1 Introduction

The Extended Air Defense Simulation (EADSIM) is a many-on-many simulation of air, missile and space warfare. It provides analysis, training, and operational planning to the warfighter in one package. EADSIM is one of the most widely used simulations in the world with over 390 user agencies worldwide. EADSIM is managed by the Future Warfare Center (FWC), Modeling and Simulation Division (MSD), U.S. Army Space and Missile Defense Command (SMDC), as the executive agent for the Missile Defense Agency(MDA). Inquiries should be directed to the SMDC EADSIM Manager's Office in writing at the address shown below or by telephone.

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A web site is also available, providing information on EADSIM and directions on how to obtain the model.

http://www.eadsim.com/

Our signature poster (Figure 1) depicts the flow of reality from the synthetic environment provided by EADSIM. It reminds us to be ever mindful of the impact of the modeling on reality through analysis decisions, training, and operational plans.

Figure 1 - EADSIM Supports Analysis Decisions, Training, and Operational Plans

EADSIM is used for scenarios ranging from few-on-few to many-on-many. It represents all the missions on both sides. It is unique in the scope of modeling at such a level of detail, where each platform (such as a fighter aircraft) is individually modeled, as is the interaction among the platforms. It includes an extensive functional and statistical representation of perception feeding perception based C3. It models the Command and Control (C2) decision processes and the communications among the platforms on a message-by-message basis. Intelligence, surveillance, and reconnaissance is explicitly modeled to support offensive and defensive applications.

EADSIM has been proven practical for a wide range of applications. User training is available, and over 700 students have been trained. There are existing databases describing blue and red systems.

EADSIM is the most mature and widely-used force-on-force model in the world. It has received extensive examination by the user community, resulting in multiple accreditations. Application of the model by hundreds of users adds to the confidence in EADSIM. EADSIM incorporates user-driven capabilities, with a proven rapid response capability to develop and support the model to meet evolving user needs. Teledyne Brown Engineering is the original and continuing developer of EADSIM, first deployed in 1989. TBE is ISO 9001 certified in Engineering Development and Maintenance of Software, Information Technology, Modeling/Simulation, and Analysis Products and Services, Design of Hardware Products. (Certificate #32855) TBE is continuing to improve the EADSIM processes, with processMax™ and ClearCase™/ClearQuest™ being adopted for process and configuration management tool uniformity.

MDA has repeatedly performed assessments and updated these assessments of EADSIM. Some notes from these assessments:

- EADSIM is generally the most comprehensive, widely used, and heavily scrutinized model in the MDA community.
- "... development process defined in the SDP is enforced"
- "... reviewed source code was extremely well documented."
- "...documentation was found to be of good quality, useful, and consistent."
- "The Configuration Management process is well documented and there is evidence that the process is well understood by the developers and consistently implemented."

EADSIM is supported with maintenance, configuration management, extensive documentation, a user hot line (1-800-C3I-USER), web and email help (eadsim.hotline@tbe.com), user conferences, and ongoing enhancements.

2 EADSIM Architecture

The EADSIM architecture can be viewed in three major pieces: the simulation setup, the run-time models, and the post-simulation analysis, as shown in Figure 2.

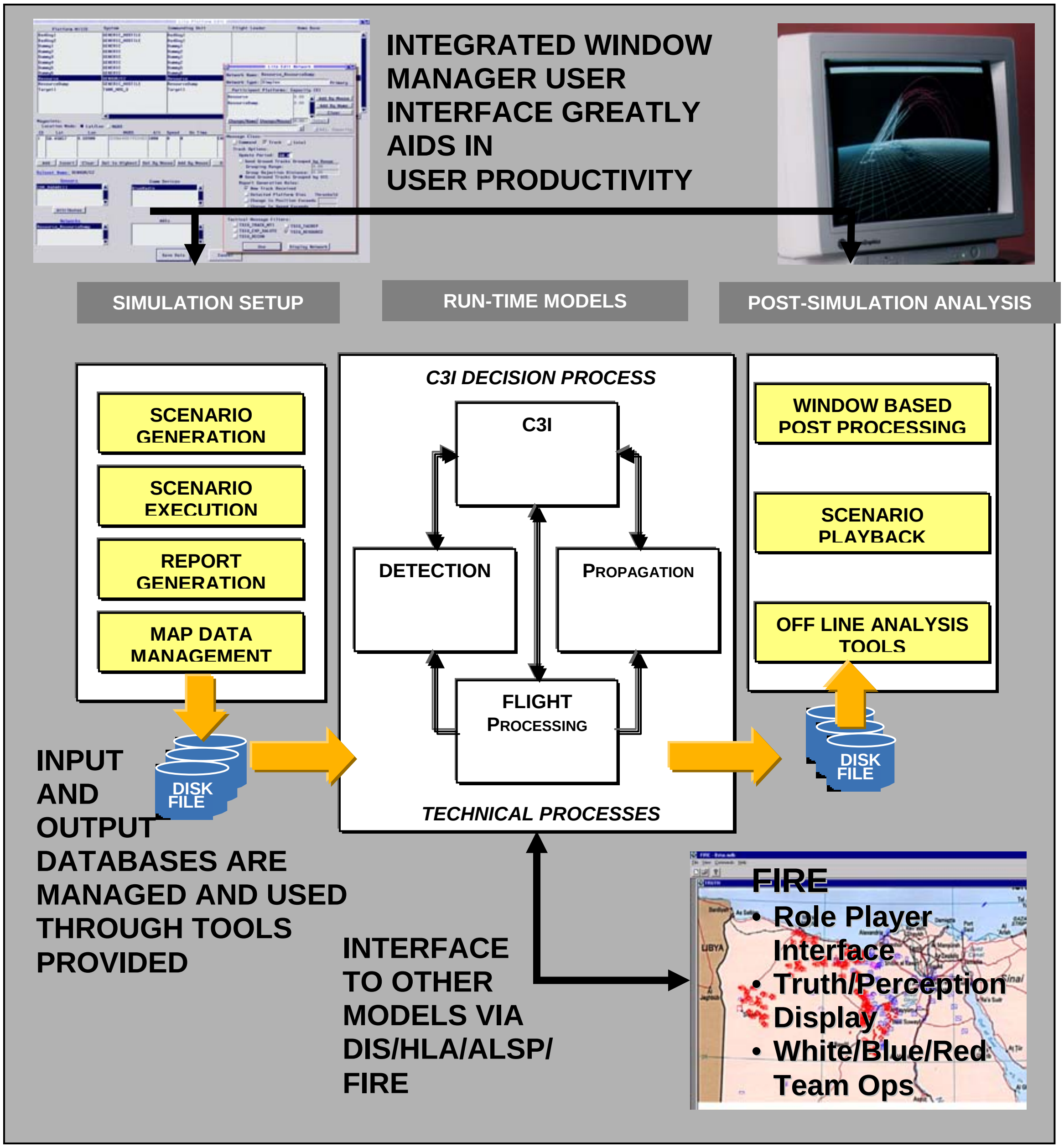

Figure 2 – EADSIM Architecture

The model has software for three basic functions: simulation setup, execution of a scenario, and post-processing and analysis. The processes and applications making up each of these areas are shown in Figure 2. The simulation setup and post-processing and analysis tools are contained almost entirely in a graphic window manager that provides the primary user interface. The execution of a scenario is performed by a set of run-time models that can be optionally linked to other models, operator stations, and tactical hardware. The simulation setup provides the tools to input, visualize, and manage the simulation data with tools to run the model. The post simulation analysis tools provide the ability to visualize the combat along with tools to analyze the data.

EADSIM provides a wide range of graphics to present the scenario generation, preview, and post run information to the user. This includes basic full color terrain data with overlaid scenario icons, three dimensional displays of the situation from any location on the battlefield, previews of the scenario with flight paths, cross sections through the terrain, attacker to target pairings and sensor intervisibility displays; overlaid text windows, overlaid maps on terrain; zoom, roam, etc. The displays are easy to access, presentation is fast, and they provide great information content to the user.

The GUI provides a series of pull-down menus as well as many point-and-click windows to view specifications and input data. All data can be added directly by highlighting the field using the mouse. Additionally, help screens are available throughout the model, which give a short description of the specific input area including any appropriate units and examples. Another positive contribution of the GUI is the graphics available in generation and playback of scenarios. This provides a good overall picture of the simulation and its mechanics, such as engagement, launch, and kills. EADSIM also offers a bounds checking feature which includes contextual and consistency checks.

3 Simulation Setup Tools

The simulation setup tools include:

- Scenario Generation
- Map Generation
- Run A Scenario
- Scenario Report Generator

The primary preprocessing tool is the Scenario Generation application of the window manager. It is related to the run-time processes through the input files it creates. It provides tools for scenario definition, modification, and analysis. It also performs some preprocessing of the scenario data and serves as the data base manager for multiple scenarios.

The Scenario Generation application provides the capability to input, visualize, and manage the simulation data. The Map Generation application provides an integrated user interface that allows creation of maps using Digital Terrain Elevation Data (DTED). The scenario report generator, FormScen, provides a formatted scenario report, giving a print-ready document defining all the inputs to the run-time processes. The Run A Scenario application starts an EADSIM run. Run startup diagnostics examines the success or failure of an attempt to run a scenario and provides a description of what failed.

EADSIM has an extensive set of consistency and boundary checks. These look at allowable values for inputs and reports any errors to the user. These include:

- Consistency and boundary checks on the inputs
- User interface analytic tools
- Run startup diagnostics
- Extensive log file outputs
- Post processing report generators
- Scenario Playback, with an extensive set of analytic tools

The consistency and boundary checks operate along with Scenario Generation as the run is defined, in the run as it is initiated, and in the FormScen utility when a printout of the inputs is produced. The boundary checks look at allowable values for inputs. The consistency check examines the inputs relative to other inputs. These tools produce reports of the problems found for viewing by the user.

The run startup diagnostics examine the success or failure of an attempt to run a scenario and provide descriptions of what failed. This allows the user to correct the configuration of the run.

The post simulation analysis section below describes the extensive diagnostic capabilities of the log file reports, report generators, and Playback.

4 EADSIM Combat Models

EADSIM models all the player types for air, missile, and space warfare as shown in Figure 3. These include fixed- and rotary-wing aircraft, ballistic and cruise missiles, satellites, and surface platforms performing both offensive and defensive missions for both friendly and hostile forces.

Figure 3 - EADSIM Combat Models

Land, sea, air and space systems can be modeled. All types of systems in various environments can be treated within the model both as attacker and defender.

Red and Blue players have the same model features. All features available for Red players are also available for Blue players, with the flexibility to represent the differences between Red and Blue. This allows analysts to use scenarios having dynamic, two-sided warfare.

Command, control, communications, computers, and intelligence, surveillance, and reconnaissance (C4ISR) is explicitly modeled for both sides. The activities of both friendly and hostile players are determined by sensed and communicated information.

Surface-to-air engagement modeling allows the participant to search and identify targets, choose the target most threatening to itself or to its assets, assign a weapon or weapon system to the threat, and engage and attempt to destroy the threat. Engagement of both Air-Breathing Threats (ABTs) and Tactical Missile (TM) threats is modeled. Engagement status and multiple targeting deconfliction is also involved in the surface-to-air engagement modeling.

Surface-to-surface modeling allows targets to be selected, an appropriate weapon to be selected, and the target to be engaged. The model accounts for the time delay required for the launcher to relocate. The target selection and weapon selection can be user-defined. The counterforce engagements can be dynamically determined for either friendly or hostile forces.

Air-to-surface engagement modeling provides the capabilities for a participant to search and identify its targets and then attempt to destroy that target. Avoidance of hostile attackers is practiced, and weapons are released from an optimum distance in order to allow maximum protection of the participant by terrain. This avoidance includes reactions to air attack and "Wild Weasel" approaches and surface-to-air reaction tactics.

For air-to-air, the emphasis is on beyond-visual-range engagements with both semi-active and active air-to-air missiles. Rulesets control target assignments, the modeling and resolution of dual targetings, and the production of engagement status information. The modeling allows for fighter engagement of both aircraft and ballistic missiles.

4.1 Mission / Functional Areas Modeled

A number of mission / functional areas are modeled in EADSIM, as shown in Figure 4. The general areas modeled include air defense, attack operations, electronic warfare, and support operations. Each of these is discussed below.

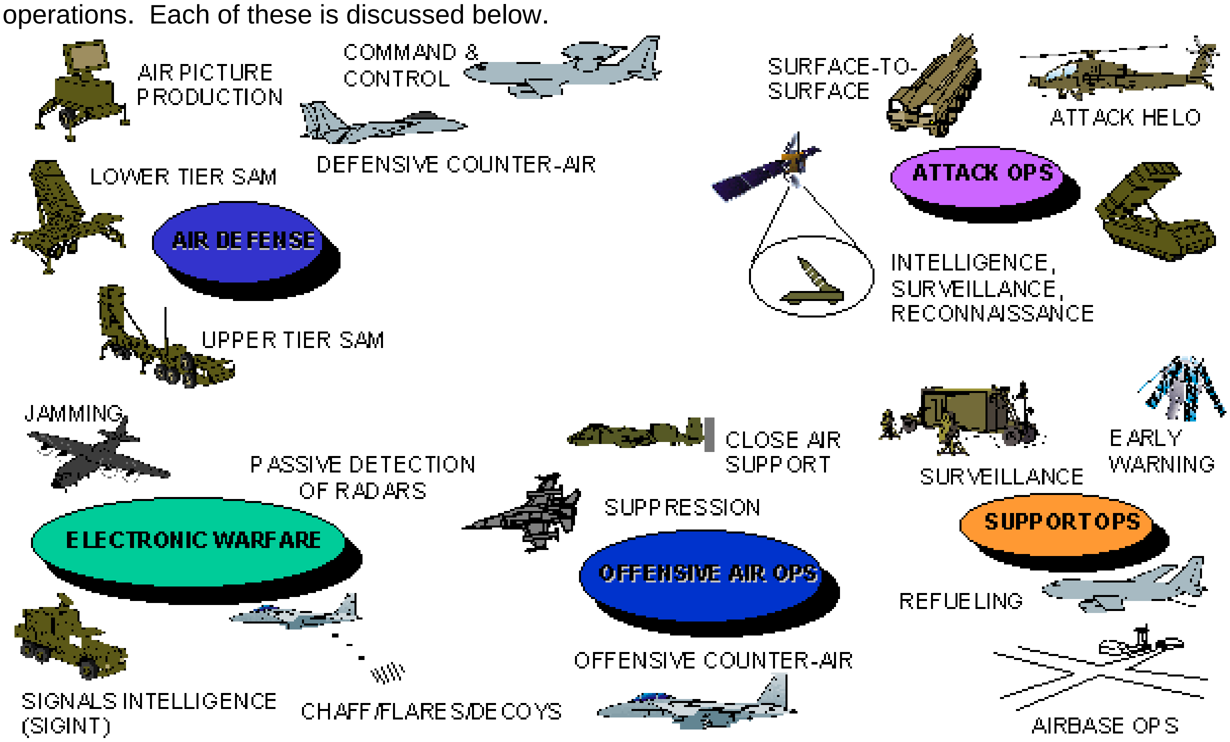

Figure 4 – Mission / Functional Areas Modeled

4.1.1 Air Defense

Surface-to-air engagement modeling encompasses missiles and guns operating in both anti-missile and anti-air roles. Surface-to-air missile (SAM) engagements are modeled for the full range of systems from shoulder-fired weapons to integrated air defenses and multi-tier theater missile defense systems. The units are either assigned targets by controlling C2 nodes or they choose their own targets from among targets for which they have track data. An engagement will be initiated when the target can be intercepted by one of the SAM's weapons.

Defensive Counter Air missions are modeled for fighters engaging aircraft and tactical missiles. Group behavior models of a flight of aircraft are provided for both air-to-air and anti-missile engagements.

Air to air engagement modeling generally considers flights of aircraft engaging groups of targets. These targets may be either commanded targets from the defensive commander or may be selected by the fighter aircraft. Either highly centralized operations, where the fighters will rely on commanded targets, or decentralized operations with the fighters selecting their own targets, are modeled. Maneuver tactics for the air to air engagement are modeled. Cooperation among the flight is modeled both in sorting targets and also in reaction to the engagement of flight members by opposing aircraft.

Anti-missile operations of aircraft have extensive group and cooperative tactics to maintain aircraft on station, select targets for engagement, and to provide track support for an engagement.

The fighter ruleset uses both local and remote track data to make engagement decisions and conduct the engagement. For engagements against TBMs, the fighter can operate with offboard sensors to provide track information from engagement decision to intercept.

The defense may have poor information to use for vectoring fighters. The uncertainties of the fighter ever finding the target are included in the model. Similar uncertainties for the location of ground targets are modeled for air to surface engagements.

EADSIM models defensive and offensive command and control with unlimited levels of command. The defensive and offensive commander centers can be configured to make decisions at all levels. This integrated structure can model command of both air and ground forces. The defensive commander ruleset types allow modeling of centralizing command anywhere in the command chain. Hierarchical, distributed, and cooperative relationships are modeled. The offensive command and control controls all facets of attack operations including intelligence, surveillance, and reconnaissance, target engagement, and battle damage assessment. The rulesets used to represent these capabilities provide options and capabilities to tailor the representation of a particular system.

Air picture production and dissemination is modeled, with track processing, target identification, and sharing of tracks among multiple platforms. This air picture is based on sensed and communicated information and can disagree among the players.

4.1.1.1 Track Processing

Track processing is modeled for surface, air, and missile targets. Sensor detections form the basis for the formation of tracks. Sharing of track information among multiple platforms is modeled. The management of multiple tracks is modeled, with saturation alleviation processing for large numbers of tracks.

4.1.1.2 Target Identification

Identification and classification is modeled for both single platforms acting against multiple targets and also for multiple platforms sharing information on one or many targets. A robust combat identification capability is provided, including IFF interrogations, procedural identification, and non-cooperative target recognition. Factors considered in procedural identification include Point of Origin, Self-Defense, target on a Low-Level Transit Route (LLTR), Jammer detected, Safe Velocity/Altitude, Pop Up threats, Prohibited Volumes, Restricted Volumes, and Classification volumes.

All of the factors are considered in making identification decisions, using a weighted decision scheme controlled by the user. Similarly, each platform can use information from other platforms in making decisions concerning identification and classification.

4.1.2 Attack operations

Command and control of strike operations is modeled for both sides. The command and control can prioritize among targets and direct surveillance changes and strikes on targets. The strikes on targets can be surface-to-surface engagements or air-to-surface engagements. The air-to-surface engagements can be carried out by either fixed wing or rotary wing aircraft. Aircraft can be scrambled from air bases, vectored from patrol, or diverted from other missions. Also, aircraft can strike scripted targets and targets of opportunity.

Intelligence gathering and processing (including imagery intelligence) is modeled. Surveillance is modeled for both sides, with all sensor types gathering information and with processing of surveillance information. The intelligence gathering can be either scripted missions or dynamically determined missions. The intelligence gathering platforms can be space, air or surface based. Any player can collect and disseminate data while conducting other activities. Any player can receive and process multi-source data. Intelligence collection centers are modeled including data correlation, fusion and processing from multiple sources. Correlation failures, identification and classification errors, and errors in perceived positions are modeled. User-defined latency, accuracy, throughput, confidence and target prioritization are used in the modeling.

Intelligence gathering is explicitly modeled and the intelligence information used in both offensive and defensive operations. Intelligence gathering in EADSIM is modeled through sensor capabilities representing various intelligence gathering technologies. These sensors operating on platforms representing space-based, airborne, and ground based (potentially forward observers/human intelligence) provide information to battle management nodes designated as Intelligence Collection and Analysis Centers. These centers process the information through a probabilistic correlation process to develop targeting information on target types which have been selected as targets of interest. This information can then be disseminated to attack operations platforms for both air-to-surface and surface-to-surface engagement of targets of interest, or if the information is not sufficient then surveillance tasking may be generated to attempt to gain engagement level information. Intelligence systems may also provide information to the SAMs to allow improved selection of the most threatening targets for priority engagement.

EADSIM models several aspects of ballistic missile transporter-erector-launcher (TEL) behavior and their interaction with an attack operations threat. TELs launch surface-to-surface missiles at both scripted and dynamically determined targets. EADSIM models the tactics of TELs to hide, launch, and reload.

4.1.3 Offensive air operations

In addition to the attack operations described above, EADSIM models other offensive air operations. Offensive counterair missions are modeled, providing air to air modeling for strike operations. Specialized missions such as close air support are modeled. Suppression of enemy air defense (SEAD) missions are modeled, including both lethal and non-lethal suppression methods. Command and control, to include dynamic retasking, is modeled for these offensive air operations as it is for attack operations.

4.1.4 Electronic combat

EADSIM models offensive and defensive electronic combat. Jamming is modeled for sensors and communications. It includes standoff, escort and self-defense jamming. The jamming can be scripted or dynamically determined. Players can dynamically activate and point jammers in response to a threat. Management of limited jammer resources is modeled (number of beams, allocation of power to frequency and beams).

Non-reactive jamming can be directional or non directional, as defined by the antenna pattern. Radars can react to jamming with a number of techniques such as adaptive power outputs. Home-on-jam weapons are modeled, and the processing of jammer strobe detections. Sensed jamming is considered in ID processing.

As a counter to suppression modeling, the Emission Control (EMCON) capability in EADSIM provides the ability to manage emitter/receiver on/off status as a function of a platform's awareness of the current situation. Dynamic surveillance management is modeled as part of an extensive emissions control modeling capability, where commanders can perform offensive and defensive surveillance management.

Signals intelligence collection and processing is also modeled. The sensed information on emitters is used in command and control decisions, and sharing of sensed information is modeled.

Decoys, chaff, and flares are modeled. Expendable countermeasures used by aircraft (such as chaff and flares) use probabilistic effects modeling. The impact of countermeasures employed can be seen in changes in the ability of a target to be tracked and in the probability of kill (Pk) when engaged. Countermeasures and decoys can also be used by ground platforms.

4.1.5 Support operations

Aerial refueling is modeled for both mission planned refueling and dynamically determined refueling needs. The refueling operations include the management of multiple aircraft attempting to refuel and the behavior of the tanker.

Airbase operations are modeled for offensive and defensive aircraft. Airbases can have aircraft both scripted to take off and perform specified missions and other aircraft available to be scrambled based on demand.

Damage and repair of airbases is modeled. Weapons impacting on an airbase increase the amount of delay between aircraft flight takeoffs, and possibly destroy aircraft flights on the airbase. The first weapon to impact an airbase causes a shock delay, stopping all operations for a time. Airbase repairs are modeled by decreasing the takeoff delay after a time delay for repairs.

4.1.6 Logistics and Supportability

The model includes supportability modeling. Reliability, availability, maintainability, and logistics are modeled. Aircraft and TBMs both consume fuel at user specified rates. The rate of consumption for aircraft is a function of either thrust for fixed wing aircraft or power for rotary-wing aircraft. Ground platforms do not consume fuel. Weapon inventory is expended as engagements are conducted.

EADSIM provides an accounting of warfighting consumables. It tracks fuel consumed by airborne platforms and weapons expended by all players. The simulation also tracks and accounts for the number of weapon reloads for each type system.

EADSIM provides a robust reliability, availability, and maintainability (RAM) modeling, to include multi-day scenarios. This RAM modeling allows specified components of a system to fail based on a mean-time-to-failure statistical distribution. Each component has a mean-time-to-repair, also specified by a statistical distribution, and a user specified inventory of spare components that can be drawn from as a remove-and-replace (R&R) process. R&R times are also specified as a statistical distribution. In all cases where distributions are used, the type of statistical representation is user selectable. Depot ordering with shipping delays for individual components is also captured in the RAM modeling.

A RAM scoring system indicates the operational availability of a system depending on which component or combination of component failures has occurred. The resulting impact on the system can range from simple degraded operation to a decision to abort (airborne missions) to a catastrophic failure which basically "kills" the system.

4.2 Physical Models

The mission/functional area modeling is supported by a number of physical models as shown in Figure 5. These include flight and movement, communications, sensors, jammers, weapons, and constructs such as air space control.

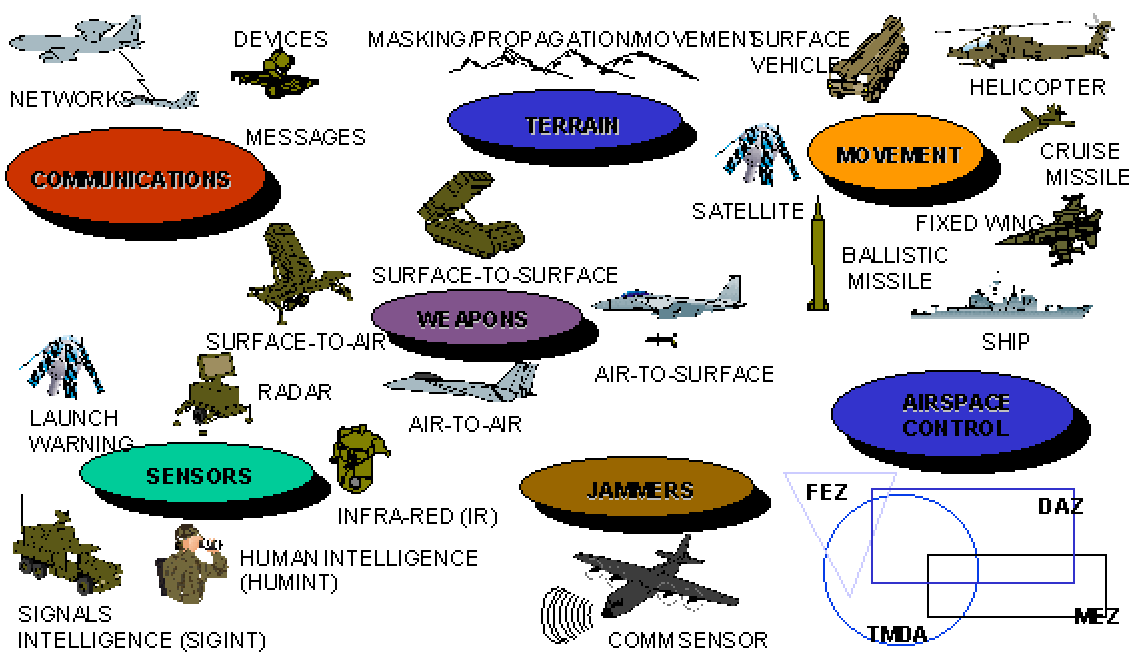

Figure 5 - Physical Models

4.2.1 Communication Modeling

The communications modeling within EADSIM has three major aspects: the networks, the messages, and the devices. The networks allow the specification of which players will attempt to communicate with each other and the types of information exchanged. The messages are then transmitted over these networks, providing both the loading on the network and the transfer of the message content. The networks can change as the conditions dictate. EADSIM includes logic to dynamically alter networks, modeling the reconfiguration of the network. The device modeling allows the modeling of the RF propagation, capturing the impact of relative geometry, terrain, and jamming.

4.2.2 Sensor Modeling

EADSIM models sensor types including radar, infrared, passive RF, and intelligence sensors. Targets are detected if sensor/target specific detection tests are passed, there is an unobstructed line-of-sight between the target and the sensor, and the target is within the sensor's field-of-view.

4.2.2.1 Radars

EADSIM provides comprehensive radar modeling capabilities. Constructs are provided to model single function radars (surveillance, track, etc.) and multifunction radars that perform surveillance, tracking, fire-control, and engagement support. Multifunction radars can model autonomous search, cued search, tracking, and engagement. Radar sensors can detect aircraft, tactical ballistic missiles (TBMs), and surface platforms. For aircraft and missile targets, the specific detection tests can be deterministic (scaling with radar cross section) or probabilistic and based on target fluctuation models. For ground targets, probability of detection is a function of range.

4.2.2.2 Passive RF Sensors

This sensor class models the detection of RF emissions. This sensor detects targets based on active emitters such as radars, communications devices, and jammers on those targets. The user may restrict which emitters are detectable by the passive RF sensor. The Passive RF sensor applications include suppression aircraft (such as Wild Weasel or jammer platforms), Intelligence, Surveillance, Reconnaissance (ISR) applications (such as Electronic Support Measures [ESM]), air defense applications (where the sensor can be configured to perform jammer strobe detections), and seeker applications (such as a HARM seeker).

4.2.2.3 HUMINT, IMINT

Both of these classes of sensors are modeled probabilistically, with sensor characteristics represented by detection probabilities for different target types and target characteristics represented by probability of susceptibility.

4.2.2.4 IR Sensors

This sensor class uses the infrared signature of a target, the amount of the signature presented to the sensor, and the geometry involved. Target types are selectable by the user (i.e., ground, air, TBM).

4.2.3 Movement Modeling

EADSIM provides movement models for a variety of platform types. These movement models include fixed wing and rotary wing aircraft, cruise missiles, air-to-surface weapons, ballistic missiles, surface to air missiles, satellites, and surface platforms. The movement models provide for both the scripted and reactive movement of platforms.

The aircraft flight can be represented in several ways within the simulation:

- An internal physics based model
- An internal interpolation model
- Externally provided aircraft flight paths
- Externally flown aircraft via a distributed simulation interface

The physics based model includes both fixed wing and rotary wing flight dynamics. Fixed and rotary wing aircraft can fly in formations specified by the user. Formations can be “broken” based on mission requirements or in response to threats, then aircraft can return to formation. Cruise missiles and explicitly flown air to surface weapons use the same flight models as aircraft. Aircraft can fly in formations specified by the user. Formations can be “broken” based on mission requirements or in response to threats, then aircraft can return to formation. Search profiles are modeled where the formation will split up in order to search an area, with different search profiles for the flight leader and wing. There are a number of flight modes:

- Scripted waypoint flight using orbit patterns, push-off-points, target waypoints, hover waypoints, refueling waypoints, and simple route waypoints
- Combat Air Patrols definable for offensive or defensive operations, with user control over shape of orbit pattern through multiple waypoint deployment
- Altitude maintenance during air-to-air engagement operations
- Predicted intercept during threat aircraft pursuit, keeping target within sensor FOV limits
- FPole maneuver to keep target within sensor FOV limits while minimizing closure during target engagement
- Fuzzy vectoring after enemy aircraft or ground targets
- User-defined dynamic profiles adopted during air-to-surface attack operations; used also during cruise missile flight
- User-definable defensive maneuvering
- Airborne refueling operations as part of aircraft mission
- Terrain following at user-definable altitudes
- Earth curvature sensitivities throughout using all flight modes

Ballistic Missiles can be represented in several ways within the simulation:

- an internal physics based model
- an internal curve fit
- externally provided missile trajectories, commonly called threat tapes
- externally flown missiles via distributed simulation interfaces

All representations have the capability to realistically represent multi-segment trajectories; the TBMs can have distinct propulsive, aerodynamic, guidance, and RCS characteristics in each flight segment.

Satellite movement provides the capability to model orbits based on specification of a state along an orbit. The orbit over time is then modeled using equations of motion. Satellites can also be externally flown via distributed simulation interfaces.

Surface platform movement is a constant speed movement along great circle paths between specified locations. Surface platforms can also be externally moved via distributed simulation interfaces.

Surface to air missiles have a selection of flight models. The simple model uses a constant speed approximation to fly the missile to intercept. There is also the ability to use a physics-based flight model with guidance considerations.

4.2.4 Weapon Model

EADSIM models four general types of combat engagements covering a variety of weapon capabilities. The simulation models air-to-surface, surface-to-air, surface-to-surface, and air-to-air engagements.

Air-to-surface engagement modeling supports free-fall bombs, anti-radiation missiles (ARMs), a warhead, and other Air-to-Surface Missiles (ASMs). The engagements may be either pre-briefed or dynamically determined engagements. Simple models of the weapons are available, where the weapon directly strikes the given target. The air-to-surface modeling also supports additional fidelity of certain types of weapons through the use of captive platforms. These platforms can be used to model such systems as cruise missiles, drones, or ARMs. Once launched, these platforms are capable of performing any of the functions that a platform with the same ruleset can perform. An additional feature allows the captive platform to be a smart weapon type possessing a sensor. For example, an ARM defined as a captive platform could follow a defined set of waypoints, use its sensor to find the designated target, fly into its target, and cause the kill/no-kill determination to be performed. ARMs unable to detect primary or alternate targets will dead-reckon a path toward the last known position of the primary target. Cruise missiles can be modeled to launch munitions against several targets and impact the final target.

Modeling of surface-to-air engagements allows representation of SAM and gun systems in engagements against both aircraft and tactical missiles. Semi-active, command-guided, "fire-and-forget," and Non-Line of Sight (NLOS) missiles are modeled. Several flyout model approaches are available, from constant velocity flight, through definition of a missile flyout table or through explicit flyout of the interceptor. When a missile reaches its target, a kill/no-kill determination is made based on the Pk assigned to the missile against the target. Semi-active missiles require track by the platform on the target all the way through to intercept. Fire-and-for-get missiles and guns only require track by the platform through launch of the weapon. Command-guided missiles have varying degrees of requirements for track maintenance throughout interceptor flyout. The NLOS weapon requires track on the target at the time of engagement decision; however, this track does not have to be from a sensor on the platform.

Air-to-air engagement modeling supports both semi-active and fire-and-forget missiles. The semi-active weapon model requires the aircraft to maintain track on the target through intercept of the missile with the target. The semi-active model also limits the engagement to one target at a time. Once a fire-and-forget missile is launched, the aircraft does not have to maintain track on the target. The aircraft is thus able to engage another target during the missile flight to the first target. The flight model is the same straight-line, constant-velocity model used for the other missile engagements; however, the intercept time is updated as the target aircraft maneuvers. The kill/no-kill determination is based on the Pk of the weapon against the target.

The surface-to-surface modeling handles both ballistic missiles and the cruise missile weapon types. The kill/no-kill determination is based on the Pk of the weapon against the target. Collateral damage and damage of multiple targets is modeled. Errors in weapon impact are modeled.

4.2.5 Terrain / Environment Modeling

Natural environments modeled include terrain, atmosphere, and weather within that atmosphere. Digital Terrain Elevation Data (DTED) is used to model the terrain. The terrain impacts flight and movement, sensor coverage, and communications capabilities. Standard atmospheric models are used for aircraft and missile flight modeling and RF propagation. Weather modeling is limited to uniform layers of clouds, particulants, etc. over the entire scenario (unless running with an external weather model, in which case non-uniform effects are captured).

4.2.6 Jammer Modeling

EADSIM models jammers and their impact on sensors and communications. The behavior models include dynamic jamming controls. Jammed radars suffer loss in detection capability. Jammed communication systems suffer loss of SNR. Jamming can affect main lobe, side lobe, and back lobe (as specified by antenna pattern). Jamming can also impact Pk and Non-Cooperative Target Recognition (NCTR). Detection of jamming is considered in target identification, commonly used to indicate hostile intent. Total noise from all active jammers is considered in the computations. Collateral effects are modeled. Rather than computing effects only on the intended jamming targets, EADSIM also computes the effects on non-targeted systems on both sides.

4.2.7 Airspace Control

Airspace control is accomplished through Areas of Interest (AOI). These are geographical regions that are defined by the user to better partition and control the battlefield. These include:

- Missile Engagement Zone (MEZ), Fighter Engagement Zone (FEZ), Weapon Engagement Zone (WEZ). The engagement zones define regions where a particular type of player is allowed to (or forbidden to) engage targets. For example, a MEZ defines the region where a surface-to-air missile system will assess air threats.

- Area of Responsibility (AOR). An AOR defines the region of interest (responsibility) for a fighter or surface-to-air missile system. It can be used in conjunction with or in place of MEZs or FEZs. Threats inside the AOR will be assessed; threats outside the AOR will not.

- Track Area of Interest (TAI). The TAI represents the region in which tracks on targets will be maintained by the associated platform. Objects seen outside the TAI, either by the platform's organic sensing capability or via tracks from other systems, will not be initiated or maintained.

- Tactical Action Line (TAL). TALs are most often used by EADSIM users to distinguish geopolitical borders, or other lines of interest, for display on EADSIM maps.

- Theater Missile Defense Area (TMDA). The TMDA represents a region that will be defended against TBMs by the associated platform(s). Tracks whose projected impacts fall within the TMDA will be assessed as threatening and will be engaged, if possible.

- Friendly Origin (FOR), Hostile Point Of Origin (HOR), Restricted Volume (RVOL), Prohibited Volume (PVOL). Regions which are used in identification of tracks.

- Defense Alert Zone (DAZ). The DAZ is a region used by a Defensive Counter Air commander. The defense level associated with each region specifies the desired ratio of defensive aircraft to attacking aircraft. Based on the defense level and the present ratio of defensive to attacking aircraft in the region, the commander can decide to scramble more defensive aircraft into the region.

- Area of Operations (AOO). Used to define the area where an aircraft will conduct operations. Used for attack aircraft for surveillance, strike, electronic warfare, and battle damage assessment.

4.3 Behavior Modeling

Object behavior is controlled via flexible rulesets. This is the primary means for modeling battle management in EADSIM. The rulesets for phase and message processing contain battle management and engagement decision processing as well as the engagement modeling for the simulation. Users select rulesets, select behaviors, set parameters in the rulesets, and program trigger event/response combinations to control the dynamic reactions of platforms to events in a scenario. For example, the ruleset on an airborne platform will take control of the plane and perform maneuvers to achieve its objectives if needed. Multiple rulesets are available for each of the following categories: airbases, aircraft, defensive commanders, offensive commanders, sensor platforms, and surface platforms.

The model allows for both scripted and reactive behaviors. While the interactions in EADSIM are primarily reactive, a significant portion of a scenario must be established according to a script, i.e., scenario specification. Other portions of a scenario can be either reactive or scripted. Scripted actions fall into specific categories: platform placement and movement, emitter timing and pointing, targeting, and weapon launches both air-to-surface and surface-to-surface. Each of these scripted areas is complemented by an analogous reactive decision capability to perform each of these missions.

Scripted operations for platform placement and movement include static deployment of ground/surface platforms, scripted movement of ground/surface platforms, scripted waypoints for aircraft, refueling and rearming operations for aircraft at airbases, airborne refueling operations for aircraft, formation specification for aircraft relative to flight leads, and orbit specification for satellites.

Platforms can transition from scripted behavior to reactive behavior as a function of their respective ruleset and ruleset options. The majority of the switching is as a result of threat detection by a specific platform. Threat detections can trigger a reaction or an engagement. The ruleset for an airborne platform will take over control of the platform’s maneuvers and perform maneuvers to achieve its current objectives if needed. In instances where the reaction is to modify the current setting of available emitters, the platform’s ruleset will operate its jamming control logic to determine the best setting of its jammer suite to counter the threat.

4.4 System Types Modeled

EADSIM uses the combination of the element data to define a system type. This allows virtually any system type to be represented in a scenario. This allows a great deal of flexibility in the representation of new system types. Of course, EADSIM allows modeling of aircraft, missiles, surface platforms, and satellites. These can be deployed in all of the roles described. The available interactions and relations are also very rich. For example, track distribution networks can be deployed free form and EADSIM can properly represent the management of that network, representing the reporting responsibility, update rates, and forwarding behavior. Extensive command and control capabilities are modeled. Many complex behaviors are available in EADSIM, and users can specify complex behaviors that go beyond those already in place. These go well beyond simply representing engagement decisions. Dynamic reconfiguration of the command relationships and communication networks is modeled. Dynamic surveillance management is modeled as part of an extensive emissions control modeling capability.

5 Post Simulation Analysis

The Post Simulation Analysis tools include Playback and Post Processing. The Playback application provides a visual display of the scenario in an animated scene display. The Post Processing tools provide the means to extract data for reports.

5.1.1 Scenario Playback

Scenario Playback, with an extensive set of analytic tools, is one of the most powerful diagnostic tools. It provides the user with an animated scene display of the scenario as it ran. It includes the complete set of analytic tools common to it and scenario generation. More than any other tool, it allows the battle to be viewed as it happened and the combined functioning of the model to be seen.

5.1.2 Post processing

Post processing report generators are provided to allow the user to generate detection, communication, and engagement report statistics. The post processing queries are specified through the graphical user interface allowing tailoring of a set of queries. The reports may then be generated and viewed through the user interface or generated off-line. The detection post processor provides information on which entities were detected by which platforms. The communication post processor provides information on the communication network performance and loading. The engagement post processor provides a number of events relating to tracking, IFF, engagement, platform activation, and flight events.

Extensive log file outputs are provided from each of the processes detailing the run. They include a processing statistics file for each process (time and memory use), a log file (general information and error messages) and some fixed format reports (such as the detection outputs which show why detections did not happen - often a key diagnostic). There is a capability to specify the types of outputs to some of the log files by specifying either debug levels or individual classes of outputs. A number of methods are available to provide flight path information including a utility to extract the information for aircraft trajectories, waypoint reports, plot files for trajectories, and ballistic missile trajectory files.

6 Graphical Analysis Tools

EADSIM provides a number of graphical analysis tools that are available in the user interface. These tools are available in both Scenario Generation and Playback. These include:

- Intervisibility - a tool used in Scenario Generation and Playback to display two-dimensional cross-sections of the area visible to a platform’s sensor and provides a display of any sensor coverage given: sensor location, terrain, target RCS or IR signature, and noise jamming.

- Connectivity - a display showing which platforms can communicate given the types of communication devices, jammers, and terrain effects. It includes a diagnostic report on the failure cause of each link. This diagnostic report can either be viewed on line or saved to disk.

- Flight Preview - provides an animated display of missiles, aircraft, satellites and surface platforms using planned motion profiles.

- Side View LOS Profile - The sideview profile map utility in the Scenario Generation application shows a graph of elevation, line of sight, and the lower boundary of the first Fresnel zone versus ground range. It can be used to model the effects of terrain in communications between any two points

- Error Checking - The Scenario Generation function contains an error checking utility to prevent erroneous data from being used in the execution, and allows users to check or correct the data. If a major error is found, then the scenario will not be loaded and the user will be notified.

- Flight Path Side Profile - allows display of the flight of an aircraft, showing altitude versus either time or ground range with waypoints highlighted and the engagement status color-coded in the plot.

- Platform Status - provides a running status, location, speed and heading for a specified platform.

- Color Preferences - allows for the selection of colors for each display item.

- System Count - counts the number and type of platforms by system type and also by friendly and hostile air and ground platforms. This can be for the entire scenario or for selected parts of the scenario.

- Command Chain Checking - can be performed to check the validity of specified command relationships.

- Air Base Information - provides a summary of the types and number of aircraft at an airbase.

- Distance Measure - allows distance to be measured.

- Lat/Lon/Altitude Display - shows the cursor location and terrain elevation as the cursor moves.

- Display Preferences - a combination of approximately 150 preferences and criteria. These can be used to declutter the display and show only desired information. The preferences can be stored for later recall and allow EADSIM displays to be used as a graphical database query system. The display preferences allow airspace deconfliction through provision of proximity alarms.

- Time-on-Target - specifies the start time required for an aircraft to reach a location at a specified time.

- Ballistic Missile Launch/Impact Time - allows the impact time to be specified and the required launch time to be computed, or vice versa.

- Ballistic Missile Performance - a graphic display of ballistic missile flight performance. This tool produces a log of the ballistic missile trajectory. This can either be used as part of the user interface or as an off-line tool.

- Intel Interface - allows direct import of order of battle from an intelligence database showing what platforms have changed, been deleted, or been added. This allows comparison to the previous intelligence database.

- Jammer Footprint – displays the region impacted by a jammer.

7 Documentation

EADSIM users are provided with a complete set of documentation. EADSIM's documentation contains a vast amount of information about EADSIM in a fairly easily accessible manner. The User's Guide gives a good overview of the use of the model; the Methodology Manual provides an in-depth look at the equations and assumptions used to formulate the model itself; and the User's Reference Manual details the inputs. Release notes are provided with each release of the software. The documentation contains all the formats listed for all the EADSIM input files. Another positive aspect of the documentation is the listing of most bounds associated with specific input fields.

A source information package is provided with EADSIM that provides programmer level information such as a call tree and module descriptions.

On line help is provided, where the user interface presents the reference manual write-up on the selected item.

8 User Skill Level

The user skill level required to operate EADSIM depends on the problem at hand. Users develop and run a scenario during the first few hours of the EADSIM training course. This is a simple scenario that uses provided sample data. The model includes a large number of error checks and consistency checks along with analysis utilities to aid in scenario development. More complex scenarios require greater familiarity with the model.

9 Help and Training

Help is available to the user via the user's hotline, which is open during normal business hours. Additional help may be obtained by attending training courses and User Conferences held twice each year. A web page is available at http://www.eadsim.com/.

Teledyne Brown offers a training course that is useful for both beginners and experienced users of EADSIM. This weeklong course gives the user both hands-on training and informational briefings concerning specific modeling topics. Several advanced training courses are offered also. In addition, a hotline, which is provided free-of-charge, is available to the user and is open during normal business hours. Problems cannot often be diagnosed immediately, and the hotline will research issues and contact the user when fixes or work-arounds are found. The hotline also gives the unique opportunity to talk with the specific programmer involved in developing that particular piece of code. In addition, the user will be invited to attend User Conferences which are held twice a year to present the latest upgrades to the model and work-in-progress.

10 Language

EADSIM is written in C. A few included routines from legacy codes are in FORTRAN. The interactive console is written in C++.

11 Run Time

EADSIM run times vary with the size and complexity of the scenario and the capability of the machine. A typical analysis case will run much faster than real time. Cases that use high fidelity features (such as the use of clutter and multipath) will generally run slower than real time.

12 Level of Fidelity

EADSIM offers multiple, user selectable levels of fidelity for most features. A general description of the overall level of fidelity would be ‘medium’. The system is flexible because it models nearly any object relevant to air, missile, and space warfare in at least one level of detail, and models many at a number of detail levels. EADSIM allows the analyst the flexibility of having a scenario with varying levels of detail modeled. For example, the user may define a scenario with low detail SAMs and high detailed aircraft, or a mixture of low and high detail SAMs and aircraft. In addition, the communications, rulesets and environmental features can be functional at many levels of detail. The amount of postprocessing data can be selected by the user, as can the use of situation displays.

13 Data Hierarchy

One of the most substantial flexibilities of EADSIM is the ability to combine elements to make a system or weapon. This is illustrated by viewing the data as a hierarchy, as shown in figure 6. The low-level components are specified as elements in EADSIM. The elements include sensor specifications, aircraft, weapon, jammer, communication device, RCS and IR signature, rulesets, and a number of others. These elements can be combined to form systems, which are prototype players. Instances of these systems are deployed in the scenario as platforms, which are the individual entities. This aspect of EADSIM allows an enormous flexibility in representing defense systems by combining the elements to represent individual systems.

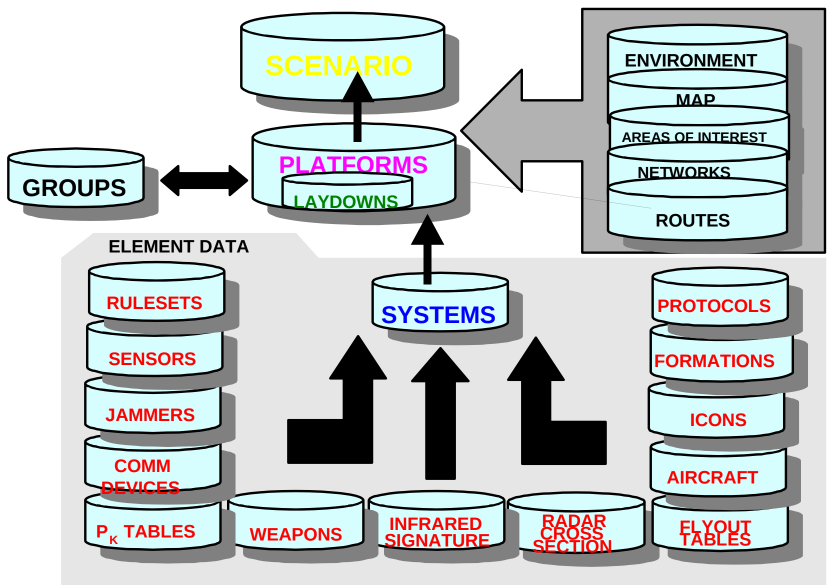

Figure 6 – EADSIM Data Hierarchy

This flexibility to determine what elements make up a system is the heart of the EADSIM representation of defense systems. It is the characteristics of the constituent elements which are used to determine performance, taken together to determine the overall system performance in the scenario. For example, a different sensor can be placed on a system type to do a rapid trade study on sensor type.

The degree of integration of EADSIM becomes apparent when considering the ramifications of this ability to combine elements. Any capability is generally available to any type of player. This is particularly true of physical models such as radars.

14 Flexibility

One of the outstanding features of EADSIM is the enormous flexibility provided to the user in a number of areas. This is a long-standing emphasis of the program. This flexibility has helped in the wide variety of uses that EADSIM users make of the model today. The flexibility can be found in all parts of the model, with some noteworthy areas being:

- Fidelity / accuracy of representation
  - radars
  - signatures
  - flight modeling
  - survivability/lethality
  - rulesets
  - communications connectivity
  - intelligence representations
  - data input granularity and handling
- Data hierarchy / ability to combine elements
- Geographic scope
- Scripted and reactive behaviors
- Selectable outputs
- Post processing queries and output formats
- Two sidedness
- User interface
- Run tailoring
- Network architecture
- Overall data driven nature

User selection of fidelity / accuracy of representation is a major flexibility of EADSIM, allowing the user to select the degree of fidelity and/or accuracy at which things are represented. This is particularly useful in early concept analysis studies where little is known about the system under study and in analyses where entities must be represented only to provide a context for study. Fidelity upgrades to EADSIM over time broaden this flexibility due to the EADSIM method of retaining existing features and adding new features as options.

Radar representation is one of the more flexible areas. The many options range from simple sensor models allowing detection range to be modeled deterministically (scaling with radar cross section) to an advanced radar model with probabilistic detection. There are various target models, and a number of options on representing the behavior and level of modeling of the radar. Signatures can be modeled as a user specified function of frequency/wavelength, aspect angle, flight section (for TBM staging), weapon loading (for aircraft), and aircraft speed. The granularity of the tabular data is specified by the user, and does not need to be a constant granularity. Flight modeling for aircraft can include aerodynamic computations or can be an interpolation between waypoints for the case where threats must be modeled and aerodynamic data is not known.

Flyout modeling can be performed at several levels of fidelity. The simplest is a constant velocity approximation. Next in complexity is the use of flyout tables to provide time of flight. Next is the use of added flyout tables to allow a state at intercept to be reconstructed. Next after this is the use of trajectory families to allow the state to be reconstructed at other times. Finally, an explicit flyout model is available.

Survivability/lethality can be modeled at a number of levels, with the primary flexibility being through the Pk tables. Due to the many data types, granularity, and parametric dependencies that analysts encounter, EADSIM provides not only a user specification of the granularity of the data but also a user specification of the parametric dependencies of the data. This allows a multidimensional specification of Pk data to fit the realistically available data. Further flexibility in survivability and lethality is provided by the EADSIM capability to associate anti-weapons with entities, allowing the modeling of decoys, countermeasures, and shelters or bunkers.

The rulesets have provisions for varying the level of fidelity of the representation through varying the use of general parameters, target class specific parameters, or target type specific parameters. There is also a capability to model the decision processing at varying levels of aggregation (such as considering 10 targets every 10 seconds or 1 target every second). Communications connectivity computations can be varied by whether or not they are performed and also with controls on how often connectivity is checked.

Intelligence representations can be broken out by each sensor and processing center with the associated communications among them, or they can be considered in an aggregated sense when the intelligence is only to be considered as an input to the processes to be analyzed. The environmental files that specify path loss and irradiance for IR allow user specified granularity.

The geographic scope is user specified, with up to global scenarios allowed. The terrain data to support any scenario is imported through the Map Generation utility.

Scripted and reactive behaviors form another substantial flexibility of EADSIM. For example, attack operations can be scripted missions by the aircraft, surface to surface artillery, and helicopters, or it can be dynamically determined based on the current perceptions of the platforms and their commanders. The scripted and reactive behaviors can further be mixed, with rules for overriding the scripted actions such as when attacking a target of opportunity.

Selectable outputs are provided from running a scenario, with the ability to specify whether or not a file is output and the contents of the file. After the run, post-processing queries allow generation of highly tailored outputs using a variety of output formats.

EADSIM allows all capabilities to be available to both blue and red forces, resulting in a robust two sidedness available to the user. This allows a large flexibility in determining which scenarios to use in analyzing a problem.

The graphical user interface has a number of flexible features. Most of these are above. A number of run tailoring features allow the user to select things such as the number of monte carlo runs, specify seeds, and select which processes to use.

The modeling of communications networks is specified by the user, with enormous flexibility in specifying network architecture and use of the networks by the platforms. Command networks are highly flexible, and track networks are free form.

The overall data driven nature of EADSIM is behind much of the flexibility. The data specifies nearly everything about EADSIM, with no items beyond some physical constants requiring changes to EADSIM.

15 EADSIM Interfaces

EADSIM Provides a number of distributed simulation, operational planning, exercise, training, and wargaming interfaces as shown in the figure below. These include High Level Architecture (HLA), Distributed Interactive Simulation (DIS) and Aggregate Level Simulation Protocol (ALSP) capabilities. capability is in progress. Other interfaces include our Force on Force Interactive Retasking Environment (FIRE), operational planning tool and a number of operational database interfaces. EADSIM is used in a number of exercise applications. Most commonly, EADSIM is used as the model engine, providing the simulation of air and missile warfare forces. In these applications, EADSIM is providing interaction with multiple tactical workstations. Scenario Playback and Post-Processing can be run while the scenario is running, allowing the progress of the scenario to be viewed. EADSIM can drive any Distributed Interactive Simulation (DIS)-compliant display while running using DIS.

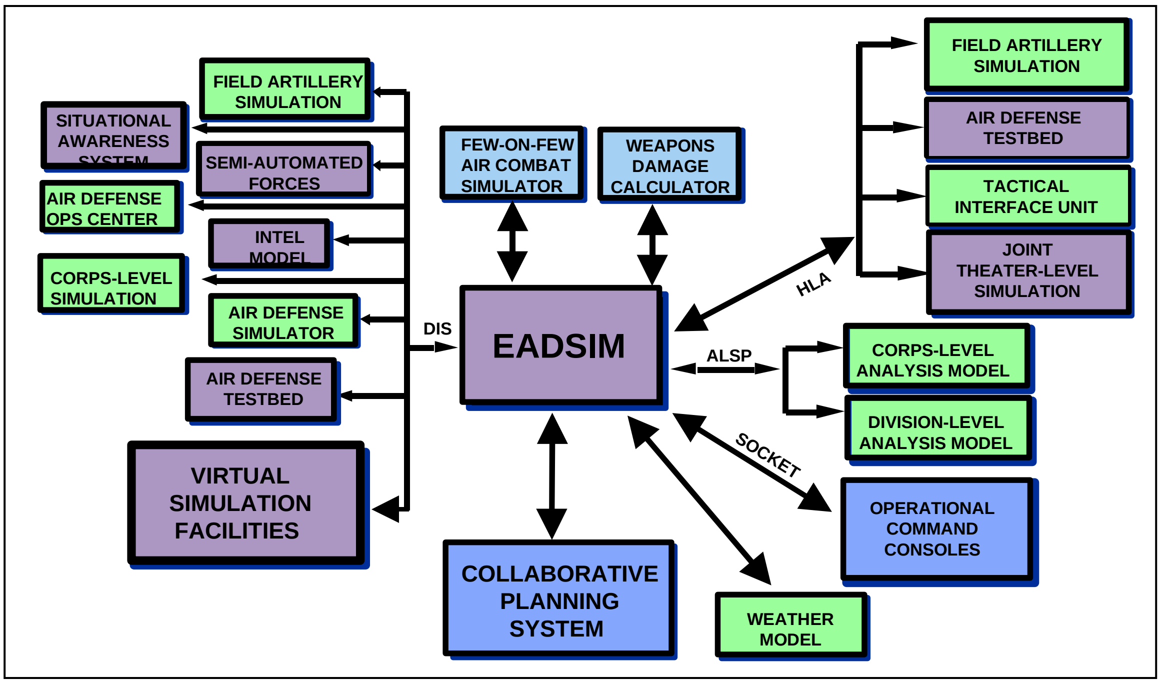

Figure 7 - EADSIM Interfaces

15.1 Model Federations

EADSIM can easily be federated with campaign-level models for analysis, training, and exercises; with other mission-level models or functional area models such as artillery and land combat models; with high-fidelity models for specialty functions such as detailed air to air combat; and with virtual simulators, allowing a live gunner or pilot to operate a training simulator that interacts with the full scenario. In these federations, EADSIM provides a variety of functions, such as providing real-time computer generated forces, playing Tactical Ballistic Missile warfare, or commanding aircraft transferred to other simulations.

15.2 Operational Interfaces

EADSIM provides capabilities to interface with operational planning tools and standard databases. The planning tools include aircraft routing tools to provide the details of an aircraft flight plan. The standard databases include Air Task Orders, allowing a large number of missions to be automatically deployed.

15.3 FIRE – The Command Console Interface

The EADSIM environment provides a graphic user interface-supported interactive command console to allow human-in-the-loop dynamic retasking of modeled attack operations, suppression operations, and C4ISR operations within the simulation. The command console can be used to provide immediate retasking of scripted platforms in the model. This feature, used in conjunction with interface units, provides a powerful tool for stimulating tactical workstations during wargames and training exercises. The command console tool runs on a Windows NT PC.

15.4 Tactical Workstation Interface

A network-messaging feature within EADSIM allows the user to send tactical message information generated during simulation interactions to tactical workstations either directly or through interface units. Current messages being used provide EADSIM sensor platform-generated detections and processed intelligence, surveillance and reconnaissance information. In conjunction with the retasking tool this feature expands the tactical workstation training and interaction during wargames.

15.5 Human Participation

EADSIM has capabilities for human participation and for analytic use without human participation. Human participation is allowed through interfaces with tactical command and control stations, intelligence consoles, tactical operations centers, and white team, red team, and blue team consoles. EADSIM has interfaces to tactical communications systems, producing and accepting tactical messages. There is an extensive capability for human interaction through EADSIM's Advanced Distributed Simulation (ADS) capability. This capability is used to interact with manned simulators.

16 EADSIM Users

EADSIM is now being used at over 390 subscriber sites around the world, including all of the U.S. military services and several foreign users.

17 EADSIM Sponsor

EADSIM is managed by MSD , U.S. Army Space and Missile Defense Command, as the executive agent for MDA.

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18 Verification, Validation and Accreditation (Certification for Datasets):

EADSIM is a comprehensive, widely used and often scrutinized model. It has and continues to support numerous analytical activities and the number of organizations using EADSIM continues to increase. Accreditations by joint and service organizations have been performed including BMDO and the THAAD program. Verification and Validation efforts have been conducted by many organizations including USSTRATCOM, AFOTEC, JSF, SMART, USASMDC, BMDO, and others. EADSIM has undergone a number of examinations by users and has completed a level 1 confidence assessment as part of the BMDO Analytic Tool Box. A multi-service assessment has been performed several times. The EADSIM program is ISO 9001 certified.

Several certified datasets are available for EADSIM. Data providing agencies now provide data in EADSIM electronic format. The agencies providing this data include the JNTF, AFIWC, and MSIC. Many project offices provide EADSIM characterizations of their systems. The EADSIM program is currently discussing a cooperative data exchange process. The goal of this effort is to establish a comprehensive EADSIM data set at unclassified and collateral levels, controlled and available to government sponsored organizations. Until this becomes available, contact the Government EADSIM Manager for data points of contact.

EADSIM includes the capability to annotate data in the EADSIM database. EADSIM includes automated interfaces to the Multi-spectral force deployments (MSFD), Air Task Orders (ATOs), and automated use of detailed plans from mission planning tools such as AFMSS and TAMPS.

19 History

The history of the Extended Air Defense Simulation (EADSIM) is rooted in user participation from requirements development to funding support.

EADSIM, formerly known as the Command, Control, Communications, and Intelligence Simulation (C3ISIM) and the Theater Missile Defense (TMD)/C3ISIM in its earliest years, is a technology outgrowth of a computer-based modeling program developed by Teledyne Brown Engineering for the Assistant Secretary of Defense for C3I in 1987. That model was used to analyze the relative combat effectiveness of F-15 fighter aircraft without Joint Tactical Information Distribution System (JTIDS) and those equipped with JTIDS.

In late 1987, the Joint Tactical Missile Defense (JTMD) Special Task Force (STF) required a model to conduct analysis of tactical missile defense (TMD) architectures. Teledyne Brown Engineering undertook the development of what is currently called EADSIM to meet the JTMD STF needs. The JTMD STF evolved into the Joint Tactical Missile Defense Management Office (JTMDMO), a U.S. Army Missile Command organization.

Initial work on EADSIM was directed by a U.S. Government sponsored TMD Supervisory Working Group (SWG) composed of representatives from over twenty U.S. and foreign agencies, including representatives from all of the Military Departments, the Department of Defense (DOD), and the North Atlantic Treaty Organization (NATO). From the beginning, the intention of the SWG was to ensure that the simulation was sufficiently flexible to support analysis work beyond the scope of the initial effort. The SWG foresight and guidance contributed directly to the ability of EADSIM to support Operations Desert Shield and Desert Storm and the large number of current applications of EADSIM.

The Theater Missile Defense Applications Project Office (TMDAPO) of the U.S. Army Strategic Defense Command (USASDC), later to become U.S. Army Space and Missile Defense Command (USASMDC), joined JTMDMO in the development of EADSIM in 1988. TMDAPO and JTMDMO were later merged in a reorganization resulting in the formation of the Joint Theater Missile Defense Program Office (JTMDPO), USASDC. This organization formed the Testbed Product Office (TPO) to manage its testbed and simulation projects which later became the MSD. Since that time, the MSD, USASMDC, has maintained full development responsibility.

The successful use of EADSIM in Operations Desert Shield and Desert Storm served as a springboard for future EADSIM growth. EADSIM use expanded beyond the analytic community to become firmly entrenched in the combat development and operational communities as well. EADSIM users nearly doubled in the year following Operations Desert Shield and Desert Storm.

The SWG grew into a group of EADSIM users that provided input and guidance to the program through participation in the program reviews and an executive committee for change approval. This led to the formation of the first formal Configuration Control Board (CCB) which met in 1993. Although somewhat ad hoc in 1993, the CCB matured with the approval of a formal Configuration Control Plan in 1994. The CCB, chaired by MSD EADSIM Program Manager, , remains as standing body with full configuration control authority over EADSIM. The participation of EADSIM users in program reviews has continued and has led to the formation of the EADSIM User's Group (meeting at least twice annually) with additional regional meetings for users in the eastern and western regions of the US.

EADSIM growth continued with the introduction of the Distributed Interactive Simulation (DIS) and Aggregate Level Simulation Protocol (ALSP) into the baseline. These capabilities propelled EADSIM into the training community in addition to its role in the analytical, developmental, and operational communities. This growth continues with the addition of HLA capabilities to EADSIM.

Under the direction of MSD and increasing user funding participation, EADSIM continues to grow. Its latest successes include being selected as a primary simulation in the Ballistic Missile Defense Organization (BMDO) Tactical Missile Defense (TMD) Cost and Operational Effectiveness (COEA) study, inclusion in the Air Force Analysis Tool Kit, and selection as the primary SIOP analysis model for USSTRATCOM.

20 Configuration Management Of EADSIM

Configuration management is the responsibility of the EADSIM Manager, who is part of the MSD. The EADSIM Manager oversees the development and enhancement of EADSIM, forwards Software Change Requests (SCRs) to the EADSIM Configuration Control Board (CCB) for approval priority ranking, and allocates funds for implementation and integration of SCRs into the EADSIM baseline within the budgetary constraints of the MDS/MDA. Approved SCRs may also be funded by users for faster implementation. The EADSIM CCB is a 15-member board representing all services at the combat developer, materiel developer, and operational levels. As such, the board is uniquely capable of managing EADSIM baseline growth in a manner that satisfies user needs fairly and uniformly.

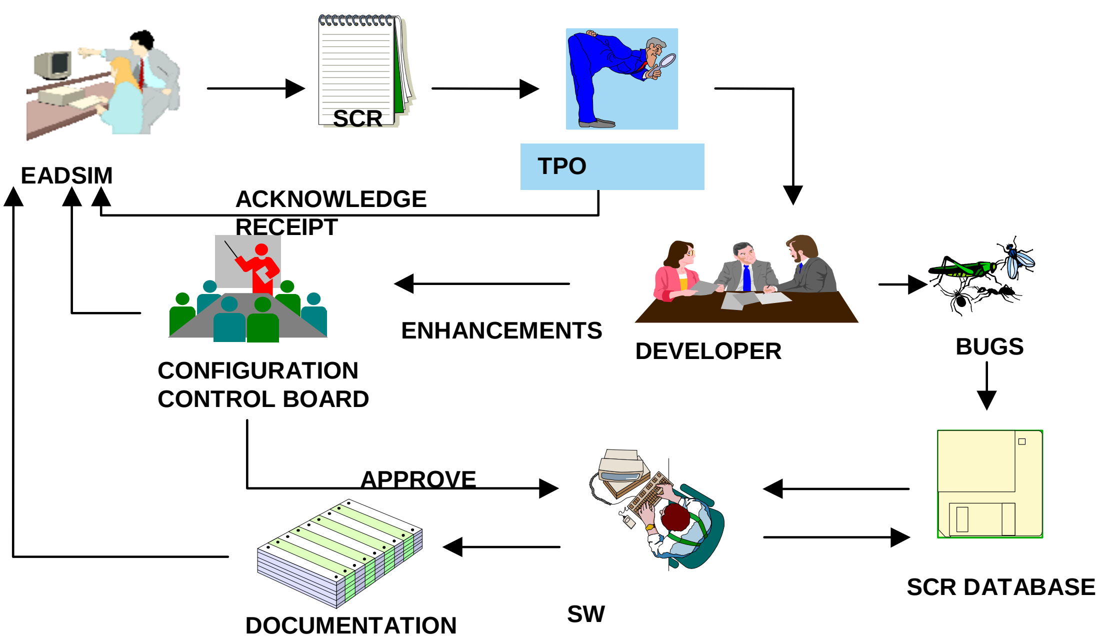

Figure 8 - EADSIM Configuration Control