLS. A typical WHIP screen is shown in Figure 2.2. The WHIP has several GUI-based features through which the user receives information from and interacts with the model. Each of these components is accessible by means of context-sensitive menus displayed within the interface window:

- Map Component
- Information Management Tool
- Command Hierarchy
- Logistics Hierarchy
- Message Browser
- Order Entry Panels
- Order Group Editor
The context-sensitive menus simplify user interaction with objects in the game. For example, detailed Combat System, supply, order, location, and posture information for any unit in the game is directly and easily accessible from the Map, Command Hierarchy, and other windows.

2.8.1.1 Map Component

The WHIP Map Component can be viewed in Figure 2.2. It provides a geographical map display on which terrain features and game objects are placed. A wide range of filtering capabilities exist to manage the objects that are displayed. In addition to basic object on or off filtering, the Map also permits the WHIP user to customize their level of detail. For example, controls exist to zoom in or out of the map display or to center the display in another geographic region. Both filters and map location/resolution can be saved by the user and recalled at a later time. If the WHIP workstation contains Compressed ARC Digitized Raster Graphics (CADRG) data, the Map Component will allow display of these high-resolution images as a user option.
2.8.1.2 Information Management Tool (IMT)

The IMT (Figure 2.3) allows the WHIP user to display dynamically updated status tables that hold game information regarding the current status, profile, and capabilities of forces including units, targets, convoys, and air missions. The IMT can also display current intelligence gathered about foreign forces. Several IMT windows can be open or iconized during any WHIP session. These present information, filtered and organized by the Player in various ways, about current operations, the current capabilities of units and targets, the status of Air Missions that are flying or scheduled to fly, and recent intelligence reports.

Figure 2.3 Information Management Tool Windows
2.8.1.3 Command and Logistics Hierarchies

The Command Hierarchy and Logistics Hierarchy windows, both illustrated in Figure 2.4, display Force Side, Faction, and unit-level information in tree structures representing the hierarchical chain of command or the supply logistics structure defined for the current scenario.

![Figure 2.4 Command Hierarchy and Logistics Hierarchy Windows](image)

Users can browse the command or logistics structure of each Force Side by toggling the switch adjacent to each node to show the presence of units within the command or logistical structures of that Force Side. Both hierarchies are organized in tree structures, the Command Hierarchy according to superiors and subordinates and the Logistics Hierarchy according to primary resupply units. A Find option simplifies locating a specific unit within each window’s hierarchy. Selecting and clicking a unit name in either window opens a context-sensitive menu for the user. It can be used to open IMT windows, access Online Player Manual pages, activate map displays options, and access selected applicable Orders for the unit.

2.8.1.4 ATO Viewer

The ATO Viewer (ATO-V) provides a graphical display of all of a side’s air missions; past, current, and those scheduled for the future. Missions are shown as individual status bars arranged horizontally along a game time reference axis. A status bar’s length is the mission duration. Each shows the mission’s planned and actual take off, landing, on station, and off station times. Bars are color-coded according to mission posture. Colors automatically change as missions postures changes, for example when a CAP mission completes its on station time and changes from Orbiting to Heading Home. Several filtering, sorting, and display compression options allow the user to tailor the display to the individual WHIP. The ATO-V is useful not only for monitoring current air operations, but also for planning the next day’s ATO.
2.8.1.5 Order Management

The JTLS order panels permit the user to create individual named orders from displayed order templates. Each order type-specific template contains fields to be completed, some of which have default values provided. The WHIP allows user access to these templates either from pull-down menus, from a unit’s Context Sensitive menu, or from the Quick Order list. For example, a user may desire to administratively Move a unit. The complete Move order template can be accessed from the Ground order menu at the top of the WHIP, or from the context sensitive menu displayed when the user clicks on the desired unit. This order has a number of fields to be completed. For example, it allows the entry of a detailed route to follow. Alternatively, the user can select the Quick Move order from the list of quick orders at the top of the WHIP. A Quick Move order requires only a Unit name and single a destination location.

The capability to manage orders is also provided. An Order Group Editor window enables users to combine saved orders, send them simultaneously to the CEP as a named group. Users can also copy, rename, delete, save, load, or share the orders with others. This tool uses a tree interface to organize, save, and display the saved orders and groups.

2.8.1.6 Situation Report (SITREP) Tool

When the user selects a map object the SITREP component will display information about the object. The SITREP information will depend on the type of object, its relationship to the WHIP’s side, and the perceived (intelligence) data available about the object if it is not on the WHIP’s side. In addition to using the map component, a SITREP can also be triggered from the IMT, Command Hierarchy, or Logistics Hierarchy components.

2.8.1.7 Message Browser

This WHIP component optimizes the process of managing and reading CEP messages, allowing users to receive messages, forward these messages to other users and C4I systems, and convert messages from text to MTF format. Messages can be displayed and viewed in the Message Browser window (Figure 2.5).

JTLS generates these basic message types:

- A message can be addressed to a specific WHIP client. Only the addressed WHIP user receives the message. If the WHIP is not executing, the XMS maintains retains such messages until the WHIP is ready to accept messages.

- A message can be addressed generally to a Force Side and function. This is known as a Broadcast message and the message is sent to each WHIP on the specified Side. A Player can control which function messages should or should not be displayed.
Typically, JTLS updates current status information to the WHIP and IMT. Under various circumstances additional information may be distributed in the form of a message. A message is generated when:

- a Player submits a request for detailed force status information;
- the CEP informs a Player about a problem (an invalid order, for example);
- one of the forces under a Players command discovers critical information the Commander should know about (for example, it is experiencing incoming artillery fire);
- a summary of the actions taken within the last reporting period is generated.

![Message Viewer](Image)

**Figure 2.5 Message Browser View Window**

### 2.8.2 Total Recall Interactive Player Program (TRIPP)

The Total Recall Interactive Playback Program (TRIPP) is a specialized WHIP that allows users to recall and replay game events for a specified time interval from a previously run JTLS game. The Interface Configuration Program (ICP) is used to enable the TRIPP and properly configure the game with its three supporting components: a dedicated logging JODA, one or more Replay Servers, and one or more TRIPP display consoles. TRIPP replays can be run both while the game is executing, and also after the exercise has completed.
2.9 SCENARIO SUPPORT TOOLS

2.9.1 JTLS High Level Architecture Interface Program (JHIP)

When JTLS is used in a High Level Architecture (HLA) federation, the JTLS HLA Interface Program (JHIP) is used to distribute simulation data through the Run Time Infrastructure (RTI) to other members of the HLA federation. While running the HLA federation using Time Management, an additional program, called the Pacer, can be used to regulate game speed.

2.9.2 Order Verification Tool (OVT)

The OVT receives JODA-distributed output from the Combat Events Program (CEP), which is used to verify the format and contents of Player and/or Controller orders that were built using programs other than the WHIP before they are sent to the game. All order checking that would be accomplished by a WHIP is also performed by the OVT. The OVT code also processes orders generated by the SDR Order Entry Client (OEC), the Order Management Authority (OMA) Web Service, the JTLS HLA Interface Program (JHIP), and the Entity Level Simulation (ELS).

The OVT supports a graphical user interface that allows the operator to verify existing WHIP Read Order Files and allows other programs to connect and verify orders by means of a socket-based interface. The order checking functionality is provided by a minimal subset of library object code necessary to perform order verification. This library is available to other programs that are designed to perform internal order checking instead of using the OVT.

2.9.3 Entity Level Simulation (ELS)

The ELS is designed to receive aggregate level unit and target information from the CEP through the primary JTLS Object Distribution Authority (JODA) and disaggregate these data into individual entity data. The separate entity level objects are then made available to clients by means of two different methods. The Run Time Infrastructure (RTI) can be used to distribute ELS data to other HLA federates or clients may connect to a secondary Entity Level JODA (EODA) to receive the entity data.

2.9.4 JTLS Operational Interface (JOI)

JTLS exercises conducted by the United States Government have required data feeds to real-world Command, Control, Communications, Computers, and Intelligence (C4I) systems. The JOI is designed to provide a configuration-managed capability to convey current JTLS force status information to these systems. This capability allows all JTLS Units and Air Missions to be passed via OTH-Gold message format to the US Global Command Control System (GCCS) or to any other system that accepts OTH-Gold messages by means of a TCP/IP socket connection.

The JOI is a JTLS Object Distribution Authority (JODA) client that has the capability to easily start and stop the feed of OTH-Gold messages according to the status of the JTLS game and is able to alter the naming data passed to the real-world systems. Consequently, any database object
naming errors can be corrected independently of the model to allow the exercise audience to view correct names while monitoring the real-world system that is populated by the JOI. The JOI has a complete checkpointing capability and can be restarted from any of its checkpoint files without losing information.

2.9.5 KML Operational Interface (KOI)

Global satellite imagery viewers similar to the C4I systems used by US forces have become widely available to exercise audiences for the display of scenario object and terrain data. One such example, the Google Earth (™) viewer, supports a robust application interface protocol known as Keyhole Markup Language (KML). The KML data facilitates an imaging program to ingest and display JTLS force status information. The KOI is the JTLS component which generates operational KML files for a remote Google Earth viewer. File transmission is accomplished via HTTP using the Apache Web Services server. This capability allows all JTLS ground Units, Naval Units, High Resolution Units, all types of Targets, Air Missions and Cruise Missiles to be displayed by operational users employing a Google Earth viewer. Any other display system capable of processing KML data may also be used for display purposes.

Like the JOI, the KOI is a JTLS Object Distribution Authority (JODA) client. The KOI serves object data intended to be displayed by visualization programs. It provides a set of periodic and specially formatted files to end users with configuration capabilities which are somewhat different than the JOI.

2.9.6 Scenario Data Repository

The Open Access Programs, the Order Entry Client (OEC), Scenario Data Client (SDC), and After Action Review Client (AARC) use an Oracle database to store game data while the game is executing. The Scenario Data Repository (SDR), an Oracle data repository, is used to hold data and interact with these client programs. Since Oracle databases support open standards, data can be accessed by third-party applications, such as reporting tools or C4I systems.

The Scenario Data Client (SDC) is responsible for populating and updating the Scenario Data Repository (SDR) with the current game information provided by the JODA. Any object information provided by a JODA is available in the SDC data tables.

The After Action Review Client (AARC) program is responsible for populating the Scenario Data Repository (SDR) with CEP object, object history, and object interaction data. These data constitute a history of the running model which can be used for AAR queries (tracking combat systems losses for example) or for run-time reporting or analysis (interim mission reports or determining why minefields were created).

The Order Entry Client (OEC) checks database tables within the Scenario Data Repository (SDR) for orders that have been placed for submission to the CEP. The OEC is responsible for retrieving, formatting, verifying, and submitting these orders.
2.10 AIR TASKING SUPPORT TOOLS

JTLS supports a robust set of interactions between Air Missions and the other components of the simulation, such as unit logistic stocks, air defense capabilities, and unit combat systems. The model does not automatically assign and task air resources. Assignment and tasking of these resources is the responsibility of a Player, and is performed on a mission-by-mission basis. Two tools exist to support and simplify this capability.

2.10.1 Air Tasking Order Generator (ATO-G)

The ATO-G is designed to assist an Air Player to create offensive and defensive Air Mission orders to be input directly to the simulation with minimal user action. The Player specifies target areas, target priorities, available aircraft resources, and the command’s desired apportionment goals for the selected ATO period. The ATO-G uses this guidance, the Player’s perception of the battlefield, and the current unit logistical status to automatically create a set of coordinated air orders. The Player is allowed to view or change individual order parameters prior to sending the generated orders to the CEP.

2.10.2 Air Tasking Order Translator (ATO-T)

The Air Tasking Order Translator (ATO-T) is designed to utilize an Air Tasking Order generated by an exercise Air Staff to create the JTLS Air Mission orders needed to properly represent the plan in JTLS. The ATO-T translates a USMTF ATO typically produced by the Theater Battle Management Core System (TBMCS) ATO generator program into JTLS Air Mission orders. Players must obtain the ATO in the specified Joint format. Technical Control personnel load the file into the correct directory on the computer. The program then allows Players to review the results of the translation and provides a limited opportunity to modify some of the taskings. This tool permits wholesale adoption of orders created by a functioning Air Operations Center (AOC). However, some ATO missions do not translate automatically. Hence, air Players are required to input these orders from the WHIP.

The ATO-T also allows users to translate a spreadsheet specifying intelligence collection areas, known as Directed Search Areas (DSAs), that should be created and used by Reconnaissance missions during an ATO cycle.

The ATO-T executes in two modes, named Basic and Advanced for the purpose of this description. The ATO-T requires libraries from Simscript and Oracle to run in either mode. The Basic mode of the ATO-T reads and processes Air Tasking Orders in USMTF format, as well as Air Mission data prepared using an Excel spreadsheet and delivered in comma-delimited format. The output from the ATO-T at the Basic level consists of ASCII order files that may be read into the CEP using the Read Order File order.

The Advanced ATO-T mode reads Air Tasking Orders and Air Mission data in the same formats as the Basic mode. However, this mode writes the orders directly to SDR tables for error checking and for input directly to the CEP using the Order Entry Client (OEC). Each order written into the
Oracle tables specifies a time the order is scheduled for submission to the CEP. The OEC continuously monitors the Oracle tables and performs a final error verification at this specified time before submitting the order.

2.11 WARFARE FUNCTIONS MODELED

The CEP simulates the execution of air, ground, intelligence, logistics, and naval activities. This section provides a brief listing of these functions. Details describing how each function is modeled are presented in other chapters of this JTLS Analyst Guide.

2.11.1 Air Functions

The air model represents the following capabilities:

- Airborne Warning and Control System (AWACS)
- Electronic Combat (EC)
- Air refueling
- Escort
- Suppression of Enemy Air Defenses (SEAD)
- Defensive counter-air (including ground and airborne alert)
- Surface attack
- Close Air Support (CAS) (including ground and airborne alert)
- Reconnaissance, both armed and unarmed, including specifications for DSAs (Directed Search Areas)
- Airdrop of units or supplies
- Airlift of units or supplies
- Air Mission Packages
- Air emplacement of land or sea mines
- Anti-Submarine Warfare
- Orbiting Air Ground Missions (OAG)
- Real-Time Commitment of OAG and diversion of surface attack missions
• Manual commitment of air missions to intercept enemy air missions

• IFF (Identification, Friend or Foe) including Unknown identification

• Detailed Air-to-Air and Surface-to-Air Rules of Engagement (ROE), including OPAREA-specific ROEs

• Establish links with other factions to share air detection information

• Search and Rescue (SAR) operations for downed pilots

• Integrated Air Defense System (IADS) operations

2.11.2 Ground Functions

The Ground model represents the following capabilities:

• Attrition caused by direct fire

• Attrition caused by indirect fire

• Counter-battery fire

• Movement

• Attack

• Hasty defense

• Prepared defense

• Delay

• Withdrawal

• Delaying effects of, and attrition caused by, land mines

• Close Air Support

• Counter-battery

• Command, Control, and Communications (C3)

• Attrition and delays caused by nuclear and chemical contamination

• Military engineering, including Bridge construction
• Attachment, detachment, and reconstitution of units
• Emplacement of mines by artillery, air drop, or unit action
• On-order destruction and repair of targets
• Special Operation Forces
• Multi-Faction coalitions
• Detailed Ground Combat/Surface ROE, including OPAREA and National Boundary specific ROEs
• Civil Affairs and PSYOPS (Psychological Operations)
• Detachment of small units (High Resolution Units, or HRUs) to carry out a variety of tactical operations

2.11.3 Intelligence Functions

The Intelligence model represents the following capabilities:

• Periodic intelligence via the Periodic Summary
• Directed intelligence through HRUs, airborne reconnaissance, and unit organic resources
• Spot/mission reports from ground forces and airborne missions
• Separate perception of the battlefield for each Force Side
• Selective sharing of Intelligence between Force Sides
• Partial Intelligence of targets and units
• External/National asset resources
• Communications networks

2.11.4 Logistics Functions

The Logistics model represents the following capabilities:

• Effects of logistics on combat capability including maintenance and return to service for Combat Systems
• Automated resupply (e.g., stockage objective, reorder level, and backorder)
• Multiple support unit assignment based upon supply category
• Player-directed supply, resupply, and cross-leveling for units
• Movement of supplies by rail, barge, or truck
• Transportation of units by rail, barge, or truck convoy
• Pipeline operation
• Caching and recovery of own supplies and capture of Enemy supplies
• Port operations for inter- and intratheater air and sea movement
• Transportation networks (linking bridges and tunnels)
• Random equipment failures

2.11.5 Naval Functions

The Naval model represents the following capabilities:

• Carrier-based air activities as listed in the air function
• Supply Sealift
• Search radar coverage (Air and Surface)
• Fleet air defense
• Ship damage, including lifeboat deployment
• Surface-to-Surface missile firing and naval gunfire
• Naval reinforcing fire, including Counter-battery fire
• Task organization (Formations) that include units from multiple Factions and Force Sides
• Amphibious pickup/extraction and assault
• Mine warfare operations, including laying, sweeping, and casualties
• Task organization (Formation) movement, including merging formations
• Submarine (diesel and nuclear) operations
• Area patrol
• Ocean depth, depth zones, and the effects of depth on operations

Additionally, the JTLS CEP models the effects of disease on personnel. Personnel contract diseases and either die or recover. The disease status of units is reported as part of the Periodic Reporting process.

2.12 EVENT-DRIVEN SIMULATIONS

JTLS is a simulation model of a joint campaign at the theater level. As such, it simulates the key aspects of the air-land battle and supporting naval operations.

Simulations may be characterized as continuous or discrete-time. JTLS is a discrete-time simulation. Discrete-time simulations may be further characterized as time-stepped or event-driven. In event-driven simulations, state changes occur at specified times, during which interactions between system components occur.

Activities are the basic components of a dynamic system, and have two fundamental characteristics:

• They take time.

• They potentially change the state of the system.

While constructing a system model, developers must identify and represent the activities in a way that enables the simulation to reproduce the time-dependent behavior of the simulated system. Activities must be modeled so that the system state changes properly when each activity occurs. This requirement imposes additional conditions for correctly modeling the characteristics of activities and for sequencing the simulated execution of activities so that their order of performance within the model corresponds to the order in which the same activities occur in the real-world system.

An activity in a system is bound by two instantaneous events: when the activity starts and when it stops. The event is the simplest component of an activity description, and has two basic properties:

• It occurs at some instant of time.

• The occurrence is instantaneous.

The changes in a system that occur when an activity starts or stops are associated with events rather than activities. Since these events cause all significant system state changes, the passage of time between events need not be accurately followed. Instead, the passage of simulation time is driven by the sequence of events, always advancing to the time of the next significant event.
2.13 SIMSCRIPT

2.13.1 Why SIMSCRIPT?

Event-driven simulation was chosen for JTLS for two reasons:

- The key processes of theater-level, air-land battle are most easily visualized as collections of discrete events.
- Event-driven simulation is relatively fast and makes efficient use of computing resources.

The main routine-subroutine structure of most high-level programming languages is not suitable for event-driven simulation because of the awkward way it represents activities which occur simultaneously in simulation time. Furthermore, the software mechanism required to maintain synchronization of simulated time with the pace of events is complex and would be most useful as a programming system utility.

For these reasons a special-purpose, discrete-event simulation language called SIMSCRIPT was chosen to implement JTLS. SIMSCRIPT has built-in mechanisms for handling both simultaneous events and simulation time. Additionally, the SIMSCRIPT world view is that of a discrete-event world, and the language has many other features that lend themselves especially well to event-driven simulation.

2.13.2 The SIMSCRIPT World View

The SIMSCRIPT world is populated with entities and sets. Entities are characterized by attributes. A set is a collection of entities sharing a logical association. Thus, a military unit such as a division may be an entity. Possible attributes are its name (such as 82.AIRBORNE), average ground speed over open terrain, and capacity to carry supplies.

An entity may be both a member of sets and an owner of sets. Thus the entity 82.AIRBORNE might be a member of the CONFLICT SET—the set of all units in the game. This entity also might be the owner of a HEADQUARTERS SUBORDINATE SET—the set of all units subordinate to it (e.g., a division artillery battalion or an engineer battalion).

A very special kind of entity is the event, the simplest component of an activity description. Events are managed by a Future Events Set that is provided by SIMSCRIPT. Each event is also associated with a subroutine, whose execution may be scheduled to occur at a specific simulation time in the future. An example of an event in JTLS is the UNIT HOURLY PROCESSING event. This event occurs at specified intervals and calls various subroutines that perform record keeping tasks over a given period of time. It is first scheduled by the routine starting the simulation. Thereafter, it schedules itself. The simulation must be started by the scheduling of one or more future events. Its continuation depends on the existence of at least one pending event in a Future Event Set.
In addition to entities and sets, SIMSCRIPT also uses arrays. The most basic form of array is a list. Another common form of array may be visualized as a table. In SIMSCRIPT, arrays may be linked to entities by means of a specialized attribute of the entity called a pointer. Thus the array (in this case a table) that holds the Rules of Engagement (ROE) for a particular Air Mission entity is linked to the mission by the ROE array pointer. Information is recovered about the status of a unit’s ROE’s merely by retrieving the ROE pointer attribute of the mission and, using the pointer, retrieving the ROE array of the mission.

The data described in this document are used to create the entities, attributes, sets, events, and arrays used by the Combat Events Program to model the represented combat situations.
3.0 MODEL CAPABILITIES

This overview of JTLS modeling functions is organized into sections that describe Force Control, Ground Combat, Logistics, Air Combat, Naval Combat, and C3I.

3.1 FORCE CONTROL

3.1.1 Command Authority

Players interact with the simulation by sending orders to units over which they have either primary or shared authority. JTLS provides the commander of each Force Side with the ability to manage the allocation of command authority among the Players on that Side. At simulation start, one Player on each Side has primary authority over all units on that Side. Thereafter, ordering authority over units, primary or shared, can be granted or revoked for individual Players.

3.1.2 Force Side Relationships

Each Force Side in the simulation has a relationship (Friendly, Neutral, Suspect, or Enemy) with each other Force Side. At the start of a simulation, each Side has a relationship to each other Side that is specified in the database for each Side. Relationships can be changed either directly by Player order or indirectly as a result of an attack. Force Side relationships determine how units react to units of other Sides. For example, a unit will kill a discovered convoy only if it perceives that the convoy came from a unit on a Side for whom the relationship is Enemy.

3.1.3 Rules of Engagement (ROE)

JTLS models flexible and changeable ROE assignments. This allows the representation of situations prior to hostilities, when units and aircraft are operating in close proximity but are not fighting. It also allows play to easily escalate to limited exchanges by some units without all-out exchange. It accommodates a situation in which unknown air missions are to be engaged while others are to be intercepted without attack. It permits the situation in which foreign objects are to be engaged only if they come within a specified distance of Friendly assets. ROE algorithms allow for automatic firing of naval SSMs and torpedoes. Finally, ROEs can be specific to designated Operations Areas (OPAREAs), and can be altitude zone specific withing each OPAREA.

JTLS represents Ground/Surface, Surface-to-Air, and Air-to-Air ROEs. Each unit has a specific ROE value for each opposing Side for each of these categories. The ROE settings include:

- No Fire: The unit is not allowed to initiate combat or return fire.
- Hold Fire: The unit may not initiate combat, but can defend itself.
- Combat Approved: The unit may initiate engagement with Enemy objects meeting the specified criteria and within range.

3.2 GROUND COMBAT OPERATIONS

The JTLS ground module performs these basic ground combat functions:

- Establish new routes for ground movement
- Attack, defend, delay or withdraw
- Perform administrative moves
- Order explicit indirect fire support (and the associated capability to cancel such orders)
Ground close combat between and among aggregate units is modeled by the use of mixed, heterogeneous, time-stepped Lanchestrian difference equations. Separate equations are used for casualties caused by direct fire Combat Systems and indirect fire systems. The amount of attrition is affected by environmental conditions, such as weather, night or day, and terrain. Engagements involving HRUs are simulated using explicit representation of the units capabilities to fire weapons and detailed assessments of the results.

3.2.1 Ground Force Movement and Deployment

Ground movement in JTLS follows a path of hexes, with the moving unit “jumping” from point to point within a hexagon or between hexagons at appropriate time intervals. The paths followed may either be minimum time or minimum distance, with the actual path optimized by the model. Movement paths are specified by Players as Ground Routes. Movement delays caused by route congestion or Enemy action (mining, nuclear or chemical contamination, artillery, and air strikes) are also simulated in JTLS. Minefields delay moving units and cause attrition.

Ground units can move either administratively or tactically. An Attack, Delay or Withdraw directive (Player order) results in a tactical move. Any other order that directs a unit to move to a location (including a Move directive) causes the unit to perform an administrative move. An administrative move can be directed for a single unit or a group of units and is typically faster than a tactical move.

3.2.2 Ground Unit Attack Operations

Only Ground Combat units can perform the Attack mission. Usually, an Attack directive is part of a larger plan, which might consist of several units attacking, other units reinforcing them by fire, and other units following in reserve, or for exploitation.

An Attack directive may specify a route to follow, an enemy unit to attack, or both. If both are specified, the unit adds the location of the Enemy unit to the end of the attack route, as that location is known at the time of execution of the directive. Whether an enemy unit is specified or not, once the attacking unit reaches its destination, it will remain in the Attack posture until the destination hex contains no Enemy units. Once the hex is clear of Enemy units, the attacking unit reverts to a Defend posture.

As an option, the Player may specify that the attacking unit is to perform a Move to Contact. The unit is permitted to do so, provided it is not already in combat. When a unit uses the Move to Contact logic, it assumes the Attack posture and moves along the attack route, but does not incur the full movement speed penalty for being in the Attack posture. Instead, it moves at a speed that is the average (arithmetic mean) of the Attack speed and the Administrative Move speed.
3.2.3 Combat Systems

Any number of Combat Systems may be represented in the database. Each system is described in terms of various characteristics, including maximum effective range, lethality, recoverability and repairability, and type of fuel and ammunition required. Combat Systems are also characterized as direct or indirect fire systems, with the appropriate differences in attrition calculations.

Indirect fire systems may also be employed explicitly. All munitions are delivered to a location specified by a set of terrain coordinates. All units, supply convoys, air missions on strip alert, and targets in the vicinity of the fire are subject to attrition, regardless of who fired. Nuclear and chemical munitions may be fired. Based on the data incorporated in the database, casualties occur both instantaneously and during the period of time a unit remains in a contaminated area. Any ground combat unit may be directed to support any other non-naval unit with indirect fire resources. Any ground unit may be ordered to lay or clear mines and to repair targets.

3.2.4 Artillery Operations

Artillery weapons that are specified as Combat Systems in JTLS can be used in four distinct ways:

- Lanchestrian combat: Enemy units are in proximity, and fighting. All of the available Combat Systems are applied to the process of causing Enemy casualties.
- Direct Support: One or more Ground Combat or Naval units have been directed to provide direct support fire for another unit.
- Explicit Fire:
  Fire missions may be directed against specific latitude/longitude or military grid locations; against a list of Enemy, Neutral, or Friendly targets; or against a list of detected Foreign units.
  The Artillery weapons may be part of an HRU and used for its combat operations.
- Counter-Battery fire: Automatic engagement of enemy artillery units firing on own forces.

Any kind of ammunition can be explicitly represented in JTLS as a Targetable Weapon. The projectile types that artillery units can fire are a subset of all Targetable Weapons included in the database. Other Targetable Weapons include: SSMs, bombs, torpedoes, Surface-to-Air and Air-to-Air missiles, and munitions for explicit use by HRUs. Each projectile has its own set of Targetable Weapon characteristics, including its time to fire, supply category, type of guidance, lethality index (area or point damage), and its effects type. Artillery can fire Targetable Weapons that cause either area or point damage.

3.2.5 Surface-to-Surface Missile (SSM) Operations

Unlike Artillery Combat Systems, SSM launchers are used only for explicit fire missions. Land-based and sea-based SSMs are fired from SSM targets owned by the firing unit. Each SSM target type can fire one designated type of missile (Targetable Weapon) having its own set of parameters (Targetable Weapon characteristics). A unit can fire more than one type of missile, provided it owns more than one type of SSM target. SSMs can be defined as either Ballistic or Cruise missiles.

Missiles are fired in two ways. First, units that own Surface-to-Surface Missiles may be directed to fire those missiles at a specified location, target, Foreign unit (naval or ground), or along a range and bearing.
Like all targets, SSM targets have one of three mobility classes: Stationary, Deployed While Moving, and Mobile. SSMs that are Stationary or Deployed While Moving (aboard ships, for example) are assumed to be in a state of advanced readiness for firing. Mobile missiles may be in a state of Prepared to Fire, Preparing to Fire, or Unprepared. SSM launchers that are Unprepared are more difficult to detect. The initialization of preparations to fire increases the detectability of the SSM launcher and may trigger a detection of the activity by surveillance assets covering the area. The increase in SSM readiness is initiated only in response to a Player order to fire or to prepare to fire.

The second method by which missiles are launched is by automatic engagement between naval units. If the naval unit has a Ground/Surface ROE that permits it to engage ships of other Sides, its owned SSM targets may be used to conduct such engagements. If a Foreign unit is subject to engagement under the ROE, the unit will engage using available SSM, as soon as the Foreign vessel is detected within range.

Unlike artillery rounds and air-to-air weapons, SSMs can be shot down before they impact. Depending on the data, they may be engaged during:
- the terminal phase of flight within the impact area;
- the terminal and mid-course phase; or
- not engaged.

Engagement depends on the presence of capable Air Defense systems. During the mid-course phase, Air Defense Artillery (ADA) systems require permissive ROE to fire. In the terminal phase, any ROE except No Fire permits engagement. Engagement can take place in both the mid-course phase and the terminal phase, regardless of the source of the launch.

3.2.6 Targetable Weapon Effects

All Targetable Weapons in JTLS cause either area or point damage. Area weapons, both precision-guided and non-precision guided, cause damage to one or more objects in the impact area, and may result in fratricide. Non-precision点 weapons hit the targeted object if there is one in the covered area; otherwise, an object in the covered area is randomly selected. Precision point weapons hit the targeted object if it is in the covered area; otherwise, an object in the covered area is selected using an algorithm “best” pK.

A point damage weapon can cause damage to one object in the affected area. The definition of an “object” depends on the entity being damaged. For a unit, one object is a packet of Combat Systems or supplies, whose size is specified in the database. For a Supply Run, it is one truck, barge or railcar. For an air mission on the ground, it is one aircraft. For Surface-to-Air Missile (SAM), Anti-Aircraft Artillery (AAA), Surface-to-Surface Missile (SSM), Equipment Shelter, and Material Handling Equipment (MHE) targets, it is one component of the target (one launcher, a single shelter, or a single item of MHE).

There are four types of Targetable Weapon effects: conventional, chemical, nuclear, and mines. Conventional munitions, including High Explosive (HE) and Improved Conventional Munitions (ICM-bomblet type), cause conventional effects based on weapon type, target type, lethality data and algorithms that are described in detail in the JTLS Analyst Guide. Chemical and nuclear munitions both cause immediate personnel casualties and also contaminate the area for specified periods of time. Mine munitions either create or add to minefields.
Targetable Weapons also can be designated as leaflet rounds by being issued from the LEAFLET supply category. These rounds disperse Psychological Operations leaflets in the vicinity of the impact point and may reduce unit effectiveness in the area.

3.2.7 Attaching and Detaching Units

Players may direct the attachment of one unit to another, and the detachment of one unit from another. This does not apply to Naval units. The attachment and detachment logic is also used for unit arrivals through ports, airlift and airdrop of units, and amphibious operations, including both opposed and unopposed pickups and landings.

Attachment has some restrictions. The two units to be attached must be on the same Side, in the same faction, of the same type (e.g., support units), and have the same type of aircraft if they are squadrons. The primary uses of the Attachment capability are to rejoin two units that were earlier separated, to provide a reconstitution opportunity, using two units, or to permit task force tailoring.

3.2.8 Mining and Minefield Clearing

Minefields are represented as target entities in JTLS. They are displayed on graphics if they have any mines in them, i.e., they have not been cleared. They are also displayed on the IMT if they have been detected. There can be many types of minefields in JTLS. One of their distinguishing characteristics is whether the emplacing Side retains knowledge of the "paths" through the minefield. This is a data entry. For such types as artillery emplaced scatterable mines, the Side would probably not now how to safely get through the resulting minefield.

Players can direct ground units, naval ships, or formations to lay or clear minefields, provided the units have that capability. The time expended depends upon the capabilities of the unit and the size and number of the minefields. For mine laying, the Player specifies the number of mines and type to emplace. Each mine requires that the emplacing unit have the required amount of the appropriate category of supply. A unit that does not have enough of the mine supplies will lay all that it has. The effects of minefields are specified in terms of the number of “standard minefields” encountered. The number of mines in a standard minefield is an entered data item that may be different for various minefield types.

3.2.9 Missions and Postures

A unit’s posture is displayed on graphics and the IMT, and included in some reports to Players. The unit mission is the last thing that the unit was directed to do and is displayed on the IMT. Units change posture either in response to Player directives, because they have completed a task, because they cannot continue a task for some reason, or because they have been attrited until they are too weak to maintain their current posture. Units enter the simulation in a DEFEND posture, and revert to a DEFEND posture upon completion of an attack or an administrative move. Generally, a unit never increases its posture unless ordered to do so. The decreasing order of postures is ATTACK, DEFEND, DELAY, WITHDRAW, INCAPABLE, WIPED OUT. MOVING and AIR OPS are the same level as DEFEND. A unit that is forced to a WIPED OUT posture is removed from the simulation.

3.2.10 Air Defense

Most surface-based air defense functions are automated, since there usually is not enough time for the Player to respond to contingencies. The Player has three principal areas of responsibility for surface-based air defense:
• ROE: Air Defense assets need ROE permission to engage Enemy objects. Each SAM/AAA target entity is either owned by or associated with a unit. The target obtains its Side affiliation and its ROE from the unit.
• Radar: Each ADA site consists of a single target entity that represents one or more ADA assets. The number of assets is specified by the TG NUMBER of the entity. Each asset consists of a sensor, and a number of firing elements. The sensor is considered a Fire Control Sensor, and provides radar tracking for its own asset only. The assets and the entire site are dependent on other sensors for early warning and acquisition. This process is discussed in Section 3.2.12.
• Resupply: When each SAM or AAA target first enters the simulation, it is provided a full load of ammunition or missiles. As those assets are fired, they must be replaced if the ADA or AAA sites are to remain effective. The ammunition is replenished from the target's associated unit, provided that unit is within a database-specified distance of the site.

3.2.11 Sensors and Jammers

Any unit can own one or more sensor or emitter targets. Three types of sensors are simulated in JTLS: air search, surface search and sonar. Air search sensors detect aircraft and missiles. Surface search radars detect surface ships. Sonars detect submarines and naval surface units. Three emitter types are modeled: communications jammers, radar jammers, and broadcast emitters.

Players can turn on or off the sensors and emitters that a unit owns. They can specify that the emitters be left on until turned off by another directive, or can direct that they be turned on for a specified period of time. Each sensor or emitter target has a target subcategory that specifies the emitter type it represents. Each sensor type has an attribute that specifies whether it is subject to interference from jamming. All ship-owned emitting jammers and jammable sensors are subject to counter-detection by foreign Sides.

Radar or communications jamming can also originate from Electronic Combat (EC) air missions. The type of jamming is for EC missions is determined by the jammers included in the JAMMER LOAD for the type of aircraft flying that mission.

Radar jammers interfere with the capability of Enemy air search sensors to detect objects. The algorithm is based on a comparison of jammer power at the sensor source to the sensor’s return signal power measured at the location of the object being detected. Communications jammers affect the transmission and receipt of messages in a similar manner, by increasing the amount of time it takes a unit to receive a directive or send a message to a Player. The JTLS Analyst Guide provides a detailed discussion of the algorithms for both types of jammers.

Broadcast emitters permit Players to perform Broadcast Psychological Operations directed at specific Factions on other Sides. The results of the broadcast are felt by all units in the covered area, but most strongly by units of the targeted Faction. The effect in the simulation is a reduction in unit effectiveness, resulting in a decreased capability to fight and longer times to perform some actions.

3.2.12 Integrated Air Defense System (IADS) Networks

IADS networks are explicitly represented in JTLS, and are subject to attack and disruption by land, air, and naval forces. An IADS network consists of ADA Sites, Sensors, and Communications Sites, with specified links between the members.
The links between the members are explicitly contained in the database. Communications sites may be linked to other Communications Sites, to Sensors, and to ADA sites. Sensors may be linked to Communications Sites and ADA Sites. ADA Sites can receive links from Sensors and Communications Sites.

The information flow is from Sensor to Communications Site (to Communications Site, etc.) to ADA Site. ADA sites only receive information. Sensors only send information, Communications Sites both receive and send information.

An ADA asset whose site is on an IADS network, and has a functioning Fire Control sensor, has its full engagement and kill capabilities. If the Fire Control sensor is damaged, the site can still engage if it is connected to an IADS network. If the site is not connected to an IADS network, its probability of detecting and engaging foreign aircraft may be reduced (depending as always, on the data.) Finally, if the ADA Site is not connected to an IADS network, and the Fire Control Sensor is non-operational, that asset simply cannot engage. In order for an IADS network connection to assist the asset in engaging, some sensor on the network must be tracking the air mission in question.

3.2.13 High Resolution Units

Two ground unit levels of resolution are represented in JTLS. Large, main force units such as brigades and divisions are represented at a high level of aggregation, and are called Aggregate Resolution Units (ARUs). These units have been represented in JTLS since its first release. Subsequent releases introduced a new unit type, the High Resolution Unit (HRU). This unit type is intended to represent very small units, such as SOF teams, small Civil Affairs units, Medical Assistance teams, Traffic Control points, and NGOs.

The structure of these HRUs is based on a set of High Resolution Prototypes (HUPs), which describe the Combat Systems, supplies and target entities the HRU is issued when the unit is created. The HRU can be created as a result of database entries, arriving when its parent unit arrives, or as a result of Player action, being detached from a Parent unit that has the requisite Combat Systems and supplies to outfit the HRU.

HRUs can perform the following missions, provided the required capability is indicated on their HUP:

- Traffic Control
- Coalition Support, providing translation services, and a capability to call in Close Air Support (CAS) to allied units that may not have that capability
- Perform Intelligence Patrol Missions, breaking radio silence to report high interest objects or activities
- Civil Affairs
- Own and operate ADA targets. Future JTLS versions will allow HRUs to fire SSMs.
- Perform Combat Patrols, engaging high-interest objects, using their Combat Systems
• Establish and execute ambushes. The subject of an ambush may be a specific unit or target, or may be any unit or target that conforms to a set of descriptions provided by the Player.

• Execute a Direct Action mission (raid). The subject of the raid is always a specific unit or target.

• Represent downed aircrew who have survived the destruction of their aircraft

• Represent lifeboats launched from sinking ships.

HRUs can move across land using their own resources, or can be moved using air resources. The extraction of downed aircrew HRUs can be played explicitly. HRUs have the capability to operate covertly, and must do so to execute an ambush. For all other combat operations, a Covert status is optional.

All attrition involving HRUs is represented using the explicit expenditure of weapons logic in JTLS. Data parameters specify the type of Targetable Weapons used by each Combat System during High Resolution Combat. HRUs can attrite and be attrited by other HRUs, and main force units (ARUs). HRUs also attack and damage targets. If the target is owned after the initial engagement, the target’s owning unit is permitted to return fire at the HRU.

HRUs are subject to the full effects of Air, Artillery and Missile fire, but are explicitly excluded from the casualties caused by minefields. They are currently not permitted to clear minefields.

JTLS includes a limited representation of Civil Affairs. When a Civil Affairs HRU is stationed in a location, it provides two benefits to its Side. First, any stationary Civilian units that are from a Friendly or Neutral Side do not contribute to the congestion penalty assessed against units and convoys moving in or through the hex. Second, when the unit performs a Tactical Intelligence update for its Side, any of its HRUs that are performing a Civil Affairs mission can acquire information about any unit or target within intelligence range of any Friendly, Neutral, or Suspect foreign unit in the same hex as the HRU. This can significantly enhance the intelligence-gathering capability of the Civil Affairs unit’s Side.

3.2.14 Psychological Operations (PSYOPs)

JTLS models PSYOPs (or MISO, Military Information Support Operations) as leaflet delivery and PSYOP broadcasts.

PSYOP leaflets can be delivered by artillery fire, SSM, Air Attack, or Air Drop to a unit. The leaflets are delivered to the targeted unit first, and then to other units in the area. Leaflets are fully effective against units that belong to the same Faction as the targeted unit, one half as effective against other units on the same Side, and have no effect on units on other Sides. Units on other Sides do pick up leaflets. The effect of leaflets is to reduce the unit effectiveness. The amount of the reduction depends on the number of leaflets delivered to the unit.

PSYOP broadcasts can originate from a broadcast emitter owned by a unit, or from an EC mission that includes a broadcast emitter in its mission load. In either case, a targeted faction must be specified. The amount of effect from broadcast PSYOP depends on the power and duration of the broadcast. The effect of broadcast PSYOP is to reduce unit effectiveness.
3.3 LOGISTICS FUNCTIONS

JTLS provides Logistics Players significant and vital capabilities to augment the automatic requisitioning/delivery process. Logistics Players must interact with the model by monitoring the IMT, requesting reports, interpreting advisory messages, scheduling resupply airlifts, sending resupply to units in trouble or lacking supporting units, changing stockage objectives and reorder levels, assigning new support units, or directing mandatory transfers of supplies. The commander’s concept of the operation must consider a variety of combat support and combat service support activities. These logistics capabilities exist in JTLS:

- Movement of supplies between units by truck, barge, or rail
- Use of trucks from one unit to pick up supplies from one or more other units, and deliver them to the other units or locations
- Mandatory transfer of supplies from one unit to another.
- Automatic or Player-directed resupply of units
- Creation of logistics loads for use in future orders
- Creation of supply caches for future use
- Operation of pipelines, including drawing supplies from the pipeline and replenishing supplies
- Capture of Enemy supplies and recovery of own supplies
- Modification of stockage objectives and/or reorder thresholds of one or more supply categories for either a single unit, a group of units, or all units
- Change of the depot from which a unit orders its supplies or from which a pipeline is replenished
- Airlift operations (through the air module). An aircraft squadron or helicopter company is capable of lifting either a unit or supply load from a loading location to an offloading location.
- Airdrop operations (through the air module). An aircraft squadron or helicopter company is capable of airdropping a unit or supply load at a specified primary location or alternate location.
- Sealift operations (through the naval module). A naval unit or formation is capable of sealifting either units (Amphibious Operations) or a supply load from a loading location to an offloading location.
- Evacuation of casualties whose expected recovery time is longer than a Faction-specific maximum time. Casualties are evacuated by convoys that deliver supplies to the unit, and are evacuated to the unit’s support unit. Players also can cause evacuation of casualties using an Airlift or Sealift order, in addition to the Directed Resupply and Automatic Push. Evacuation to medical units requires Player intervention.
3.3.1 Supplies and Supply Categories

Database builders and exercise planners have total control over how a side’s support hierarchy is designed, and over units’ initial quantities, usage rates, and other supply status data. On the one hand, units can be given basically unlimited supplies. This permits assessment of operations in an environment that is totally unconstrained by availability of supplies.

At the other extreme, high-resolution micro-management of the logistics situation is permitted by the very specific Directed Resupply, Airlift, Airdrop, Sealift, Reorder Level, and Stockage Objective directives. Between these two extreme conditions, modeling normal constrained availability, automatic requisitioning, and automatic (Player-initiated) Push shipments provides a medium-level management-by-exception capability.

An unlimited number of different supply categories can be represented. Categories of supply need not correspond to the standard military classes of supply. A very small unclassified JTLS database for example included these categories:

- Personnel
- Ground Fuel
- General Ammunition
- Mines
- Aviation Fuel
- Major End Items
- Artillery Ammunition
- Engineer Supplies

Database entry variables determine the normal periodic consumption rate for each category of supply by unit. In addition to this “normal” consumption, units that are in combat (or moving) will consume supplies at higher rates. Explicit expenditure of supplies occurs in JTLS because of events such as: ground or naval indirect fire missions, destroyed convoys, depots that have been attacked, air movement (airlift and airdrop), and air engagements.

The logistics module includes a maintenance function that simulates the initial fail on issue rate, repair of systems damaged in combat, and their eventual return to operational status. Each Combat System has several attributes in the database; one of these specifies a percentage of casualties that can be recovered from combat, and another specifies a percentage of those that will eventually return to their combat unit. This method is used to represent recovery and repair times of various Combat Systems.

Explicit supply categories may be specified for Casualties and Remains. If no such categories are specified, the evacuation of casualties is not represented, nor is recovery and evacuation of remains. A database may have either, neither, or both.
3.3.2 Support Unit Operations

As part of the data that describe a unit, a general support unit and separate support units for each category of supply can be specified, as well as a time between supply adjustments. Each time a unit performs a supply adjustment, it computes the amount of each class of supply it has used, whether it owes supplies to any other unit, and whether it should requisition more supplies. If it needs to requisition more supplies, it requisitions them from the unit specified to provide that category. If none is specified, the requisition is sent to the general support unit.

When a supporting unit receives a requisition, it ships what it can, and places the rest on backorder. As more supplies or more transportation assets become available, the supporting unit looks at each backorder, and fills them in priority order. The priority is: Directed Resupply, Automatic Push, Combat, and Normal. Directed Resupply and Automatic Push result from Player directives. A combat backorder is one from a unit that is in combat or from a unit supporting a unit in combat.

3.3.3 Directed Resupply, Convoys

A Player can direct a support unit, airbase, or Forward Arming and Refueling Point (FARP) to send a one-time shipment of supplies to another unit. This creates a Directed Resupply requirement at the shipping unit. The shipping unit will either ship the supplies by convoy or backorder them. A Directed Resupply can be used to build up stocks prior to an operation, or to temporarily solve a supply shortage problem.

Supply convoys can consist of Trucks, Railcars, or Barges. For truck convoys, the truck assets from one unit can be dispatched to another unit, or units, to pick up supplies, for delivery to other units in the scenario. The convoys attempt to fulfill the requirement, but a 'Fill or Kill' philosophy is followed. If the required supplies are not available at a pickup point, the convoy continues on its route, delivering what it can. Upon completion of the route, the convoy returns to the unit that owns the trucks, for further tasking.

3.3.4 Automatic Push

A Player can direct a support unit, airbase, or FARP to send a periodic shipment of supplies to another unit. This creates an Automatic Push requirement at the shipping unit. An Automatic Push requirement is the second highest priority requirement. The shipping unit will either ship the supplies or backorder them. The period may be any length of time. The Automatic Push order was designed to be used by units without a supporting unit from which to requisition. It has also proved useful for establishing throughput shipments for units attacking or supporting attacks, to keep them supplied with fuel and ammunition.

3.3.5 Pipeline Operations

A pipeline consists of a source node, one or more pipelines arcs, and one or more other nodes. Units in the simulation interact with Supply Storage Area targets associated with the pipeline. When a unit goes through the Adjust Supplies process, it accesses available supplies from Supply Storage Area targets in the area before it requisitions supplies. When it tries to fill a requisition, it takes supplies first from local supply storage area targets. These include pipeline associated targets. The Supply Storage Area targets have a limited amount of supplies available. When a unit takes supplies from a pipeline target, it creates a requirement that the target be refilled. The supplies are replenished by the unit that is designated to operate the pipeline.
3.3.6 Mandatory Transfer

While only support units, airbases, and FARPs can originate Directed Resupply and Automatic Push actions, any unit can originate a Mandatory Transfer. There are several differences between a Mandatory Transfer and other supply actions. The most significant is that in all supply actions except a Mandatory Transfer, the shipping unit retains a portion of its basic load, and prevents any of its issued Combat Systems from being shipped. For a Mandatory Transfer, nothing is held back. The requirement is fulfilled to the maximum extent of the shipping unit's ability.

3.4 AIR COMBAT OPERATIONS

JTLS air combat is achieved using either the automatic ATOG, by entering all the directives manually, by importing translated real world ATO data created externally, or by a combination of these methods. An ATO can be created for the Players to plan and schedule missions well in advance of their desired launch and alert times. The ATOG permits the building of mission “Packages” comprised of various types of aircraft and also allows Players to create individual single-aircraft missions. These types of missions can be tasked:

- Airborne Warning and Control System (AWACS)
- Combat Air Patrol/Defensive Counter Air, or in orbit, at a location or referenced to the location of a unit
- Escort
- Electronic Combat
- Air Defense Suppression (SEAD)
- Airdrop
- Transfer of aircraft to another unit
- Transport of Supplies, following a sequence of pickup, dropoff and route transit points
- Air Refueling
- Offensive Air Support–Close Air Support, or in orbit, at a location, or referenced to a unit
- Reconnaissance and Armed Reconnaissance
- Air Interdiction and Offensive Counter Air
- Airlift
- Area Patrol Missions (Anti-Submarine Warfare (ASW) surveillance)
- Insert/extract of an HRU

The ATOT (Air Tasking Order Translator) software is designed to read data files containing an ATO developed by the U.S. TBMCS, NATO’s ICC, or NATO’s NEC CCIS. The ATOT then translates the ATO to a set of Air Mission orders for use within a JTLS scenario.

3.4.1 General Functions

Modeling air assets includes aircraft and the weapons they use. Aircraft are given mission orders that describe details such as: the routes to fly, rendezvous or orbit points, the type of mission to perform, number of aircraft, targets to strike, and arrival time. For example, aircraft that are directed to perform combat air patrol missions are assigned an orbit location (or a specific mission patrol area) and will remain there until they are directed to a new orbit location or they
must depart due to a fuel or weapon shortage. Airlift and airdrop missions are checked within the model to determine the aircraft capacity available for flying. The air module logic will then schedule the appropriate number of sorties.

All missions that can be sent to orbit locations (Combat Air Patrol (CAP), orbiting Offensive Air Support (OAS), Airborne Warning And Control System (AWACS), Air Refuel (AIREF), Electronic Combat (EC), Orbiting Reconnaissance (RECCE), and Mining) can alternatively be defined as strip alert missions. These are subsequently launched automatically (under certain circumstances) by the simulation or by Player order.

Standard mission loads are configured within the database for each aircraft type. When a JTLS Air Mission is flown, the simulation selects the load based on database entry priority, mission type, environmental conditions and ordnance stocks, and then flies the mission. Damage is assessed based on the weapons effects entered in the database for that aircraft and the weapons in the load (either area effects or a specific probability of kill may be specified). Air-to-Air ROE are specifically represented at the squadron and individual mission levels. The Player can override the automatic weapon load directing a new loadout on mission order. The mission will use the new load provided the items in the load are available at the launch base.

As missions are flown, weapons and fuel are deducted from available stocks. Returning flights return unexpended weapons and fuel to inventory. When the weapons specified in the primary weapon load are not available, a mission will fly with its secondary or tertiary load alternative, if one has been specified in the database.

Returning aircraft may, depending upon the type of aircraft and the amount of recent flying by the squadron, enter maintenance upon landing. These become unavailable for re-tasking until maintenance is complete. Damaged aircraft always enter maintenance, and stay in maintenance longer than those entering for periodic routine maintenance. Player-directed sorties for which aircraft are unavailable will be delayed until aircraft become available or the maximum launch delay time has expired.

Air defense is represented by the activities of SAM/AAA sites, within Integrated Air Defense Systems. These sites are capable of engaging Enemy aircraft, and may be capable of engaging Enemy missiles. Engagement ranges and probabilities of kill of SAM/AAA sites are dependent on, among other things, mission altitude.

3.4.2 Offensive Air Operations

Offensive air missions include SEAD, Air-Ground Attack, Armed Reconnaissance, Patrol, and Orbiting Offensive Air Support missions.

The SEAD mission is specifically tasked to suppress Enemy air defenses. The Air-Ground Attack mission is best suited for attacking things that are fixed, or where there is a reasonable amount of time to plan. The Armed Reconnaissance mission is best used to look for and attack moving objects, such as convoys, and moving units, including naval units. The Patrol mission is used to locate foreign submarines and surface ships, and if armed, will attack them, ROE permitting. The orbiting OAS mission is suitable to respond to calls for immediate air support. The OAS is also useful for attacking newly pinpointed units beyond the Forward Line of Troops (FLOT) to slow them down; for attacking interdiction points to block an Enemy maneuver; or even (if properly loaded) for an immediate suppression of Enemy air defense, (perhaps to assist a returning Air Mission Package or support a CAS strike).
An OAS mission can be a strip alert mission (or QRA.OAS), either at home base or at some forward location. QRA.OAS missions can be used either to fulfill requests for CAS or to launch as Air-Ground Attack missions.

3.4.3 Defensive and Alert Air Operations

CAP missions, orbiting or strip alert (QRA.DCA), are available to defend a Side's airspace against Enemy air missions. The Enemy missions must be detected and must come within the defensive missions' protection radii. Finally, the defensive missions must have an ROE that permits them to engage after interception.

An airborne CAP mission takes off, flies to its orbit location, turns on its sensors, and waits to be committed. The Player specifies a protection radius in the directive, and also specifies whether the mission is eligible for automatic assignment by the model, or can be committed only by a Player's Manual Pairing action.

When the mission is committed by the simulation, it is never committed to intercept a mission that is farther from the CAP's orbit point than the protection radius, and the CAP mission will not go outside that radius, even in hot pursuit. However, it may shoot outside that radius if it has long-range weapons and appropriate ROE.

If a Player attempts to commit the CAP to intercept a mission outside its protection radius, the CAP will commit and head toward the intercept point. If it reaches the limit of its protection radius, it will break off the intercept and return to its orbit point.

The Alert CAP (or QRA.DCA) mission is a strip alert mission. When it begins operations, it loads the specified weapon load for Air-to-Air. If a Forward Operating Location (FOL) is specified, the mission takes off, flies to the FOL, refuels and rearms, and goes on ground alert, ready to launch. Until it finishes refueling and rearming it is not available for intercepts. If no FOL is specified, the mission goes on alert at home. Once on alert, the Alert CAP mission waits to be committed to intercept or moved to orbital alert.

Identification, Friend or Foe (IFF) is represented in JTLS, and may result in initial misidentification of air missions. CAP missions engage based on both the perceived Side of the detected mission and their ROE for that Side. A mission may be engaged and killed before it is correctly identified if it enters the detection capability of a CAP mission with long range weapons and is already within ROE range.

3.4.4 Support Missions

Support missions include AWACS, RECCE, AREF, EC, and ESCORT mission. These provide functions that assist other JTLS Air Missions or Players to perform their functions.

An AWACS carries a sensor load that allows it to detect, track, and identify other missions. Its load may include a surface search sensor giving it the ability to detect and report foreign naval units.

The AIREF mission is an independent orbiting or strip alert mission. Once the tanker reaches the orbit area, it is designated as available to give fuel. The model handles the entire refueling procedure automatically. The Player can specify that an AIREF mission be permitted to give fuel to missions belonging to another Friendly Force Side. In addition, the Player may reserve fuel on
the AIREF mission for specific missions, by specifying a list of missions for which fuel is reserved and the amount reserved for each mission. This list is specified within the AIREF directive.

The RECC mission provides two important functions. It updates the Side’s knowledge of the battlefield. Also, as a support mission in an Air Mission Package, the RECC provides detailed battle damage information when the Package returns. An orbiting RECC mission orbits at a specified location for a directed time collecting intelligence for its Side.

The EC (Electronic Combat) mission is an independent mission like the AIREF mission. EC missions can carry radar jammers, communications jammers, broadcast emitters, or any combination of the three.

The Escort mission exists only to support Air Mission Packages. Its task is to protect the Package from Enemy air missions. Like all other support missions, it meets the rest of the Package at the time release point. Escort missions only engage Air Missions that are attempting to engage the Package they are protecting. Escort missions are automatically provided information concerning intercepting aircraft. They are allowed to fire as soon as the escorted Package is within ROE firing range and weapons range of the intercepting missions.

3.4.5 Mining Missions

JTLS Air Missions can lay and clear mines if the aircraft are capable. Separate capabilities are specified for laying and clearing mines and for land and sea minefields.

3.4.6 Air Mission Packages

A JTLS Air Mission Package is a group of several main and supporting Air Missions, usually from different squadrons and possibly from different coalition sides designed to carry out a coordinated attack on targets within a region. It permits a group of Air-Ground Attack missions to transit the FLOT or another high-intensity environment, and then disperse to attack multiple, geographically separated targets. In addition to the Air-Ground Attack missions, the Package may include Suppression of Enemy Air Defense (SEAD), Escort, or PostStrike RECC missions. The Package meets at a common rendezvous Time Release point. The Package leaves the Time Release point at the release time, unless additional assets are engaged to join the Package. In that case, the Package waits. If assets continue to be delayed, the Package may wait until just before a further wait would make them miss their Time Over Target (TOT) by more than the maximum launch delay for the Air-Ground Attack mission type. At that point, unless the Package is short of SEAD or Escort missions, it will commit. If it is short of SEAD aircraft or escort aircraft, it will abort.

Missions from any Friendly Side can be assigned to the package. Players can even, after significant coordination, create three-Sided or four-Sided Packages.

3.4.7 Airlift, Airdrop, Air Transport, and Insert/Extract

JTLS provides for units, HRUs, and loads of supplies to be moved by air. A Player can move a Friendly or Neutral unit or HRU, and specify any unit to receive the supplies. When supplies are moved, they are drawn from units (first priority) or supply dumps in the vicinity of the pickup point.

For both unit airlifts and airdrops, multiple missions may be used, coming not only from different squadrons, but from squadrons with different types of aircraft. For airdrop, fixed-wing aircraft
require a runway at only the pickup location. Helicopters do not require a runway at either the pickup or drop locations.

The Air Transport mission is designed to move supplies. The mission permits a Player to commit aircraft to go to a series of locations picking up, dropping off, and/or inserting (parachuting) supplies. Supply pickup requires landing. In addition to a location and a list of supplies, a unit may be specified. If specified, the unit is the intended source or receiver of the supplies. If no receiving unit is specified, the standard airlift/drop delivery logic is followed. If no unit is specified at a pickup point, the mission attempts to find the supplies at local own Side units and targets.

The Insert/Extract mission is an analog to the Air Transport mission, except that the objects being transported are High Resolution Units. As with the Air Transport mission, a series of points is defined. These may be pickup points (landing required), dropoff points (landing and offload), extraction points (retrieve an HRU without landing), insertion points (deliver an HRU without landing), or simply transit points.

3.4.8 Moving Squadrons and Aircraft

Fixed wing squadrons cannot be airlifted from one airbase to another, nor can they perform ground moves. They can, however, airlift themselves. Rotary wing squadrons can perform ground moves, but it is generally more efficient and safer for them to be airlifted or to conduct self-lift.

There are several ways to move aircraft from one squadron to another. In all cases, both squadrons must have the same type of aircraft, as JTLS does not permit composite squadrons.

The Transfer mission is the primary and simplest means to move aircraft. The Transfer mission permits the Player to specify that a squadron must transfer several aircraft to a location. Only the number of aircraft, new location, and the desired time need be specified. The aircraft are transferred to that location, provided a suitable landing area is found. If an own-Side squadron with the same type aircraft is present, the aircraft are added to that squadron. Otherwise, an independent squadron (a Detachment) is created, and assumes ownership of the aircraft. This permits contingency stationing, such as for a Noncombatant Evacuation Operation (NEO), or other possible but uncertain, future operation. Another way is to specify the unit that is to receive the aircraft as the return squadron in any air mission. The aircraft fly a normal mission, but they return to the new squadron and become part of its complement of aircraft.

3.5 NAVAL COMBAT OPERATIONS

Naval units can perform the following operations, either independently or in a Formation:

- Ship-to-ship combat using naval gunfire, torpedoes, or SSMs
- Amphibious pickup transportation and assault, supply sealift
- Naval air operations
- Mine warfare
- Shore bombardment using naval gunfire or SSM
- Area patrol and ASW
- Air defense, including terminal defense against missiles
- Shadowing of Foreign naval units
3.5.1 Surface Units

Naval surface units have the ability to maneuver and engage targets with naval gunfire and SSMs. Aviation carrying assets of all types may be included in the scenario. Units have the ability to maneuver and conduct air operations simultaneously. JTLS models all types of naval combat. Attrition is based on weapon pK or area effects, as modified by environmental conditions. Ships may be joined in a formation and moved as a task organization.

Ships have defined Combat Systems, but do not engage in Lanchester Combat with each other as do ground units. Ships can, though, be placed in a Direct Support role supporting own side or friendly land units ashore. For ships in a direct support role, their combat systems assist their supported land units in Lanchester combat when the land unit is fighting.

Ships have ROE just as other units do, and use them in the same way, except for the Ground/Surface ROE. Naval units whose surface ROE is set to Weapons Free will automatically engage known Enemy ships with missiles, if they can.

Various ship capabilities, including onboard aircraft, are degraded or rendered inoperable when subjected to Enemy attack. Ships will begin sinking when they have sustained too many hull breaches. Repairs to damaged systems are made based on time factors set in the database. Ships in the process of sinking stop moving and cease accepting most operational orders, and automatically deploy lifeboats, represented as HRUs.

Units can be moved by sea during amphibious operations and supplies may be sealifted with offload rates contingent upon the presence of a port facility and MHE.

3.5.2 Submarines

Submarines are modeled as unique types of naval units. They enter the simulation in a covert, undetected status. They cannot be seen by radar, but can be detected by shipboard sonar (active and/or passive) or ASW aircraft. After being detected, contact is eventually lost if not maintained by the detecting Side. The submarines are usually equipped with sonar, SSMs and/or torpedoes. They can only be damaged by weapons specifically designated to be effective against submerged targets.

If submarines are required to operate in water shallower than a database-specified depth for the submarine class, they lose their covert capability, and can be detected by any sensor that can detect a surface vessel. Like surface units, they can be part of a formation or operate independently, and can be used to shadow Enemy surface units, lay mines, or patrol multi-Sided polygonal areas.

Submarines can be nuclear powered, meaning that they can remain submerged indefinitely, or they can be conventionally powered, and must either surface or go to periscope depth periodically to recharge batteries. Surfac ed or snorkeling submarines are detectable by radar.

3.5.3 Amphibious Operations

Ground units and assault helicopter squadrons can be embarked on naval units in formation at simulation start, or picked up from shore locations in preparation for amphibious assault. Amphibious assaults may be conducted, by moving assault forces ashore in groups via landing craft and helicopters. If such landings are opposed, attrition is modeled using distinctive Lanchestrian coefficients. Attrition of landing craft due to artillery and Air-to-Ground action, and the associated loss of Combat Systems are simulated.
3.6 COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE (C3I)

The commander and staff must possess information about their Enemy in order to execute the military mission with adequate and timely tactical plans. One of the defining characteristics of a Force Side is that all the units share the same perception of the battlefield. When any collection resource obtains intelligence, the information is available to the entire Force Side. Different gathering methods have different delays and fusion times, but once the information is passed to the receiving unit, it is available to all members of the Side.

When a unit or target is first detected by a Force Side, complete information about it is not known. In this case, the object is displayed as an Unidentified object, with a name starting with UI. The true identification of the object becomes available after the fusion time has elapsed.

JTLS Players have the ability to share intelligence (on individual or multiple units and/or targets) with another Side. The specified information is passed to the receiving Side either as a one-time event or periodically.

JTLS can be operated with the graphics display or Information Management Tool showing simulation truth or a Side’s perception of truth. When running in the perceived mode, the commander must take action to determine the true location of Enemy units. All gathered intelligence data are available to be displayed on the IMT/graphics display as soon as they have been fused and passed from the gathering agency to the responsible unit. The results are also included in the intelligence section of the Periodic Report.

3.6.1 Organic Ground and Air Intelligence

Each unit in JTLS can have a capability to note and report the presence and status of Enemy units and targets in its vicinity. The vicinity is defined by ground and air distance parameters unique to the unit’s prototype. This capability simulates the unit’s capability to patrol the immediate vicinity and report on what is there. The Player does not need to do anything to obtain the resulting intelligence.

3.6.2 HRU Intelligence Collection

A Player may direct an HRU to perform a Patrol mission with a sub-mission to collect Essential Elements of Information (EEI). As part of the order, the Player specifies a single type or list of types of objects that are of high interest to the HRU and either a specific location or a route for the patrol to follow. The patrol moves to the location or the first route point and begins the intelligence gathering. If an object of high interest is encountered, the HRU breaks radio silence and reports the presence of the object in a new HRU Urgent Report. Objects that are detected but do not meet the High Interest criteria are retained and reported periodically. A message, graphics, and IMT updates are produced. In addition, any HRU performing a Collect EEI mission may detect and report either missile launches or preparations of mobile Tactical Erector Launchers (TELs) for such launches.

3.6.3 Explicit Air Intelligence

The RECCE and Armed RECCE missions collect information on all units, targets, convoys and air missions within sensor range of their designated flight paths. Attack and Offensive Air Support missions collect information only in the hex associated with their assigned target. Real time sensors report information gathered each time the mission moves into a new hex. Non-real time sensors hold on to the information until the mission lands at its home base. If the mission is killed prior to returning to base, the non-real time data are not reported.
3.6.4 Naval Intelligence

Surface naval units can be detected by land based surface sensors, shipboard surface sensors or surface sensors located on JTLS Air Missions that include AWACS, Patrols, Reconnaissance, Armed Reconnaissance, and Air-Ground Attack. Surface detections are accomplished as a stochastic process using a probability of detection. Submarines can be detected by the same sources, but the subsurface detection algorithm uses a stochastically generated time to detection.

Any actively emitting sensor on a naval unit is subject to passive detection by other naval units. The user receives bearing information and a rudimentary indication of the strength of the passive signal.

3.6.5 Non-theater Intelligence Collection Resources

Non-theater intelligence collection assets are represented in JTLS by Controller orders. These orders include:

- Area Collection: All detected units and detected targets within the specified rectangular area are reported to the indicated Side. Detection is stochastic and the Controller indicates the baseline probability of detection for units and a baseline probability of detection for targets.
- Unit Collection: Information concerning the Controller-specified units is passed to the indicated Side. The information concerning the specified units is always sent.
- Target Collection: Information concerning the Controller-specified targets is passed to the indicated Side. The information concerning the specified targets is always sent.
- Electronic Intelligence (ELINT): The Controller enters an order to indicate that a Side has theater ELINT assets available. The entire theater is assumed covered until the Controller enters an order to remove the ELINT assets. When a Side has ELINT assets available, Players receive intelligence whenever an SSM or air defense site fires; and when a sensor or jammer site is either moved, activated or deactivated.

3.6.6 Reports to Players

The capability to obtain information, either through periodically disseminated reports or through Player queries, is essential to the successful planning and decision-making process. JTLS provides 30 queries and several reports that enable users to maintain current information about the situation. These are incorporated into four generic groups: Command (Ground and Naval), Air, Logistics, and Intelligence. These groups are described in the JTLS Controller Guide and JTLS Player Guide and include:

Command (Ground and Naval) Reports:

- Situation Report (SITREP): A Player may request a current Situation Report for any unit or group of units in that Player's reference database. The SITREP is available for HRUs.
- Periodic Reports: These provide the commander with a summary of current own-side air, ground, and logistical operations; as well as intelligence held on other foreign units and targets. There are 15 separate messages, each reporting the current status of a subset of all the data concerning a Side. Examples are the Own-Side Combat Systems Summary, Airbase and Squadron Summary, Other-Side Target Intelligence Summary, and BDA (Battle Damage Assessment) Reports. These reports are provided at a time interval
specified in the database for the Force Side. A second parameter specifies the frequency of Summary Reports, which roll up two or more Periodic Reports. These reports have the same format as the Periodic Report, but cover multiple single periods.

Air Reports:
- Air Report: This report provides a status summary of a squadron, its currently active missions, and aircraft due out of maintenance. Cumulative information is also provided, including runway length and repair time.
- Air Mission Report: This report is available for a single squadron or all squadrons on the requesting Player's Side (all squadrons for the Controller). It provides information concerning the status of all missions associated with the squadrons, including mission name, posture, time scheduled to launch or come out of maintenance, current number of aircraft, number of aircraft launched, mission type and location. In addition, the all-squadron report includes a list of unfulfilled CAS requests and a list of all airbases that are out of aviation fuel.

Logistics Reports:
- Logistics Report: This report is available upon request for a particular force or a specific unit. It contains general information, the status of Combat Systems (Table of Organization and Equipment (TOE) in maintenance and operational), and the status of supplies (available as supplies, backorder, or due in). The capacity of the unit to carry wet and dry supplies is included, as well as a listing of the backorders owed to other units or targets, including their origination times. For support units, truck status is provided; for squadrons, aircraft status is included. An abbreviated LOGREP is available for HRUs.
- Logistics Roll-up Report: This report is similar in format to the Logistics Report, but contains logistics data for a single unit, all its subordinates, and their subordinates, recursively. Details are omitted concerning individual units’ trucks dispatched, aircraft flying and available, and the listing of backorders. This report is useful for obtaining a summary of the operational Combat Systems or the complete ammunition status of an entire division, for example.
- Convoy Status Report: This report provides data about the status of all convoys that are outbound from a unit, inbound to a unit, or bound from one specified unit to another. The report includes the convoy home unit, next destination, location, Estimated Time of Arrival (ETA), status of transportation assets, and supplies carried.

Intelligence Reports:
- HRU Patrol Report: HRUs with a collect EEI mission report their observations at a time interval set in the database. This report contains information on units and targets seen. Depending on the length of time the Foreign units are observed, the HRU teams will report posture, status, location, and percent capability. The results are displayed on the graphics and IMT screens. A message is generated.
- Tactical Intelligence Report: This report is automatically provided by units on a periodic basis. Only units that have a specified capability to do so gather tactical intelligence. The results provide updated information on foreign units and targets, with the amount of detail depending on the amount of time an entity has been observed. The intelligence is provided directly to the IMT and graphics, and included in the Periodic Report. No printed message is generated.
• ELINT Report: This report provides a listing of all detected and currently emitting jammer targets, and all detected and emitting sensor targets, provided the sensor is a jammable (emitting) sensor.

• Launch Preparation and Launch Reports. Any surveillance asset may detect that a foreign unit has begun preparations to launch an SSM, or may detect the launch. These assets include units, airborne or surface sensor assets, and patrolling HRUs. When either of these events is detected, the information is communicated as quickly as possible to the Players. A printable message is generated. Patrolling HRUs will break radio silence to report either preparation or launch.
# APPENDIX A. ABBREVIATIONS AND ACRONYMS

Terms are included in this appendix to define their usage in JTLS design, functionality, and documentation.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAA</td>
<td>Anti-Aircraft Artillery</td>
</tr>
<tr>
<td>AADC</td>
<td>Area Air Defense Commander</td>
</tr>
<tr>
<td>AAL</td>
<td>Air-to-Air Lethality</td>
</tr>
<tr>
<td>A/C</td>
<td>Aircraft</td>
</tr>
<tr>
<td>ACP</td>
<td>Air Control Prototype</td>
</tr>
<tr>
<td>ADA</td>
<td>Air Defense Artillery</td>
</tr>
<tr>
<td>AEW</td>
<td>Airborne Early Warning</td>
</tr>
<tr>
<td>AFB</td>
<td>Air Force Base</td>
</tr>
<tr>
<td>AG</td>
<td>Air-Ground (Air-to-Ground)</td>
</tr>
<tr>
<td>AI</td>
<td>Air Interdiction</td>
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<tr>
<td>AIM</td>
<td>Air Intercept Missile</td>
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<tr>
<td>AIREF</td>
<td>Air Refueling</td>
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<tr>
<td>AKL</td>
<td>Area Kill Lethality</td>
</tr>
<tr>
<td>AMMO</td>
<td>Ammunition</td>
</tr>
<tr>
<td>AO</td>
<td>Area of Operations</td>
</tr>
<tr>
<td>AOC</td>
<td>Air Operations Center</td>
</tr>
<tr>
<td>APC</td>
<td>Armored Personnel Carrier</td>
</tr>
<tr>
<td>ARECCE</td>
<td>Armed Reconnaissance</td>
</tr>
<tr>
<td>ARTE</td>
<td>Air Route</td>
</tr>
<tr>
<td>ARTY</td>
<td>Artillery</td>
</tr>
<tr>
<td>ASC</td>
<td>Automatic Supply Calculation</td>
</tr>
<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
</tr>
<tr>
<td>ASW</td>
<td>Anti-Submarine Warfare</td>
</tr>
<tr>
<td>ATC</td>
<td>Aircraft Target Category</td>
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<tr>
<td>ATGM</td>
<td>Anti-Tank Guided Missile</td>
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<tr>
<td>ATK</td>
<td>Attack</td>
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<tr>
<td>ATO</td>
<td>Air Tasking Order</td>
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<tr>
<td>ATORET</td>
<td>Air Tasking Order Retrieve Program</td>
</tr>
<tr>
<td>ATOT</td>
<td>Air Tasking Order Translator</td>
</tr>
<tr>
<td>AWACS</td>
<td>Airborne Warning And Control System</td>
</tr>
<tr>
<td>AZ</td>
<td>Altitude Zone</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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</tr>
<tr>
<td>BADGE</td>
<td>Bilateral Air Defense Ground Environment (used by Japan Defense Agency)</td>
</tr>
<tr>
<td>BAI</td>
<td>Battlefield Air Interdiction</td>
</tr>
<tr>
<td>BDA</td>
<td>Battle Damage Assessment</td>
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<tr>
<td>BDE</td>
<td>Brigade</td>
</tr>
<tr>
<td>BN</td>
<td>Battalion</td>
</tr>
<tr>
<td>C3</td>
<td>Command, Control, and Communications</td>
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<tr>
<td>C3I</td>
<td>Command, Control, Communications, and Intelligence</td>
</tr>
<tr>
<td>C4I</td>
<td>Command, Control, Communications, Computers, and Intelligence</td>
</tr>
<tr>
<td>CA</td>
<td>Civil Affairs</td>
</tr>
<tr>
<td>CADRG</td>
<td>Compressed ARC Digitized Raster Graphics</td>
</tr>
<tr>
<td>CAP</td>
<td>Combat Air Patrol</td>
</tr>
<tr>
<td>CAS</td>
<td>Close Air Support</td>
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<tr>
<td>CAT</td>
<td>Category</td>
</tr>
<tr>
<td>CCF</td>
<td>Central Control Facility</td>
</tr>
<tr>
<td>CCP</td>
<td>Command Control Prototype</td>
</tr>
<tr>
<td>CCU</td>
<td>Controller Change Unit</td>
</tr>
<tr>
<td>CEP</td>
<td>Combat Events Program</td>
</tr>
<tr>
<td>CMDR</td>
<td>Commander</td>
</tr>
<tr>
<td>COP</td>
<td>Common Operational Picture</td>
</tr>
<tr>
<td>CP</td>
<td>Combat Power</td>
</tr>
<tr>
<td>CS</td>
<td>Combat System</td>
</tr>
<tr>
<td>CSP</td>
<td>Combat System Prototype</td>
</tr>
<tr>
<td>CTAPS</td>
<td>Contingency Tactical Air Planning System</td>
</tr>
<tr>
<td>CTG</td>
<td>Commander Task Group</td>
</tr>
<tr>
<td>CTRL</td>
<td>Control keyboard command</td>
</tr>
<tr>
<td>DCA</td>
<td>Defense Counter Air</td>
</tr>
<tr>
<td>DCL</td>
<td>Digital Command Language</td>
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<tr>
<td>DDS</td>
<td>Database Development System</td>
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<tr>
<td>DEMSDB</td>
<td>Demonstration Standard Database</td>
</tr>
<tr>
<td>DISA</td>
<td>Defense Information Systems Agency</td>
</tr>
<tr>
<td>DIV</td>
<td>Division</td>
</tr>
<tr>
<td>DMA</td>
<td>Defense Mapping Agency</td>
</tr>
<tr>
<td>DoD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DOS</td>
<td>Days of Supply</td>
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</tbody>
</table>
DPICM  Dual Purpose Improved Conventional Munitions
DS    Direct Support
DSA   Directed Search Area
DTG   Date Time Group
EC    Electronic Combat
ECM   Electronic Counter Measure
ECP   Engineering Change Proposal
EEI   Essential Elements of Information
ELINT Electronic Intelligence
ELS   Entity Level Server
EODA  Entity Level JTLS Object Data Authority
ETA   Estimated Time of Arrival
FARP  Forward Arming and Refueling Point
FLP   Fire Lethality Prototype
FLOT  Forward Location of Troops
FOL   Forward Operating Location
FWL   Frederick W. Lanchester (originated a differential equation model of attrition)
GAL   Gallon
GCCS  Global Command and Control System
GRTE  Ground Route
GS    General Support
GSR   General Support Reinforcing
GUI   Graphical User Interface
HARM  High-speed Anti-radiation Missile
HE    High Explosive
HELO  Helicopter
HMMWV High Mobility Multipurpose Wheeled Vehicle
HQ    Headquarters
HRU   High Resolution Unit
HTML  Hypertext Markup Language
HTT   High resolution unit Target Type
HUP   High resolution Unit Prototype
ICM   Improved Conventional Munitions
ICP   Interface Configuration Program
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICPL</td>
<td>Interface Login Program</td>
</tr>
<tr>
<td>ID</td>
<td>Identifier</td>
</tr>
<tr>
<td>IFF</td>
<td>Identification Friend or Foe</td>
</tr>
<tr>
<td>IIP</td>
<td>Intelligence Information Prototype</td>
</tr>
<tr>
<td>IMT</td>
<td>Information Management Tool</td>
</tr>
<tr>
<td>INFO</td>
<td>Information</td>
</tr>
<tr>
<td>INTEL</td>
<td>Intelligence</td>
</tr>
<tr>
<td>JCATS</td>
<td>Joint Conflict And Tactical Simulation</td>
</tr>
<tr>
<td>JDA</td>
<td>Japan Defense Agency</td>
</tr>
<tr>
<td>JEDI</td>
<td>JODA Entity Data Identifier</td>
</tr>
<tr>
<td>JDS</td>
<td>JTLS Data System</td>
</tr>
<tr>
<td>JDSP</td>
<td>JTLS Data System Protocol</td>
</tr>
<tr>
<td>JRSG</td>
<td>Joint Rapid Scenario Generation (formerly JIDPS: Joint Integrated Database Preparation System)</td>
</tr>
<tr>
<td>JMCIS</td>
<td>Joint Maritime Combat Information System</td>
</tr>
<tr>
<td>JMEM</td>
<td>Joint Munitions Effectiveness Manuals</td>
</tr>
<tr>
<td>JODA</td>
<td>JTLS Object Distribution Authority</td>
</tr>
<tr>
<td>JOI</td>
<td>JTLS Operational Interface</td>
</tr>
<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
</tr>
<tr>
<td>JSDF</td>
<td>Japanese Self-Defense Force</td>
</tr>
<tr>
<td>JTLS</td>
<td>Joint Theater Level Simulation</td>
</tr>
<tr>
<td>JTOI</td>
<td>JTLS Transaction Operational Interface</td>
</tr>
<tr>
<td>JXSR</td>
<td>JTLS XML Serial Repository</td>
</tr>
<tr>
<td>KIA</td>
<td>Killed In Action</td>
</tr>
<tr>
<td>KM</td>
<td>Kilometer</td>
</tr>
<tr>
<td>KNOTS</td>
<td>Nautical miles per hour</td>
</tr>
<tr>
<td>LA</td>
<td>Lethal Area</td>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>LAT</td>
<td>Latitude</td>
</tr>
<tr>
<td>LB</td>
<td>Login Build (JTLS order type)</td>
</tr>
<tr>
<td>LDAP</td>
<td>Lightweight Directory Access Protocol</td>
</tr>
<tr>
<td>LDT</td>
<td>Lanchester coefficient Development Tool</td>
</tr>
<tr>
<td>LOG</td>
<td>Logistics</td>
</tr>
<tr>
<td>LOGIN</td>
<td>Logistics Input</td>
</tr>
<tr>
<td>LOGREP</td>
<td>Logistics Report</td>
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</table>
LONG Longitude
LOTS Logistics Over The Shore
LR Long Range
M&S Modeling and Simulation
MAPP Modern Aids to Planning Program
MB Megabyte
MCP Mobility Counter-mobility Prototype
MCR Model Change Request
MG Machine Gun
MHE Materiel Handling Equipment
MIP Model Interface Program
MOGAS Motor Gasoline
MOPP Mission-Oriented Protective Posture
MOSAIC NCSA user interface software
MOTIF X Window System graphical interface
MP Maneuver Prototype
MPP Message Processor Program
MSC Major Subordinate Command
MSG Message
MTF Message Text Formats
MUREP Munitions Report
MUSE Multiple Unified Simulation Environment
NCSA National Center for Supercomputing Applications (University of Illinois)
NEO Noncombatant Evacuation Operations
NFS Network File Server
NGO Non-Governmental Organization
NIS Network Information Service or Network Information System
NM Nautical Mile
NTSC Naval Telecommunications System Center
OAS Offensive Air Support
OBS Order of Battle Service (formerly UGU: Unit Generation Utility)
OCA Offensive Counter-Air
OJCS Organization of the Joint Chiefs of Staff
OMA Order Management Authority
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ONC</td>
<td>Operational Navigation Chart</td>
</tr>
<tr>
<td>OPM</td>
<td>Online Player Manual</td>
</tr>
<tr>
<td>OPP</td>
<td>Order Preprocessing Program</td>
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<tr>
<td>OTH</td>
<td>Over The Horizon</td>
</tr>
<tr>
<td>OTH Gold</td>
<td>Over The Horizon message specification</td>
</tr>
<tr>
<td>OTH-T</td>
<td>Over The Horizon-Targeting</td>
</tr>
<tr>
<td>pD</td>
<td>Probability of Detection</td>
</tr>
<tr>
<td>pE</td>
<td>Probability of Engage</td>
</tr>
<tr>
<td>pH</td>
<td>Probability of Hit</td>
</tr>
<tr>
<td>pK</td>
<td>Probability of Kill</td>
</tr>
<tr>
<td>PKL</td>
<td>Point Kill Lethality</td>
</tr>
<tr>
<td>POL</td>
<td>Petroleum, Oil, and Lubricants</td>
</tr>
<tr>
<td>POSIX</td>
<td>International operating system standard based on System V and BSD</td>
</tr>
<tr>
<td>PPS</td>
<td>Postprocessor System</td>
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<tr>
<td>PSYOPS</td>
<td>Psychological Operations</td>
</tr>
<tr>
<td>RAM</td>
<td>Random Access Memory</td>
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<tr>
<td>RDMS</td>
<td>Relational Database Management System</td>
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<tr>
<td>RECCE</td>
<td>Reconnaissance (air missions)</td>
</tr>
<tr>
<td>RECON</td>
<td>Reconnaissance (ground missions)</td>
</tr>
<tr>
<td>REGT</td>
<td>Regiment</td>
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<tr>
<td>RNS</td>
<td>Random Number Seed</td>
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<td>ROE</td>
<td>Rules Of Engagement</td>
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<td>RPT</td>
<td>Report</td>
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<td>RSP</td>
<td>Reformat Spreadsheet Program</td>
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<tr>
<td>SAL</td>
<td>Surface-to-Air Lethality</td>
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<tr>
<td>SAM</td>
<td>Surface-to-Air Missile</td>
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<tr>
<td>SAM/AAA</td>
<td>Surface-to-Air Missile/Anti-Aircraft Artillery</td>
</tr>
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<td>SC</td>
<td>Supply Category</td>
</tr>
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<td>SCP</td>
<td>Simulation Control Plan</td>
</tr>
<tr>
<td>SDB</td>
<td>Standard Database</td>
</tr>
<tr>
<td>SEAD</td>
<td>Suppression of Enemy Air Defenses</td>
</tr>
<tr>
<td>SIMSCRIPT</td>
<td>Simulation programming language (product of CACI, Inc.)</td>
</tr>
<tr>
<td>SIP</td>
<td>Scenario Initialization Program</td>
</tr>
<tr>
<td>SITREP</td>
<td>Situation Report</td>
</tr>
</tbody>
</table>
SLP  Sustainment Log Prototype
SOF  Special Operations Forces
SP   Survivability Prototype
SQL  Structured Query Language
SR   Short Range
SRP  Start/Restart Program (a JTLS component)
SRTE Sea Route
SSM  Surface-to-Surface Missile
STR  Software Trouble Report
SUP  Ship Unit Prototype
SVP  Scenario Verification Program
SYNAPSE  Synchronized Authentication and Preferences Service
TADIL Tactical Digital Interface Link
TCP/IP Transmission Control Protocol/Internet Protocol
TEL  Transporter Erector Launcher
TG   Target entity attribute prefix
TGS  Terrain Generation Service (formerly TPS:Terrain Preparation System)
TGT  Target
TMU  Terrain Modification Utility
TOE  Table of Organization and Equipment
TOT  Time Over Target
TOW  Tube-launched Optically-tracked Wire-guided missile
TPFDD  Time-Phased Force Deployment Data
TTG  Target Type Group
TTL  Target Types List
TUP  Tactical Unit Prototype
TW   Targetable Weapon
UBL  Unit Basic Load
UIM/X GUI builder tool
UNIX POSIX-compliant operating system
UNK  Unknown
UOM  Unit Of Measure
USA  United States Army (U.S. and U.S.A. refer to United States and United States of America)
USAF United States Air Force
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCG</td>
<td>United States Coast Guard</td>
</tr>
<tr>
<td>USMC</td>
<td>United States Marine Corps</td>
</tr>
<tr>
<td>USMTF</td>
<td>United States Message Text Format</td>
</tr>
<tr>
<td>USN</td>
<td>United States Navy</td>
</tr>
<tr>
<td>UT</td>
<td>Unit entity attribute prefix</td>
</tr>
<tr>
<td>UTM</td>
<td>Universal Transverse Mercator</td>
</tr>
<tr>
<td>VIFRED</td>
<td>Visual Forms Editor</td>
</tr>
<tr>
<td>VMS</td>
<td>Virtual Memory System</td>
</tr>
<tr>
<td>VTOL</td>
<td>Vertical Take-Off and Landing aircraft</td>
</tr>
<tr>
<td>WAN</td>
<td>Wide Area Network</td>
</tr>
<tr>
<td>WDRAW</td>
<td>Withdraw</td>
</tr>
<tr>
<td>WEJ</td>
<td>Web Enabled JTLS</td>
</tr>
<tr>
<td>WHIP</td>
<td>Web Hosted Interface Program</td>
</tr>
<tr>
<td>WIA</td>
<td>Wounded In Action</td>
</tr>
<tr>
<td>WPC</td>
<td>Warrior Preparation Center</td>
</tr>
<tr>
<td>WPN</td>
<td>Weapon</td>
</tr>
<tr>
<td>WT</td>
<td>Weight</td>
</tr>
<tr>
<td>XMS</td>
<td>XML Message Service</td>
</tr>
</tbody>
</table>
APPENDIX B. JTLS OPERATING EQUIPMENT

The hardware configuration needed to support JTLS depends upon the size of the database, the number of Player stations, and the anticipated level of activity during the game. A large exercise may require additional server capability to distribute the processing load of the CEP and Web Services and to improve simulation performance and user interface response. The CEP and Web Services require Linux operating systems. However, for exercises or user training events, Microsoft Windows platforms are recommended to execute the WHIPs.

Table B.1 and Table B.2 describe the minimum hardware and operating system requirements for the server and client components of a typical JTLS installation to be used to support an exercise.

These equipment requirements were established during stress testing by the model proponent and have been refined based upon user exercise experiences. The stress test database consisted of approximately 5,000 units and 30,000 targets. Throughout the test, simulation speeds of 1-to-1 and greater were maintained consistently while supporting 90 or more Player stations. Other critical elements, such as exercise analysis or training environments, and scenario size and complexity, must be considered while planning an optimal JTLS installation.

Because computer hardware is continually being improved, this information represents the nominal JTLS requirements. Users are encouraged to purchase the most capable machines within their budget constraints. Machines with faster processor speeds (greater than 2.8 GHz), more memory (greater than 16 GB) and more disk space (greater than 300 GB) are acceptable and desirable. The end result will be hardware architecture that will be useful well into the future.

If JTLS will be used to support large training exercises, R&A strongly encourages users to purchase a fully-functioning backup server. Hardware failures can occur and a backup server is a relatively low-cost precaution that may be the difference between an unsuccessful end to an exercise and the successful completion of an expensive training event. JTLS has been designed to have all of its processes operate on similar computer systems to make it easy to re-distribute executing processes, when and if a catastrophic hardware failure occurs during a critical training exercise event.

Chapter 3 of the JTLS Installation Manual provides guidance for the proper installation of the JTLS software on Linux platforms. Chapter 4 of that document provides JTLS client workstation configuration information. The JTLS Technical Coordinators Guide describes how to prepare a database for use in the game, how to configure the system including all the workstations to be used in the exercise, and how to start all JTLS main and support programs.
### Table B.1 Representative JTLS Server Hardware Specifications: Exercise Environment

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>OPERATING SYSTEM</th>
<th>CPU</th>
<th>RAM</th>
<th>DISK</th>
<th>VIDEO</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JTLS SERVERS AND WEB SERVICES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEP and JODA</td>
<td>Red Hat Enterprise Linux 5.0 64-bit</td>
<td>AMD Opteron, Intel Xeon or i7, or greater</td>
<td>16.0 GB</td>
<td>500 GB (Note 1)</td>
<td>Generic video card</td>
<td>Generic monitor</td>
</tr>
<tr>
<td>1 unit required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apache Data Server</td>
<td>Red Hat Enterprise Linux 5.0 64-bit</td>
<td>AMD Opteron, Intel Xeon or i7, or greater</td>
<td>16.0 GB</td>
<td>200 GB (Note 1)</td>
<td>Generic video card</td>
<td>Generic monitor</td>
</tr>
<tr>
<td>1 unit required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XMS, SYNAPSE, OMA</td>
<td>Red Hat Enterprise Linux 5.0 64-bit</td>
<td>AMD Opteron, Intel Xeon or i7, or greater</td>
<td>16.0 GB</td>
<td>200 GB (Note 1)</td>
<td>Generic video card</td>
<td>Generic monitor</td>
</tr>
<tr>
<td>1 unit required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JXSR</td>
<td>Red Hat Enterprise Linux 5.0 64-bit</td>
<td>AMD Opteron, Intel Xeon or i7, or greater</td>
<td>16.0 GB</td>
<td>500 GB (Note 1)</td>
<td>Generic video card</td>
<td>Generic monitor</td>
</tr>
<tr>
<td>1 unit per 20 workstations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oracle Database Server</td>
<td>Red Hat Enterprise Linux 5.0 64-bit</td>
<td>AMD Opteron, Intel Xeon or i7, or greater</td>
<td>8.0 GB or more</td>
<td>1 TB (if AAR is used)</td>
<td>Generic video card</td>
<td>Generic monitor</td>
</tr>
<tr>
<td>1 unit required</td>
<td>Oracle Enterprise Linux 5.0 64-bit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Note 2)</td>
<td></td>
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</tr>
</tbody>
</table>

### Table B.2 Representative JTLS Workstation Hardware Specifications: Exercise Environment

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>OPERATING SYSTEM</th>
<th>CPU</th>
<th>RAM</th>
<th>DISK</th>
<th>VIDEO</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JTLS CLIENT WORKSTATIONS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 WHIPs per workstation</td>
<td>Red Hat Enterprise Linux 5.0 Microsoft Windows 7, XP Professional, or Vista</td>
<td>AMD64/EM64T single or dual processor</td>
<td>4.0 GB</td>
<td>200 GB</td>
<td>3D hardware accelerated; DirectX compatible</td>
<td>21 inches; color; 1600 x 1200</td>
</tr>
</tbody>
</table>
Table B.2 Representative JTLS Workstation Hardware Specifications: Exercise Environment (Continued)

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>OPERATING SYSTEM</th>
<th>CPU</th>
<th>RAM</th>
<th>DISK</th>
<th>VIDEO</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 WHIPs per workstation</td>
<td>Red Hat Enterprise Linux 5.0 Microsoft Windows 7, XP Professional, or Vista</td>
<td>AMD64/EM64T single or dual processor</td>
<td>8.0 GB</td>
<td>200 GB</td>
<td>3D hardware accelerated; DirectX compatible</td>
<td>21 inches; color; 1600 x 1200</td>
</tr>
<tr>
<td>6 WHIPs per workstation</td>
<td>Red Hat Enterprise Linux 5.0 Microsoft Windows 7, XP Professional, or Vista</td>
<td>AMD64/EM64T single or dual processor</td>
<td>16.0 GB</td>
<td>200 GB</td>
<td>3D hardware accelerated; DirectX compatible</td>
<td>21 inches; color; 1600 x 1200</td>
</tr>
</tbody>
</table>

Note 1: The disk space values listed here are more than sufficient to accommodate the indicated processes. The main disk space requirement is for whichever machine is to be the File Server in your configuration. One or more of these processes may run on the machine that is the File Server. JTLS creates several relatively large data files during exercises, notably CEP Checkpoint files, that are stored on the File Server. A minimum of 1 TB of disk space is required for the File Server machine.

Note 2: Applicable Oracle Database Server versions, patchsets, and CPU licensing issues are described in Chapter 1 of the current JTLS Version Description Document delivered with each JTLS release.

All servers and workstations used for this configuration require at least one generic CD/DVD R/W drive and 100 MBit or greater Ethernet connectivity. A minimum of one laser printer per installation is optional; one unit per work area is recommended.

Smaller databases and scenarios used for analysis, training, testing, experimentation, or demonstration will operate successfully on significantly reduced platforms. For example, a small-scale testing or training scenario can be executed on a single Linux server platform supported by a single CPU and 4.0 GB of RAM.

Large scenarios, such as the Standard Database delivered with JTLS, can also be executed on a single platform for training or demonstration purposes. A platform with 8 GB of RAM will usually suffice for a small number of WHIPs and a limited amount of game activity.