

OneSAF Objective System: Modeling The Three-Block War

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Abstract. General Charles Krulak, former Commandant of the United States Marine Corps, envisioned that our service members would be asked to fight a highly lethal, mid-intensity battle and simultaneously execute humanitarian assistance and peacekeeping operations. Further, these operations could occur within three city blocks. The OneSAF Objective System (OOS) is the next generation simulation system planned to provide the U.S. Army with an entity-level simulation to serve the training and analysis communities. The ability of the OOS to provide variable levels of fidelity and support high resolution synthetic environments makes it particularly suited to simulate the precise urban operations described by General Krulak. This paper will discuss the physical, behavioral, and environmental models being developed by the OneSAF program. Related modeling of the Contemporary Operating Environment will also be covered.

1. INTRODUCTION

The Three-Block War is a way of thinking about contemporary military operations in which U.S. forces are involved in peacekeeping, humanitarian assistance, and mid-intensity conflict simultaneously on adjacent blocks of an urban environment. OneSAF Objective System (OOS) is a next-generation computer generated forces simulation designed in a modular composable architecture. The ability of OOS to be easily enhanced and tailored has allowed the developers to simulate the full spectrum of military operations. This paper will describe the Three Block War. It will then discuss the physical, behavioral, and environmental models being developed by the OneSAF program, including the ways in which OOS will uniquely support simulation of all three blocks of the Three-Block War. Finally, this paper will describe some planned improvements to OOS after initial release in March of 2006 that will continue to grow its capabilities in this area.

2. THE THREE-BLOCK WAR

General Krulak, former Commandant of the US Marine Corps, captured the essence of the contemporary operating environment as:

“In one moment in time, our service members will be feeding and clothing displaced refugees—providing humanitarian assistance. In the next moment, they will be holding warring tribes apart—conducting peacekeeping operations. Finally, they will be fighting a highly lethal mid-intensity battle. All on the same

day, all within three city blocks—It will be what we call the “Three-Block War.” [5]

Indeed, U.S. soldiers and Marines often find themselves facing two or more of these situations *in the same block*. In the contemporary operating environment (COE), U.S. forces face asymmetric challenges that affect military planning, operations, and decision-making. The COE includes those circumstances, conditions, and influences extant today and for the foreseeable future.

Most current simulations were built many years ago to support training for combat in a symmetric, Cold War threat environment. By “symmetric” we mean that the enemy has roughly equal capabilities to U.S. forces. These Cold War simulations stressed large mechanized forces fighting in open terrain. Within the past ten years, there has been resurgence in interest in fighting in urban environments.

It is estimated that as much as 70% of the world’s population lives in urban environments, so the Cold War doctrine of isolating and bypassing urban centers while fighting in rural terrain is no longer viable. In addition, enemy forces attempt to negate or reduce U.S. technical advantages by taking refuge in urban areas where they can shield themselves within civilian populations and civilian structures. Military operations in urbanized terrain are characterized by a complex physical environment (e.g., three-dimensional structures and protected sites, such as schools, hospitals, and cultural symbols), a complex human environment (e.g., heavy presence of non-combatants, multiple religious and/or cultural groups, etc.) and a complex informational environment, in which there are “multiple sources or

transmission paths for communications, data or information (including news media).” [1]

OneSAF Objective System (OOS) is a simulation that was designed and built for many environments. It is the only simulation designed to be used for both analysis and training. It was also designed with a flexible, modular architecture so that it can be tailored by developers and users to meet specific use cases. Because of these design paradigms, OOS is uniquely positioned to simulate all three blocks of the Three-Block War.

2.1 Humanitarian Assistance

Humanitarian assistance is defined as “Programs conducted to relieve or reduce the results of natural or manmade disasters or other endemic conditions such as human pain, disease, hunger, or privation that might present a serious threat to life or that can result in great damage to or loss of property.” [4] Whether providing basic services in Afghanistan and Iraq or providing relief and medical aid to tsunami victims in Asia, U.S. forces find themselves involved in ever more humanitarian assistance operations.

2.2 Peacekeeping Operations

Peacekeeping operations involve keeping two warring factions apart. U.S. forces have been involved in peacekeeping in the Sinai between Israel and Egypt for decades. Similarly, U.S. forces have been involved in peacekeeping missions in the Balkans for many years.

Peacekeeping operations are often confused with Stability and Support Operations (SASO). Support operations involve humanitarian assistance (described above) and environmental assistance (e.g., response to flooding or other natural disasters). Many support operations involve both humanitarian and environmental assistance.

Stability Operations involve the use of military forces to effect the political and civil environment or to interrupt specified illegal activities. As an example, U.S. forces have been involved in anti-narcotics operations in Central America and Afghanistan. Stability operations can have the purpose of strengthening faltering governments or to reassure allies and friendly governments. They can also be designed to restore order, such as operations to quell riots or enforce law and order. Stability operations conducted during mid-intensity conflict are designed to stop the spread of hostilities or to deter civilian interference in ongoing military operations.

2.3 Mid- to High-Intensity Conflict

Mid- to High-Intensity Conflict is best described as open warfare between organized conventional military forces. The traditional “World War III” scenario with hordes of Soviet vehicles sweeping across the plains of

Europe going toe-to-toe with NATO forces is an example of a mid-intensity to high-intensity conflict situation. Often mid-intensity conflict involves large military formations in what is referred to as conventional warfare in which opposing forces are in open, no-holds barred opposition. Mid- to high-intensity conflict generally is waged by military formations of battalion level and above. This kind of combat often involves significant aerial combat as well. Most extant simulations were built to train battalion and brigade staffs to fight as part of larger formations in mid- to high-intensity conflicts.

3. THE US ARMY’S NEXT GENERATION SIMULATION

The One Semi-Automated Forces (OneSAF) Objective System (OOS) is the U.S. Army’s next generation, composable, entity based simulation system. It is being developed to provide an integral simulation service to the Advanced Concepts and Requirements (ACR); Training, Exercises, and Military Operations (TEMO); and Research, Development, and Acquisition (RDA) domains. With requirements ranging from closed-form analytical support to command-level, human-in-the-loop training, OneSAF will be a High Level Architecture (HLA)/Distributed Interaction Simulation (DIS) compliant, entity-level simulation providing a common solution for a broad range of user requirements. [7] Postured as an open-architecture, open-source application, the OneSAF program will put this software into the hands of a vast number of developers and users in the international and U.S. defense community.

Before discussing the specific physical and behavioral models in the OOS that will simulate the Three-Block War, it is important to understand the underlying software services that support that modeling. These services include multiple sides and forces, environmental representation, and the composability toolset.

3.1 Multiple Sides and Forces

Soldiers on the ground in Afghanistan and Iraq are clearly carrying out aspects of the Three-Block War today. As these soldiers engage with the civilian community in an urban setting, properly identifying friend and foe adds to the risk in accomplishing any given mission. In the past, identification of friend or foe may have been as simple as recognizing a uniform or identifying the type of tank seen through sensors. Soldiers must be aware of possible volatility associated with how the various groups in that urban setting see each other. A humanitarian task may become deadly when two opposing factions arrive at the same time to receive assistance, leaving the soldier possibly in the middle to resolve the conflict. Regularly, new events occur and new information becomes available that cause relationships between these sides to change. The dynamic relationship between sides adds to the intricacy of any situation.

The OOS provides for multiple-sided engagements with changing relationships across the full range of military operations. During both planning and execution, the OOS provides the capability to:

- Create and remove sides
- Modify the relationships between sides
- Create and remove forces under sides
- Create units under sides or forces
- Change the side a unit or force belongs
- Create at least 25 sides

Sides and forces are established during the planning phase and modifiable during simulation execution, where modifications are injected directly into the ongoing runtime simulation database. [3] The user will be able to change the side or force for which a unit or entity is associated. More significantly, the ability to change a unit or entity's force or side will also be available for behavior models to support specific behaviors/orders that support defections. The OOS modeling infrastructure will allow the creation of behaviors that may automatically change a side relationship. For example, the urban noncombatant that has been viewed as friendly or at least neutral can become hostile when an event occurs, such as the destruction of a religious or cultural symbol.

Another important modeling aspect provided by the OOS is the notion of asymmetric relationship between sides. Modeling of sides in traditional simulations relates sides viewing each other in the same way; either as friends, hostiles, or neutrals. Real world side relationships are rarely so simple.

Table 1 shows relationships between four notional sides. Note that Side 3 views Side 4 as neutral, but Side 4 views Side 3 as hostile. If these two groups were to meet at a food drop off point, Side 3 would be taken unaware if fired upon by Side 4.

Table 1: From/To Sides Relationships Example

	Side 1	Side 2	Side 3	Side 4
Side 1	Friendly	Friendly	Hostile	Friendly
Side 2	Friendly	Friendly	Neutral	Friendly
Side 3	Hostile	Hostile	Friendly	Neutral
Side 4	Friendly	Hostile	Hostile	Friendly

3.2 Environmental Representation

Creating an appropriate, high-resolution urban environment is critical to executing a meaningful Three-Block War type of scenario. Today's terrain databases must have the flexibility to accommodate the density and complexity associated with an extensive cityscape. Further, the runtime simulation software must be able to handle the intricacy as well. Some of the features in the OOS that will support this type of environment include:

- Multi-resolution terrain databases
- Entity reasoning and movement planning in an urban environment

- Ray-trace Line-Of-Sight through terrain, features and building apertures
- Multi-resolution NBC, Smoke, and Obscurants
- Support for subterranean structures

3.2.1 High-Resolution Terrain Representation

The representation of buildings is especially significant, particularly for the mid- and high-intensity conflict in the urban environment. The OOS provides a multi-resolution capability to support the battle both in and around buildings. At the lowest resolution, buildings consist of only the exterior shell. At the next higher step of resolution entities can enter the building and interact, through windows and through open doorways, with entities outside of the building. At the highest level of resolution (called Ultra High Resolution Buildings (UHRB)), buildings will account for all interior geometry and features. [2] The UHRB format was designed to provide the feature and attribution information needed for SAF entities to properly reason about the environment. Some of the capabilities provided by UHRBs include:

- Anterooms, atriums, balconies, closets, elevator shafts, escalators, hallways, fire escapes, ramps, stairs, ventilation ducts/shafts
- Apertures: breach holes, doors, skylights, trapdoors, ventilation openings, loopholes
- Enhanced attribution: length, width, height, lighting characterization, railing type, aperture state, interior wall construction, floor construction, exterior wall construction
- Enhanced route planning within buildings to include routes through apertures
- Ray-traced line of sight through apertures
- Bullets/munitions fragments passing through walls
- Underground structures
- Building damage and rubble of building

3.3 Composition Toolset

The OOS will be fielded with a robust set of entities, units, and behaviors; however, the contemporary operating environment describing the Three-Block War will continually demand that this set be expanded and changed. The OOS will provide a toolset that allows users to independently create new OOS battlespace compositions. The tools use Graphical User Interfaces and support processes to remove, to a large extent, the dependency on software experts to develop new unit, entity, and behavior model compositions. The composition tools use and build on existing primitive and composite models to develop new and unique entities (e.g., individual combatants, helicopters, tanks, sensors, weapons, etc.), units (i.e., organizations of entities that behave according to certain sets of rules or doctrine), and behaviors (e.g., move tactically, defend position, etc.) that are associated with units and entities. [6] The construction of these models may include model components that vary across a range of physical and

behavioral fidelity (e.g., low, medium, and high). The following list describes each of the model composition tools.

Entity composition is handled by the Entity Composer Tool. The composer provides the user with a drag-and-drop capability to develop new OOS entities. For example, a user might need to create an entity model of a terrorist suicide bomber.

Unit Composition is supported with the Unit Composer Tool. This tool allows entities to be combined to form asymmetrical friendly, enemy, and neutral type organizations. A possible user of this tool would be the creation of a terrorist cell.

The Behavior Composer Tool allows users to create new behavioral representations that are subsequently associated with units and/or entities. For example, once a suicide car bomber entity is created, the users must build a behavior to dictate how the suicide bomber might behave when approaching a particular target, such as a military checkpoint. This tool allows the creation and/or modification of behaviors that entities and units will use to guide their interactions within the simulation.

4. OOS MODELING OF THREE-BLOCK WAR

OOS modeling will represent a full spectrum of combat operations from entity up to brigade level and will span across many battlefield functional areas. OOS is designed to allow tailorability through the use of an open architecture, open source methodology and a robust set of GUI tools that allows the user to create unique entities, units, and behaviors. Though the simulation can be modified by users, often without writing or recompiling the software, OOS will be fielded with a robust set of entities, units, and behaviors to support most military applications. This section will discuss only the specific OOS capabilities supporting the Three-Block War.

4.1 Supporting Humanitarian Assistance

OOS will simulate Army forces employed in humanitarian assistance roles that provide critical services and supplies to designated groups. OOS utilizes the Army Universal Task List (AUTL) to decompose and model appropriate military behaviors. The following humanitarian assistance behaviors will be supported:

- Conduct Casualty Evacuation
- Conduct CL III Tailgate Resupply
- Conduct Equipment Repair
- Conduct Medical Treatment
- Conduct Tactical Road March
- Conduct Towing
- Load/Unload Personnel/Supplies/Equipment
- Move a Casualty
- Construct Roads and Trails

Non-Governmental Organizations (NGOs) and Private Volunteer Organizations (PVOs) provide humanitarian

assistance and disaster relief. There are several thousand of humanitarian relief organizations worldwide, OOS will model the following representative organizational structures in support of humanitarian assistance; while offering units composition toolsets to users to compose specifics.:

- Field Mission Delegate Branch
- General Support Branch
- Medical Support Branch
- Relief Work Branch
- Construction Element
- Private Security Guard Team
- Crowd Rioters

4.1.1 Non-Combatants and Crowds

To varying degrees, the civilian population has an impact on all other elements that compose the contemporary operating environment. Aside from military and paramilitary forces, the civilian population of a nation or region is often the single most important aspect of the environment. [8] There are so many factors and influences that affect the interactions of a crowd that modeling is very difficult. OOS attempts to overcome this problem by developing hierarchical goal decomposition as an effective method of representing the behavior of the crowd entities. Weighted rules are used to select subgoals at each level of the hierarchy which will allow external and internal factors to influence subgoal selection in a continuous fashion. Emotional states can be represented as continuous internal state variables, which change dynamically in response to events. OOS modeling will include the dynamics of crowd movement as individuals move together, flowing around obstacles and through restricted areas. The model will simulate the decisions of the crowd to perform routine activities, to collect together, to move toward attractive events and run away from frightening events. Emotional states and the actions of the nearby crowd will play roles in governing each individual's choices of action. Finally, the crowd behavior model will incorporate parameters that will allow users to set the initial attitude of the crowd and the sensitivity of the crowd to events, thus allowing the simulations to create different types of situations or different cultural contexts for the crowd. There are any number of ongoing crowd modeling efforts; the crowd modeling being done in OOS will likely not provide the full solution for all users and all use cases when the software is initially released, but the infrastructure will be in place to support future enhancements.

4.2 Peace-keeping Operations

OneSAF will simulate peace-making, peace-building and peace-keeping activities to include monitoring and facilitating implementation of truce agreements and supporting diplomatic efforts to reach permanent political settlements. OneSAF will simulate Army forces

deployed on peace-keeping operations individually or in unit strength.

4.2.1 Stability Operations

Stability Operations employ Army forces outside the United States and U.S. territories to promote and protect U.S. national interests by influencing the threat, political, and information dimensions of the operational environment. This is done through a combination of peacetime developmental, cooperative activities and coercive actions in response to crisis. Their overarching purpose is to promote and sustain regional and global stability. [4] The following are AUTL task lists that OOS will consider for decomposition and modeling:

- Conduct Stability Operations
- Conduct Peace Operations
- Conduct Security Assistance
- Conduct Humanitarian and Civic Assistance
- Provide Support to Insurgencies
- Support Counter-Drug Operations
- Perform Noncombatant
- Evacuation Operations
- Conduct Arms Control Operation
- Conduct a Show of Force
- Conduct Foreign Internal
- Defense Operations
- Combat Terrorism

While there will not be a “combat terrorism” behavior in OOS, the behaviors that companies and platoons would need to execute in support of “combat terrorism” will be implemented in OOS.

4.2.2 Support Operations

The purpose of support operations is to meet the immediate needs of designated groups for a limited time, until civil authorities are able to do so without Army assistance. In extreme or exceptional cases, Army forces may provide relief or assistance directly to those in need. More commonly, Army forces help civil authorities or nongovernmental organizations provide the required support. Army forces often conduct support operations as stand-alone missions. [4]. The following are the Support Operations AUTL tasks that OOS will consider for decomposition and modeling:

- Conduct Support Operations
- Conduct Domestic Support Operations
- Conduct Foreign Humanitarian Assistance
- Conduct Forms of Support Operations

As with stability operations the OOS implementation of support operations will include the company and below behaviors necessary to implement these kinds of operations.

4.3 Supporting Mid- to High Intensity Conflict

OOS provides all the required functionality to support Mid-to-High Intensity Conflicts. In support of the conflicts within a three-city block, focus has been to

implement behaviors specific to Urban Operations and the Contemporary Operating Environment.

4.3.1 Urban Operations

OOS will provide a robust ability to conduct urban operations. Some of the OOS individual combatant (a.k.a., dismounted infantry) related behavior models include:

- IC Enter a Room
- SQD Enter and Clear a Building
- Dismount Aircraft & Vehicles
- Mount Aircraft & Vehicles
- Move in Urban Terrain
- Urban Defense
- PLT Assault a Building
- TD UAV Conduct Surveillance
- Emplace Minefields- Includes IED capability
- Establish Cordon
- IED Attack
- Urban Sniper
- Execute Urban Ambush Ground
- Execute Urban Ambush Air
- COE Attack
- Conduct Raid
- Move a Casualty (Urban Ops MEDEVAC)
- Conduct Ambush

Enhanced Physical Models for Individual Combatant Representation include:

- Dismounted Infantry Mobility
- Individual Combatant Mobility Steady State
- Vulnerability from Direct Fire Weapons for Dismounted Infantry
- Vulnerability from Indirect Fire Weapons for Dismounted Infantry

4.3.2 COE Opposing Forces

Threats from traditional military opposing forces remain relevant; however, as demonstrated in recent world events, the U.S. Army must prepare for a contemporary threat that is less predictable and not based on traditional fighting doctrine. In modeling the Contemporary Operating Environment, OOS is supported by Assistant Deputy Chief of Staff for Intelligence-Threats (ADCINT-Threats) in providing valuable COE information regarding military capabilities, physical environment, information, and social demographics. OOS will be distributed with a robust set of COE entities and behaviors, to include modeling of IED's, Paramilitary forces, Guerilla forces, homicide/suicide bombers and Car bombs, as well as the following:

- OPFOR urban detachment
- COE OPFOR terrorist organization
- Guerilla and insurgent organizations
- COE OPFOR special purpose forces
- Non-combatant civilian groups
- Multiple variations of non-combatant civilian groups

5. PRE-PLANNED PRODUCT IMPROVEMENTS

(P3I)

OOS will begin fielding version 1.0 in March of 2006. Version 1.0, however, is not the end, but the beginning. The Army has designated program funding through at least Fiscal Year 2011 for pre-planned product improvements (P3I), or enhancements, to OOS. A process has been developed to assess desires from the user community and prioritize them on an annual basis so that the Product Manager can enhance OOS.

Being developed in a spiral development process, many desired capabilities were designated from program initiation to be completed as part of P3I. Through customer-funded efforts and work with TRADOC ADCS-INT, some of the work originally designated as P3I will be implemented prior to release of version 1.0. Examples of work that has been accelerated are “technicals” (civilian vehicles with mounted weapons), decoys, and shielding tactics (i.e., combatants taking cover behind non-combatants). Through some internal research and development efforts by OOS developers some crowd behavior work, including the ability to provide food and water to civilians, has been accelerated as well. Some items that remain on the P3I list are:

- Expedient Field Fortification, Expedient Breach, and Expedient Obstacles to permit fortification inside buildings using building debris, etc., that is not easily observable but provides cover to combatants engaging from buildings.
- Expedient breach functionality that permits movement from room to room and floor to floor instead using stairwells and hallways.
- Expedient obstacle creation capability that enables obstruction of roads, areas within and immediately adjacent to buildings (e.g., stairwells, hallways, rooms, roofs, etc.)
- Unconventional battle command, such as chat rooms, email, Website, BLOG, and cell phones.
- Civil affairs and psychological operations4. Nuclear, biological, and chemical (NBC) decontamination. NBC contamination and reconnaissance will be represented in version 1.0.
- Use of terrain as a weapon & environmental obstacles (e.g., landslides, intentional flooding, and contamination)
- Standoff attack, such as tracing line of sight from mouse hole without showing the weapons muzzle to enemy, and reducing muzzle flash.
- Weather effects (soft factors--morale, sleep deprivation, etc.)
- Improvised weapons, such as Molotov cocktails, machetes, and rocks.
- Improvised road blocks, such as burning debris.

While the ability of OOS to simulate the three-block war will be significant with version 1.0, that version is just the beginning of the capabilities that are planned for eventual implementation.

6. CONCLUSIONS

Most simulations available to U.S. forces were designed and built during the Cold War to simulate the kinds of combat U.S. forces were expected to face. The contemporary operating environment involves different kinds of enemy forces waging warfare in different ways. Because of the modular design and technical approach of OOS, it is ideally suited to simulate all three blocks of the Three-Block War.

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