

JTLS

Executive Overview

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DEPARTMENT OF DEFENSE
DEPUTY DIRECTOR J7
JOINT AND COALITION WARFIGHTING
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JOINT THEATER LEVEL SIMULATION
(JTLS 4.0.1.0)

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ABSTRACT

The Joint Theater Level Simulation (JTLS) system is an interactive, multi-sided gaming system that simulates 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 interoperate 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 JTLS. Corrections, additions, or recommendations for improvement must reference specific sections, pages, and paragraphs with appropriate justification and be forwarded to:

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EXECUTIVE SUMMARY

ES.1 Introduction

The Joint Theater Level Simulation (JTLS) is an interactive, Internet-enabled, computer-assisted 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 sizes, combat systems, supply categories, and militarily significant targets to be represented. High resolution target systems complement the more aggregated unit structure. The scenario database can be developed to represent the requisite detail for systems of interest within this unit structure.

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 be controlled as aggregate, multi-sided mission packages, but are adjudicated at the object level and use probability of hit (pH) and probability of kill (pK) factors for each mission element. Adjudication is stochastic.

Surface-to-air operations are modeled at the object level and use probability of engage (pE) and pK factors for each mission. Adjudication is stochastic.

Air-to-ground operations, surface-to-surface missiles, and artillery (including naval gunfire support) operations are modeled at the object level. These objects 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 attrition methodology to aggregate the effects of direct fire weapons and direct support systems not engaged in explicit fire support operations. Adjudication is deterministic.

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.

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

JTLS is an interactive simulation that requires user decisions to manage processes and entities. The Web Hosted Interface Program (WHIP) 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 the U.S. Theater Battle Management Core Systems (TBMCS) or the NATO Integrated Command and Control (ICC).

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 is dependent upon the simulation's hardware platform and scenario size. Although the capability to maintain a game ratio of at least 6 to 1 is a design objective, a maximum of 20 to 1 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 as small as individual Traffic Control Points or reconnaissance patrols are supported.

ES.9 Hardware and Software

The JTLS Equipment List page provides a summary description of supported hardware system configurations.

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 (JMIRM) 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) federation is currently an experimental federation that includes JTLS and the Virtual Battle Space 2 (VBS2) first-person shooter model.

ES.11 Planned Improvements

A Configuration Control Board (CCB) establishes priorities for continuing JTLS development and functional improvement. The CCB is comprised of representatives from the U.S. Combatant Commands, the services, and other authorized users of the simulation. The governing CCB has identified these projects as high-priority enhancements for JTLS:

- Support the USJFCOM Joint Live Virtual Constructive (JLVC) HLA Federation Object Model (FOM).
- Complete the two-way link to the TBMCS.
- Allow air missions to report damage after attacking multiple targets.
- Split air missions after takeoff.
- Represent diesel submarines.
- Improve representation of landing at foreign airbases.

ES.12 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 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 as aggregate, multi-sided mission Packages. Adjudication is at the item level and uses probability of hit (pH) and probability of kill (pK) factors for each mission element. Adjudication is stochastic.

Surface-to-air operations are simulated at the item level and use probability of engage (pE) and pK factors for each mission. 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.

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

The user specifies the desired ratio of exercise time to real time. The maximum feasible ratio is hardware- and scenario size-dependent. The design goal is a capability to maintain at least a 6 to 1 speed for most exercise support scenarios.

1.2.3 Limitations

JTLS modeling assumptions limit its usefulness when very small aggregate units are represented. High Resolution Units as small as individual Traffic Control Points or reconnaissance patrols are supported.

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 (™) 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 Forces Command Joint Warfighting Center (USJFCOM/JWFC), 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: USJFCOM/JWFC, Warrior Preparation Center, USCENTCOM, USEUCOM, USSOCOM, USSOUTHCOM, USPACOM, NC3A, and the Naval Postgraduate School. Other international users include these government defense agencies and contractors:

- Australia - Joint Warfare Doctrine and Training Centre (JWDTC)
- France - Army Defense College (College Interarmees de Defense (CID))
- Greece - Hellenic National Defense General Staff (HNDGS)
- Italy - Italian Joint Operational Simulation Center (CIMSO), Computer Sciences Corporation (CSC)
- 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)
- Slovenia - Center for Operational Research and Simulations (CORSA)
- Spain - Systems Engineering for the Defense of Spain (Ingenieria de Sistemas para la Defensa de Espana (ISDEFE))
- 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)
- United Kingdom - Defence Science Technology Laboratory (DSTL)

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.

Table 1.1 JTLS Documentation Suite

JTLS DOCUMENT TITLE	CONTENT DESCRIPTION
<i>JTLS Analyst Guide</i>	Describes the design, logic, and internal algorithms JTLS Combat Events Program (CEP), from the perspective of the simulation designer.
<i>JTLS ATOG User Guide</i>	Describes the design, logic, functions, and use of the JTLS Air Tasking Order Generator (ATOG).
<i>JTLS ATOT User Guide</i>	Describes the design, logic, functions, and use of the JTLS Air Tasking Order Translator (ATOT).
<i>JTLS C4I Interface Manual</i>	Overview and operator manual that describes the functional capabilities of JTLS external interface programs that feed C4I systems.
<i>JTLS Controller Guide</i>	Describes the role of the Controller in monitoring the game and the use of JTLS Controller orders.
<i>JTLS Data Requirements Manual</i>	Describes data elements and structures required by JTLS software and algorithms.
<i>JTLS DDS User Guide</i>	Describes how to use the JTLS Database Development System (DDS) to build, modify, verify, or query JTLS databases.
<i>JTLS Design Plan</i>	Describes the functional enhancements and database changes implemented for a Major JTLS software and Standard Database release.
<i>JTLS Director Guide</i>	Describes the JTLS Director's role of scheduling resources, locating and assembling data, training, and security.
<i>JTLS ELS User Guide</i>	Provides information and instructions for using the Entity Level Simulation (ELS), including initialization requirements, template building, configuring and executing the ELS.
<i>JTLS Executive Overview</i>	Provides a survey of the JTLS hardware, software, and functions.
<i>JTLS Installation Manual</i>	Describes procedures for installing JTLS on various hardware and operating systems and setting system parameters.
<i>JTLS JMRRM User Guide</i>	Describes the use of JTLS capabilities within a Joint Multi-Resolution Model (JMRRM) federation.
<i>JTLS Player Guide</i>	Describes the role of the Player and the use of Player orders to interact with JTLS.

Table 1.1 JTLS Documentation Suite (Continued)

JTLS DOCUMENT TITLE	CONTENT DESCRIPTION
<i>JTLS PPS User Guide</i>	Provides information and instructions for using the JTLS Postprocessor System (PPS).
<i>JTLS Software Maintenance Manual</i>	Provides information pertaining to upgrades and maintenance of the JTLS system, and is intended to be used as a reference.
<i>JTLS Standard Database Description</i>	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.
<i>JTLS Technical Coordinator Guide</i>	Provides information needed for the JTLS Technical Coordinator while starting and maintaining the game and providing system expertise.
<i>JTLS Version Description Document</i>	Describes upgrades and code corrections associated with each JTLS release.
<i>JTLS WHIP Training Manual</i>	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).

2.0 JTLS SYSTEM OVERVIEW

The JTLS system is an interactive, multi-sided analytical tool that models joint air, land, and naval civil-military environments. This theater-level simulation is designed for use in the following areas:

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

The simulation is useful as the situation driver and operations evaluation tool for combined, joint, and international staff exercises.

This chapter provides an overview of the civil-military training and analysis process, then summarizes the required JTLS operating equipment suite. Finally, each of the JTLS programs, including the major system components and support tools, are described.

2.1 THE CIVIL-MILITARY TRAINING AND ANALYSIS PROCESS

The design and execution of the civil-military training and analysis 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 civil-military training and analysis
- Open Support
- Hidden Support
- Distributed Output

The Seminar design employs a small cadre of subject matter experts (SMEs) to operate the simulation and report results to key decision-makers. An experienced SME cell enters order sets—to implement a branch of a campaign plan—then runs the simulation at high speed in a “batch mode” until a pre-defined branch point is reached or a specified time interval has elapsed. The SME cell then provides operational results to the seminar director to support the decision-making process. After key decisions are formulated, the cycle continues with a new set of orders being entered into the simulation. This approach requires only a few SMEs; however, they must be well-trained in all aspects of the simulation and must maintain expertise in a variety of civil-military training and analysis functional 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 simulation or retrieve data from it. In this mode, the simulation is completely open to the target training audience. This design is advantageous because it does not require many “overhead” SME personnel to support simulation inputs. However, the target training audience can become extensively 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 SMEs 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 simulation is operated, and the training audience. The training audience develops operational orders in their standard format, and ignores model

constraints or special requirements. A subordinate response cell then processes these operational level orders into simulation-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 any information is forwarded 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 simulation with established C4I systems. This design permits key decision-makers to send orders and monitor results over their organic, civil-military command, and control systems. Their orders are processed into simulation 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 C4I. For example, the Air Operations Center (AOC) may establish a TADIL from JTLS to an organic battlespace management system. Additionally, USMTF messages can be transmitted from the simulation over a local area network (LAN) to an interface with theater communications systems. When coupled with order entry modules like the ATOT, this design structure provides 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. As a funded U.S. Department of Defense simulation, JTLS is used in this manner to interface with U.S. 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 principal staff positions: Exercise Director, Senior Controller/Exercise Controller, Technical Coordinator, Computer Systems Manager, and Players. The functions of each position are summarized below:

- The Exercise Director plans and administers the civil-military training and analysis exercise.
- The Senior Controller/Exercise Controller monitors the progress of the campaign and uses JTLS tools to shape the electronic decision environment to meet operational requirements or training objectives as specified by the Exercise Director.
- The Technical Coordinator (Tech Control) starts and stops the simulation, monitors all computer resources needed for the simulation, and provides technical support for JTLS execution.
- The Computer Systems Manager configures the computers and coordinates system software changes and hardware maintenance.
- The Players enter simulation orders and monitor the status of assigned resources. Players may have command authority over all resources 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 has access to some of the air-related orders as well as selected LOGISTICS and INTEL orders. Commonly-used Player types include:

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 that 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.

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

2.2 JTLS OPERATING EQUIPMENT

The Combat Events Program (CEP) and its support programs, the JTLS Object Distribution Authority (JODA) data server, and the Web Enabled JTLS services ([Section 2.7](#)) are designed for execution on 32-bit or 64-bit Linux-based platforms. The Web Hosted Interface Program (WHIP), the graphical user interface for JTLS, is executed on one or more Microsoft Windows or Linux-based workstations that utilize the AMD AMD64^(TM)/Intel EM64T^(TM) architecture.

Equipment required to execute the core components of JTLS—the CEP, Web Services, and WHIP—is configured according to the intended use of the simulation within an analysis, user training, or exercise environment. JTLS can be executed on a single optimized PC 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 simulation for small groups of simulation trainees; larger groups require a network configuration similar to the specifications described in [APPENDIX B. JTLS OPERATING EQUIPMENT](#). Other critical elements, such as exercise and analysis requirements, the training environment, and the scenario size and complexity, must be considered while planning an optimal JTLS excursion.

2.3 JTLS SYSTEM STRUCTURE

The Web Enabled structure of JTLS 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. 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.

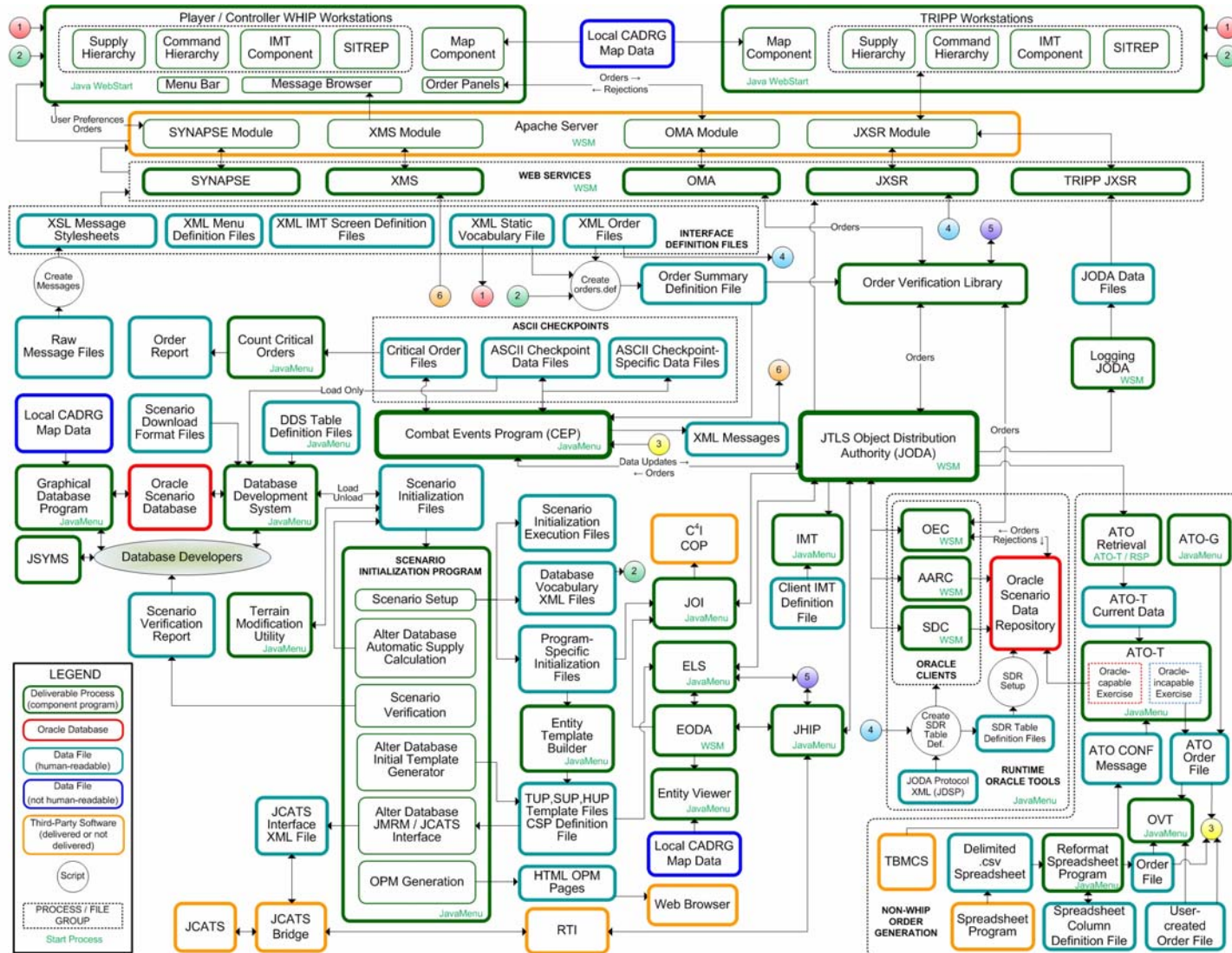


Figure 2.1 Web Enabled JTLS System Structure and Data Flow

2.4 SCENARIO PREPARATION TOOLS

2.4.1 Database Development System (DDS)

The 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. For example, the DDS can be used to obtain a list of units in the database by Tactical Unit Prototype, or TUP, that is used. The DDS is an application of the Oracle Server (a relational database management system), and was built using the Oracle Forms/Reports Developer 6i tool.

2.4.2 Scenario Verification Program (SVP)

The SVP is a primary component of the Scenario Initialization Program (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 JTLS during simulation execution. This process enables efficient and accurate database consistency checking.

2.4.3 Online Player Manual (OPM)

The OPM provides access to scenario initialization data. An OPM can be generated from either the simulation 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.

2.4.4 Lanchester Development Tool (LDT)

This program assists in the implementation of the Lanchester attrition model used to assess the results of force-on-force land combat in JTLS. The user enters 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 LDT is not depicted in [Figure 2.1](#).

2.4.5 Graphical Database Program (GDP)

This program allows the graphical placement of units and targets, and the creation or modification of National Boundaries and Areas of Operations. The GDP is used to extract current scenario data from the DDS/Oracle database and for display on a WHIP-based graphical display system. In addition to the manipulation of simulation objects, the GDP allows modification of terrain and barrier data. User object and terrain updates are written directly to the Oracle database.

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 simulation start. One of its primary functions, scenario verification, is described in [Section 2.4.2](#).

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 JTLS and other support programs, such as the Entity Level simulation (ELS), and external simulations, such

as the Joint Conflict And Tactical Simulation (JCATS). The Automatic Supply Calculation (ASC) process assists database builders by replacing many of the tedious calculations required to determine the appropriate quantities for various categories of supply for each unit prototype.

2.5.2 Interface Configuration Program (ICP)

The ICP is an interactive program that allows the user to define the specifications for each simulation process that can be started for a particular scenario: Message Delivery Program (MDP), Order Verification Tool (OVT), ATOG/ATOT programs, Keyhole Markup Language (KML) Operational Interfaces (KOIs), Replay Servers, WHIPs, JODAs, the CEP, and the ELS. The ICP uses a graphical interface to allow users to edit the default process configuration.

2.6 COMBAT EVENTS PROGRAM (CEP)

The CEP is the central component of JTLS that determines all of the actions and interactions among the air, land, naval, and civil-military forces defined and modeled for a specific scenario. The CEP creates, maintains, and reports the current status of the civil-military 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 computer 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 assigned to it. Each JODA maintains its own current simulation database and communicates with the programs assigned to it in the data communication structure.

Player entries to the simulation are in the form of orders submitted at a WHIP and transmitted to the CEP for processing via one or more JODAs. Players receive simulation information from the CEP in the form of WHIP graphics updates, messages, and IMT tabular data displays.

2.7 WEB SERVICES

The Web Enabled JTLS (WEJ) design is intended to reduce the cost of conducting a simulation-supported combined, coalition, and joint training event, and to minimize the use of personnel and equipment. Operators using a Web-based connection, or an existing WAN and LAN, can log on to the simulation via a Web browser on a personal computer, and operate the Player interfaces. This design significantly reduces the cost and the turn-around time of a training event.

The WEJ infrastructure implements four integrated Web Services ([Section 2.7.3](#) - [Section 2.7.6](#)) 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 JTLS Web Services communicate with the JODA, which functions as an ambassador between the CEP and the Apache server.

2.7.1 JTLS Object Distribution Authority (JODA)

The JODA connects directly to the CEP and distributes data to the Web Services programs or other registered JTLS Data System (JDS) client programs. By default, a JODA that connects to the CEP is configured and designated as a Primary JODA. Additional JODAs can be configured to

distribute the load of servicing clients. These secondary JODAs do not connect directly to the CEP, but to a parent 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 Server implements several modules that interface with the Web Services to provide the simulation data. These services receive the simulation data from the CEP via the JODA. Data pushed to the Web Services then become available upon request by each operator's WHIP through the Apache 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 object names for order entry. Additional JXSRs can be configured to run on separate hosts to properly distribute the processing load. Each JXSR is independent and maintains a connection only with its parent JODA.

2.7.4 XML Message Service (XMS)

The XMS connects to the JODA to monitor messages written to the file system, and provides three 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 prior to sending them to the CEP. If an order fails verification feedback is provided by the OMA to the WHIP. This feedback is then used to inform the WHIP operator of the specific problem.

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 sharing orders and drawings among WHIPs.

2.7.7 Web Services Manager (WSM)

The WSM enables users to configure each Web service component within the hardware platform to distribute the load on the system. It allows the user to start, monitor, and shut down the Apache server and primary JODA, as well as the JXSR, XMS, OMA, and SYNAPSE Web Services for a specific scenario. The window displays a tree interface that provides operating status buttons organized according to the component connectivity. Secondary JODAs and their associated services are also displayed.

2.8 PLAYER INTERFACE PROGRAMS

2.8.1 Web Hosted Interface Program (WHIP)

The WHIP is an integrated Java-based GUI that is downloaded to each WEJ 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
- SITREP

The context-sensitive menus simplify user interaction with the scenario. For example, detailed Combat System, supply, order, location, and posture data for any unit in the scenario are directly and easily accessible from the Map or Command Hierarchy windows.



Figure 2.2 WHIP Visual Components

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 simulation objects are placed. A wide range of filtering capabilities exist to manage the objects that are displayed. In addition to basic object filtering, the filtering capabilities permit WHIP users to customize their level of detail. If the WHIP workstation contains CADRG data, the Map component will display high-resolution map images.

2.8.1.2 Information Management Tool (IMT)

The IMT ([Figure 2.3](#)) displays interactive status tables that provide current scenario information regarding the status, profile, and capability of forces, including units, targets, convoys, and air missions. The IMT can also display current intelligence gathered from foreign forces.

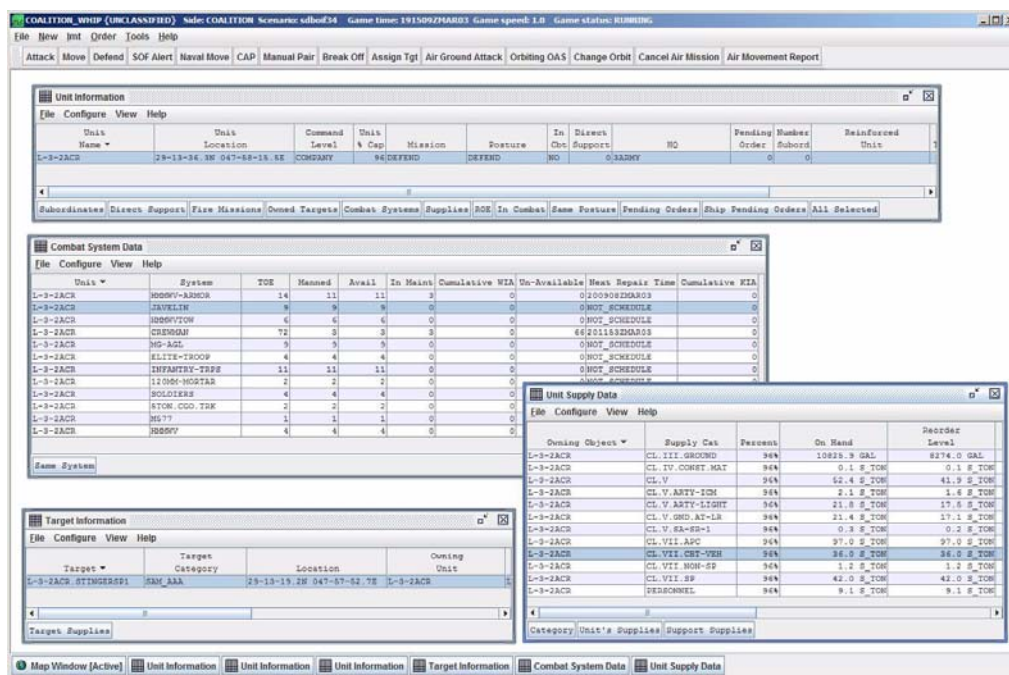


Figure 2.3 Information Management Tool Windows

2.8.1.3 Command and Logistics Hierarchies

The Command Hierarchy and Logistics Hierarchy windows, illustrated in [Figure 2.4](#), display Force Side, Faction, and unit-level information in a graphical display that visually represents the hierarchical chain of command or the supply logistics structure defined for the current scenario.

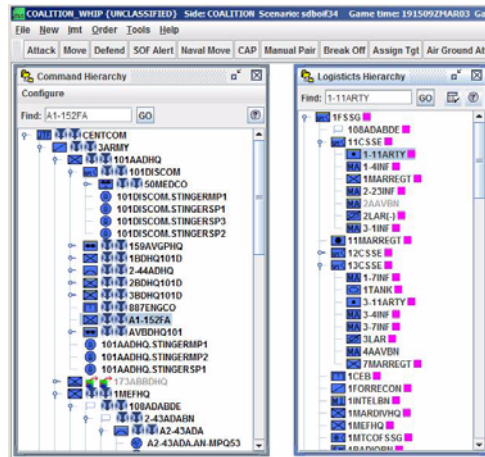


Figure 2.4 Command Hierarchy and Logistics Hierarchy Windows

Selecting and clicking a unit name in either window opens a context-sensitive menu which can be used to access IMT Reports, supply information, OPM pages, and various map displays related to the units location. Orders available for a particular unit can be initiated through this menu.

2.8.1.4 Order Management

The JTLS order panels permit the user to create named orders from a displayed order template that contains default values for the order fields. The WEJ interface allows user access to these orders either from within an order panel or from a Quick Order menu. An Order Group Editor window enables users to combine saved orders, send them simultaneously to the CEP as a named group, copy, rename, delete, save, load, or share the orders with other users. This tool uses a tree interface to organize and display the saved orders and groups.

2.8.1.5 Situation Report (SITREP)

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 data available about the object. A SITREP can also be triggered from the IMT, Command Hierarchy, or Logistics Hierarchy components.

2.8.1.6 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 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.

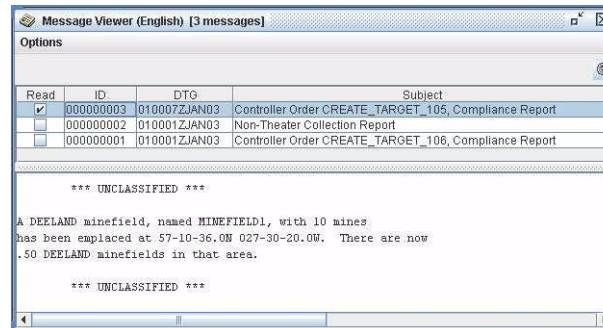


Figure 2.5 Message Browser Window

2.8.2 Total Recall Interactive Player Program (TRIPP)

The TRIPP is a specialized WHIP that allows users to recall and replay simulation events for a specified time interval from a previously run JTLS session. The ICP is used to enable the TRIPP and properly configure the simulation with three supporting components: a dedicated Logging JODA, one or more Replay Servers, and one or more TRIPP display consoles.

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 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, the Pacer, can be used to regulate simulation speed.

2.9.2 Order Verification Tool (OVT)

The OVT receives JODA-distributed output from the CEP and 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 simulation. 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 Scenario Data Repository (SDR) Order Entry Client (OEC), the OMA Web Service, the JHIP, and the ELS.

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 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 require data feeds to real-world C4I systems. The JOI is designed to provide a configuration-managed capability to deliver 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 U.S. Global Command Control System (GCCS) or to any other system that accepts OTH-Gold messages by means of a TCP/IP socket connection.

2.9.5 KML Operational Interface (KOI)

Global satellite imagery viewers similar to the C4I systems used by U.S. forces have become widely available to exercise audiences for the display of scenario object and terrain data. The Google Earth (™) viewer, supports the robust Keyhole Markup Language (KML) application interface. KML data facilitate an imaging program that retrieves and displays JTLS force status information. The KOI is a JODA client that generates operational KML files to be displayed by users employing a Google Earth viewer or other display system capable of processing KML data.

2.9.6 Scenario Data Repository (SDR)

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 simulation data while the simulation is executing. The 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 SDC is responsible for populating and updating the SDR with the current simulation information provided by the JODA. Any object information provided by a JODA is available in the SDC data tables.

The AARC program is responsible for populating the SDR with CEP objects, object history, and object interaction data. These data comprise a history of the executing simulation that 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 OEC checks database tables within the 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 (ATOG)

The ATOG is designed to assist an Air Player to create offensive and defensive Air Mission orders to be entered 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 ATOG uses this guidance, the Players 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 (ATOT)

The ATOT is designed to utilize an Air Tasking Order generated by an exercise Air Staff to create the JTLS Air Mission orders needed to represent the plan in JTLS. The ATOT translates a USMTF ATO typically produced by the Theater Battle Management Core System (TBMCS) ATO generator program into JTLS Air Mission orders.

2.11 SIMULATED CIVIL-MILITARY FUNCTIONS

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 related chapters of the *JTLS Analyst Guide*.

2.11.1 Air Functions

The air model represents the following capabilities:

- Airborne Warning and Control System (AWACS)
- Air refueling
- Wild Weasel (WW)
- Surface attack
- Reconnaissance, both armed and unarmed, including specifications for Directed Search Areas (DSAs)
- Airlift of units or supplies
- Air emplacement of land or sea mines
- Orbiting Air-Ground (OAG) missions
- Manual commitment of air missions to intercept enemy air missions
- Detailed Air-to-Air and Surface-to-Air Rules of Engagement (ROE), including OPAREA-specific ROEs
- Electronic Combat (EC)
- Escort
- Defensive counter-air (including ground and airborne alert)
- Close Air Support (CAS) (including ground and airborne alert)
- Airdrop of units or supplies
- Air Mission Packages
- Anti-Submarine Warfare
- Real-Time Commitment of OAG and diversion of surface attack missions
- IFF (Identification, Friend or Foe) including Unknown identification
- 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 Psychological Operations (PSYOPS)
- 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
- External/National asset resources
- Partial Intelligence of targets and units
- 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
- Multiple support unit assignment based upon supply category
- Movement of supplies by rail, barge, or truck
- Pipeline operation
- Port operations for inter- and intratheater air and sea movement
- Random equipment failures
- Automated resupply (e.g., stockage objective, reorder level, and backorder)
- Player-directed supply, resupply, and cross-leveling for units
- Transportation of units by rail, barge, or truck convoy
- Caching and recovery of own supplies and capture of Enemy supplies
- Transportation networks (linking bridges and tunnels)

2.11.5 Naval Functions

The Naval model represents the following capabilities:

- Carrier-based air activities as listed in the air function
- Search radar coverage
- Naval reinforcing fire, including Counter-battery fire
- Amphibious pickup/extraction and assault
- Task organization (Formation) movement, including merging formations
- Area patrol
- Sealift
- Surface-to-Surface missile firing and naval gunfire
- Task organization (Formations) that include units from multiple Factions and Force Sides
- Mine warfare operations, including laying, sweeping, and casualties
- Submarine operations
- 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 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 actual system. Activities must be modeled so that the system state changes properly when each activity occurs. This requirement imposes additional conditions for correctly simulating the characteristics of activities and for sequencing the simulated execution of activities so that their order of performance within the simulation 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?

The event-driven characteristic 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 simulations are relatively fast and efficiently use computing resources.

The main routine-subroutine structure of most high-level programming languages is not suitable for event-driven simulations 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 organic 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 features that lend themselves especially well to event-driven simulations.

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 simulation. This entity also might be the owner of a HEADQUARTERS SUBORDINATE SET—the set of all units subordinate to it (for example, a division artillery battalion or an engineer battalion).

A 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 an array is a list. Another common form of an 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 all the information about the Combat Systems of a unit is linked to the unit by the COMBAT SYSTEMS array pointer. Information is recovered about the status of a unit's Combat Systems merely by retrieving the Combat Systems pointer attribute of the unit and, using the pointer, retrieving the COMBAT SYSTEMS array of the unit.

The data described in this document are used to create the entities, attributes, sets, events, and arrays used by the CEP to simulate the operational 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 the concept of ROE, which 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).

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, return fire, or defend itself.
- Hold Fire: The unit may not initiate combat, but can defend itself.
- Weapons Tight: The unit may engage objects that it perceives as Enemy within a specified range.
- Combat Approved: The unit may engage Enemy objects or objects of a specific Side within a specified range.

3.2 GROUND COMBAT OPERATIONS

The JTLS ground module performs these basic ground combat functions:

- Establish new routes for ground movement
- Perform administrative moves

- Attack, defend, delay or withdraw
- Emplace land mines by unit, air mission, or artillery
- Clear land mines
- Destroy targets
- Perform operations using High Resolution Units (HRUs)
- Order explicit indirect fire support (and the associated capability to cancel such orders)
- Maintain ROE settings
- Repair targets
- Order reinforcing fire

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.

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 point 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 algorithmic “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), Aircraft Shelter, and Materiel 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, be 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 know 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
- Civil Affairs
- Operate ADA targets

- Perform Intelligence Patrol Missions, breaking radio silence to report high interest objects or activities
- 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.
- Represent downed aircrew who have survived the destruction of their aircraft
- Perform Combat Patrols, engaging high-interest objects, using their Combat Systems
- Execute a Direct Action mission (raid). The subject of the raid is always a specific unit or target.
- Own, (but not operate) SSM targets. Future JTLS versions will allow HRUs to fire SSMs.

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 initial 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 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
- Mandatory transfer of supplies from one unit to another.
- Creation of logistics loads for use in future orders
- Operation of pipelines, including drawing supplies from the pipeline and replenishing 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
- 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.
- Sealift operations (through the naval module). A naval unit or formation is capable of sealifting either a unit or a supply load from a loading location to an offloading location.
- 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
- Automatic or Player-directed resupply of units
- Creation of supply caches for future use
- Capture of Enemy supplies and recovery of own supplies
- Change of the depot from which a unit orders its supplies or from which a pipeline is replenished
- 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.
- 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.

- Evacuation of remains (KIA). A fraction of killed personnel are recovered by their unit. These KIA are retained by the unit until they can be evacuated. Evacuation occurs by the same methods as casualties. Casualties have priority on backhaul convoys.

3.3.1 Supplies and Supply Categories

The use of the unlimited supply capability permits assessment of both the logistics and combat results 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. An unclassified JTLS database for 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.

A new capability for convoys was added for JTLS 3.4.5. 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 pipeline 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, 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)
- Aerial Refueling
- Combat Air Patrol/Defensive Counter Air, or in orbit, at a location or referenced to the location of a unit
- Offensive Air Support--Close Air Support, or in orbit, at a location, or referenced to a unit
- Escort
- Reconnaissance and Armed Reconnaissance
- Electronic Combat
- Air Interdiction and Offensive Counter Air
- Air Defense Suppression (Wild Weasel)
- Airlift
- Airdrop
- Area Patrol Missions (Anti-Submarine Warfare (ASW) surveillance)
- Transfer of aircraft to another unit
- Insert/extract of an HRU
- Transport of Supplies, following a sequence of pickup, dropoff and route transit points

The ATOT software is designed to read a data file containing a USMTF ATO that is typically produced by the USAF Contingency Theater Air Control System (CTAPS) ATO generator program. 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 and will remain at that location 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 by specifying a specific weapons combination on the mission order.

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 automatically enter maintenance and are unavailable for re-tasking until maintenance is complete. 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, which 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 target altitude.

3.4.2 Offensive Air Operations

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

The Wild Weasel 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, orbiting RECCE, AIREF, EC, and Escort missions, which 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 RECCE 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 RECCE provides detailed

battle damage information when the Package returns. An orbiting RECCE mission orbits at a specified location for a directed time collecting intelligence for its Side.

The EC 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 JTLS Air Missions with a common purpose and represents group of aircraft with a common purpose. An Air Mission Package 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 RECCE 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 air craft, it will abort.

Missions from any Friendly Side can join the mission. 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 both units and loads of supplies to be moved by airlift or airdrop. A Player can airlift a Friendly or Neutral unit, and specify any unit to receive the supplies for an airlift or airdrop. When supplies are airlifted, they are drawn from units (first priority) or supply dumps in the vicinity of the pickup point.

For both airlift and airdrop, 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 can combine an airlift/drop of supplies. The mission permits a Player to commit aircraft to go to a series of locations picking up and dropping off supplies. If the point is a dropoff, it may be either an airdrop point or a point at which to land and deliver 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 followed, which may be pickup points (landing required), dropoff points (air drop or land and offload), or simply transit points.

3.4.8 Moving Squadrons and Aircraft

Fixed wing squadrons can be airlifted from one airbase to another, but cannot perform ground moves. Squadrons can airlift themselves. Rotary wing squadrons can perform ground moves, but it is generally more efficient and safer for them to be airlifted.

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 must 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 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 on 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 or SSM
- Amphibious pickup transportation and assault
- 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 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 sink when they have sustained too many hull breaches. Repairs to damaged systems are made based on time factors set in the database.

Units 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 or ASW aircraft. Once 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.

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 units or targets are first detected by a Force Side, their exact identification may not be known. In this case, the object is displayed as an Unidentified object, with a name starting with UI, followed by a six-digit sequence number and a unique letter. 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. Subsurface naval units 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 Report: This report provides 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. The Periodic Report is made up of 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.

4.0 SUMMARY

JTLS is a computer-based analytical model. With such a system, civil-military and conflict processes may be simulated, and the users make decisions about the allocation of resources assigned to accomplish a mission. Ground combat results are determined using Lanchestrian equations. A measurement of lethality or probability of kill determines the outcome of attacks on air, water, or ground point targets.

JTLS is designed to be used without modification as:

- a planning analysis tool;
- support material for education;
- exercise support for training; and
- a primary means to investigate the results of civil-military operations.

In addition to including explicitly defined user requirements, the JTLS baseline design provides the following benefits:

- The primary software language, SIMSCRIPT II.5, was designed for efficiently creating simulations.
- User-machine interaction permits data entry and outputs that are available at independent terminals.
- Screen menu capabilities and a message-handling system are provided to the user.
- An expandable memory capability accommodates increased database requirements.
- The design facilitates future product improvements.
- Configuration management procedures provide for ongoing visibility and control of software and documentation.
- A complete suite of documentation encompassing all areas of JTLS is provided.

APPENDIX A. ABBREVIATIONS AND ACRONYMS

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

AAA	Anti-Aircraft Artillery
AADC	Area Air Defense Commander
AAL	Air-to-Air Lethality
A/C	Aircraft
ACP	Air Control Prototype
ADA	Air Defense Artillery
AEW	Airborne Early Warning
AFB	Air Force Base
AG	Air-Ground (Air-to-Ground)
AI	Air Interdiction
AIM	Air Intercept Missile
AIREF	Air Refueling
AKL	Area Kill Lethality
AMMO	Ammunition
AO	Area of Operations
AOC	Air Operations Center
APC	Armored Personnel Carrier
ARECCE	Armed Reconnaissance
ARTE	Air Route
ARTY	Artillery
ASC	Automatic Supply Calculation
ASCII	American Standard Code for Information Interchange
ASW	Anti-Submarine Warfare
ATC	Aircraft Target Category
ATGM	Anti-Tank Guided Missile
ATK	Attack
ATO	Air Tasking Order
ATOG	Air Tasking Order Generator
ATORET	Air Tasking Order Retrieve Program
ATOT	Air Tasking Order Translator
AWACS	Airborne Warning And Control System

AZ	Altitude Zone
BADGE	Bilateral Air Defense Ground Environment (used by Japan Defense Agency)
BAI	Battlefield Air Interdiction
BDA	Battle Damage Assessment
BDE	Brigade
BN	Battalion
C3	Command, Control, and Communications
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
CA	Civil Affairs
CADRG	Compressed ARC Digitized Raster Graphics
CAP	Combat Air Patrol
CAS	Close Air Support
CAT	Category
CCF	Central Control Facility
CCP	Command Control Prototype
CCU	Controller Change Unit
CEP	Combat Events Program
CMDR	Commander
COP	Common Operational Picture
CP	Combat Power
CS	Combat System
CSP	Combat System Prototype
CTAPS	Contingency Tactical Air Planning System
CTG	Commander Task Group
CTRL	Control keyboard command
DCA	Defense Counter Air
DCL	Digital Command Language
DDS	Database Development System
DEMSDB	Demonstration Standard Database
DISA	Defense Information Systems Agency
DIV	Division
DMA	Defense Mapping Agency
DoD	Department of Defense

DOS	Days of Supply
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
GDP	Graphical Database Program
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
ICPLogin	Interface Login Program
ID	Identifier
IFF	Identification Friend or Foe
IIP	Intelligence Information Prototype
IMT	Information Management Tool
INFO	Information
INTEL	Intelligence
JCATS	Joint Conflict And Tactical Simulation
JCW	Joint and Coalition Warfighting (formerly JWFC: Joint Warfighting Center)
JDA	Japan Defense Agency
JEDI	JODA Entity Data Identifier
JDS	JTLS Data System
JDSP	JTLS Data System Protocol
JRSG	Joint Rapid Scenario Generation (formerly JIDPS: Joint Integrated Database Preparation System)
JMCIS	Joint Maritime Combat Information System
JMEM	Joint Munitions Effectiveness Manuals
JODA	JTLS Object Distribution Authority
JOI	JTLS Operational Interface
JPL	Jet Propulsion Laboratory
JSDF	Japanese Self-Defense Force
JTLS	Joint Theater Level Simulation
JTOI	JTLS Transaction Operational Interface
JXSR	JTLS XML Serial Repository
KIA	Killed In Action
KM	Kilometer
KNOTS	Nautical miles per hour
LA	Lethal Area
LAN	Local Area Network
LAT	Latitude
LB	Login Build (JTLS order type)
LDT	Lanchester coefficient Development Tool
LOG	Logistics

LOGIN	Logistics Input
LOGREP	Logistics Report
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
NCSA	National Center for Supercomputing Applications (University of Illinois)
NEO	Noncombatant Evacuation Operations
NFS	Network File Server
NGO	Non-Governmental Organization
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

ONC	Operational Navigation Chart
OPM	Online Player Manual
OPP	Order Preprocessing Program
OTH	Over The Horizon
OTH Gold	Over The Horizon message specification
OTH-T	Over The Horizon-Targeting
pD	Probability of Detection
pE	Probability of Engage
pH	Probability of Hit
pK	Probability of Kill
PKL	Point Kill Lethality
POL	Petroleum, Oil, and Lubricants
POSIX	International operating system standard based on System V and BSD
PPS	Postprocessor System
PSYOPS	Psychological Operations
RAM	Random Access Memory
RDMS	Relational Database Management System
RECCE	Reconnaissance (air missions)
RECON	Reconnaissance (ground missions)
REGT	Regiment
RNS	Random Number Seed
ROE	Rules Of Engagement
RPT	Report
RSP	Reformat Spreadsheet Program
SAL	Surface-to-Air Lethality
SAM	Surface-to-Air Missile
SAM/AAA	Surface-to-Air Missile/Anti-Aircraft Artillery
SC	Supply Category
SCP	Simulation Control Plan
SDB	Standard Database
SEAD	Suppression of Enemy Air Defense
SIMSCRIPT	Simulation programming language (product of CACI, Inc.)
SIP	Scenario Initialization Program
SITREP	Situation Report

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

USCG	United States Coast Guard
USMC	United States Marine Corps
USMTF	United States Message Text Format
USN	United States Navy
UT	Unit entity attribute prefix
UTM	Universal Transverse Mercator
VIFRED	Visual Forms Editor
VMS	Virtual Memory System
VTOL	Vertical Take-Off and Landing aircraft
WAN	Wide Area Network
WDRAW	Withdraw
WEJ	Web Enabled JTLS
WHIP	Web Hosted Interface Program
WIA	Wounded In Action
WPC	Warrior Preparation Center
WPN	Weapon
WT	Weight
WW	Wild Weasel
XMS	XML Message Service

APPENDIX B. JTLS OPERATING EQUIPMENT

The JTLS hardware configuration needed to support an exercise may need additional server capability to distribute the processing load of the CEP and Web Services and to improve simulation performance and user interface response. For exercises or user training, a Microsoft Windows platform is recommended to execute the WHIP.

[Table B.1](#) and [Table B.2](#) describe the hardware and operating system requirements for the server and client components of a typical JTLS installation that is used to support an exercise.

These equipment requirements were established during stress testing at the Joint Warfighting Center. 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, or scenario size and complexity, must be considered while planning an optimal JTLS installation. Chapter 6 of the *JTLS Technical Coordinator Guide* presents additional hardware configuration considerations in further detail.

Table B.1 Representative JTLS Server Hardware Specifications: Exercise Environment

COMPONENT	OPERATING SYSTEM	CPU	RAM	DISK	VIDEO	MONITOR
JTLS SERVERS AND WEB SERVICES						
CEP and JODA 1 unit required	Red Hat Enterprise Linux 5.0 64-bit	AMD Opteron 280 or greater	4.0 GB	60 GB	Generic video card	Generic monitor
Apache Data Server 1 unit required	Red Hat Enterprise Linux 5.0 64-bit	AMD Opteron 280 or greater	2.0 GB	30 GB	Generic video card	Generic monitor
XMS, SYNAPSE, OMA 1 unit required	Red Hat Enterprise Linux 5.0 64-bit	AMD Opteron 280 or greater	4.0 GB	30 GB	Generic video card	Generic monitor
JXSR 1 unit per 20 workstations	Red Hat Enterprise Linux 5.0 64-bit	AMD Opteron 280 or greater	4.0 GB	100 GB	Generic video card	Generic monitor
Oracle Database Server* 1 unit required	Red Hat Enterprise Linux 4.0 or 5.0 64-bit Oracle Enterprise Linux 4.0 or 5.0 64-bit	AMD Opteron 280 or greater; or single CPU*	4.0 GB or more	500 GB (if AAR is used)	Generic video card	Generic monitor

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

COMPONENT	OPERATING SYSTEM	CPU	RAM	DISK	VIDEO	MONITOR
JTLS CLIENT WORKSTATIONS						
2 WHIPs per workstation	Red Hat Enterprise Linux 5.0 Microsoft Windows 2000, XP Professional, or Vista	AMD64/EM64T single or dual processor	1.0 GB	60 GB	3D hardware accelerated; DirectX compatible	21 inches; color; 1600 x 1200
4 WHIPs per workstation	Red Hat Enterprise Linux 5.0 Microsoft Windows 2000, XP Professional, or Vista	AMD64/EM64T single or dual processor	2.0 GB	60 GB	3D hardware accelerated; DirectX compatible	21 inches; color; 1600 x 1200

Table B.2 Representative JTLS Workstation Hardware Specifications: Exercise Environment (Continued)

COMPONENT	OPERATING SYSTEM	CPU	RAM	DISK	VIDEO	MONITOR
6 WHIPs per workstation	Red Hat Enterprise Linux 5.0 Microsoft Windows 2000, XP Professional, or Vista	AMD64/EM64T single or dual processor	4.0 GB	60 GB	3D hardware accelerated; DirectX compatible	21 inches; color; 1600 x 1200

*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 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 scenario using the Standard Database delivered with JTLS can be executed on a single Linux server platform supported by a single CPU and 3.0 GB of RAM.