The Three Block War in OneSAF

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ABSTRACT

General Charles Krulak, former Commandant of the United State 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 would 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 three modeling and simulation domains. 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.

ABOUT THE AUTHORS

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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. OOS has been designed to be easily enhanced and tailored by users. This design 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.

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." (Krulak, 1999)

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.

According to a Marine Corps threat estimate, it is estimated that 45% of the world population currently resides in urban settings and it is projected that in the next ten years (1997-2007) that this percentage will increase to 60% (USMC, 1997). 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) (ADCSINT Threats, 2000).

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.

BRIEF DESCRIPTION OF ONESAF

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) domain; Training, Exercises, and Military Operations (TEMO) domain; and Research, Development, and Acquisition (RDA) domain. 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. (OneSAF ORD, 2004) 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.

HUMANITARIAN ASSISTANCE

Description

Humanitarian Assistance (FM 100-23, 1994) includes programs conducted to relieve or reduce the results of complex emergencies involving natural or man-made disasters or other endemic conditions such as human pain, disease, hunger, or privation that might present a serious threat to life or that may result in great damage or loss of property. Humanitarian assistance complements the efforts of a host nation, civil authorities, or other agencies that have primary responsibility. Assistance operations are normally conducted by a joint task force and in concert with non government organizations (NGOs) and private voluntary organizations (PVOs). The tasks may include –

- Distribution of relief supplies.
- Transportation of relief supplies and civilians.
- Provisions of health services.
- Provision of essential services.
- Resettlement of dislocated civilians.
- Disposition of human remains.
- Establishment of essential facilities.

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. OOS has been built with a number of capabilities that begin to address the unique aspects of humanitarian assistance operations.

How OneSAF Will Support Simulation of 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:

- Casualty Evacuation
- Tailgate Resupply
- Equipment Repair
- Medical Treatment
- Tactical Road March
- Towing (disabled vehicles, trailers, guns, etc.)
- Load/Unload Personnel/Supplies/Equipment
- Move a Casualty
- Construct Roads and Trails

This does not mean that there will be a behavior called "construct roads and trails," but that the tasks to subordinate units to implement that mission will be implemented. To some extent, the task decomposition work is still ongoing as we continue OOS development.

Move a Casualty is an example of the implementation of a humanitarian assistance type behavior (that might also be used in other operational contexts). This behavior describes wounded soldier (WS), or non-combatant, movement.

1. A soldier has been wounded and needs to be moved to a medic, an ambulance, or another vehicle for evacuation. If the receiving vehicle is an ambulance or a vehicle with a medic the WS will also receive medical treatment.
2. Each wound has a defined casualty transportation status of either litter or casualty.
3. All WS movement takes place at a reduced rate of speed. The WS and Individual Combatants (IC's) carrying the WS (if any) move at the reduced speed, depending on the WS's casualty transportation status.

4. Dismounted Infantry Mobility Physical Knowledge Acquisition Document (PKAD) provides the walking, normal gait.
5. The casualty movement Behavior Data Table (BDT) provides the percentage of normal movement that will be allowed when carrying a WS with or without a litter.
6. Ambulances, ground and air, have litters.
7. Ground ambulance crews can move to a WS.
8. Air Ambulance crews *do not move* to a WS. The unit requesting the air ambulance is responsible for moving the WS to the air ambulance for loading.
9. The order directing the movement provides location of the injured, location the injured are to be transported to, time movement to the pick-up site will begin, and route to WS.
10. Reports required by this behavior include SITREP sent to echelon above IC's responsible for movement of WS, upon start of movement to casualty pickup point and upon reaching casualty pickup point.

Non-Governmental Organizations (NGOs) and Private Volunteer Organizations (PVOs) provide humanitarian assistance and disaster relief. There are several thousand humanitarian relief organizations worldwide, and OOS will not attempt to distinguish between each of these groups. OOS will, however, model the following representative organizational structures in support of humanitarian assistance so that users may compose specific organizations:

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

Non-Combatants and Crowds

The emergence of civilian and paramilitary threats to US forces has brought about the need to model and simulate combatant forces and the interaction with crowds of civilians. OOS modeling of non-combatants and crowd behaviors leverages the efforts of a Science Applications International Corporation (SAIC) research effort entitled OOS Capabilities (OOSC), which was chartered to evaluate the suitability of OOS as a rapid development architecture by rapidly providing entities, behaviors, and tools relevant to non-combatant activities taking place in an urban environment. 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 various situations or different cultural contexts for the crowd. The crowd behaviors can be used in many situations. The following scenarios can give an example of how the crowd simulation may be used.

Scenario 1: Plaza Bomber.
The Plaza Bomber scenario begins with the execution of non-combatant idle behaviors, simulating the activities of a group of civilians in a crowded marketplace. A small cell of terrorist entities is located outside the plaza area. A suicide bomber makes his way to the center of the plaza, and detonates an explosive device.

The crowd responses to the detonation model with typical civilian reactions to traumatic events (such as explosions, traffic accidents, or criminal activities) in an urban setting. Within close proximity to the detonation, the entity vulnerability models assess damage, and inflict wounds or death as appropriate. Entities in close proximity to the explosion that are not wounded exhibit fear by fleeing; entities beyond a data-driven event radius but still close enough to be aware of the event exhibit curiosity by approaching the site of the detonation. This last response produces a commonly observed phenomenon of the gathering of a crowd of onlookers. A convoy of BLUFOR security forces and ambulances arrives, and must avoid the crowd as they approach the scene.

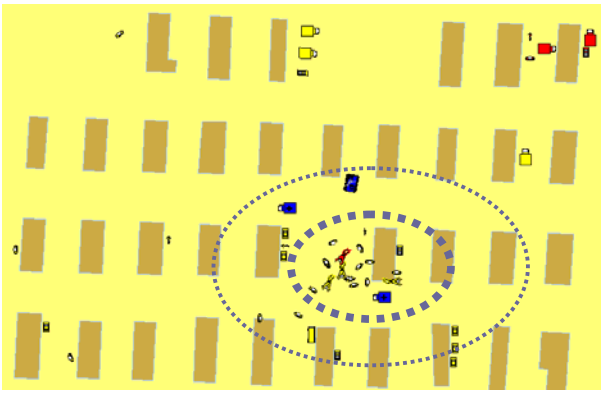

Figure 1: Plaza Bomber

Scenario 2: Humanitarian Aid.
The Humanitarian Aid scenario begins with another group of non-combatants, again executing their idle behaviors. A convoy of trucks arrives in their vicinity, and offloads a cache of supplies. Any item on the OOS supply list could be used here, e.g. water, food, etc. Entities within the range of awareness of the event exhibit interest by approaching the caches. This gives rise to the gathering of crowds that is characteristic of resource distribution events.

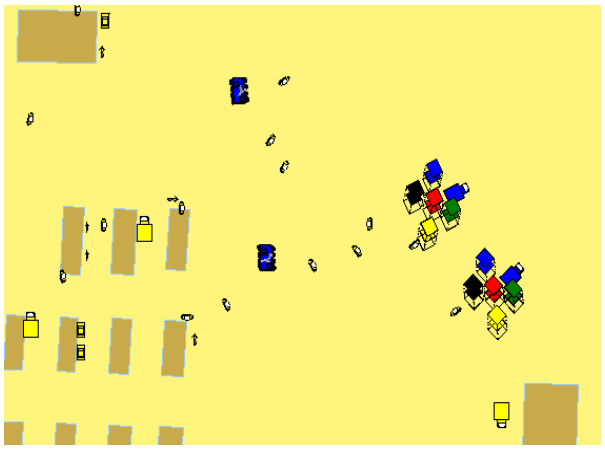

Figure 2: Humanitarian Assistance

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.

Multiple Sides and Forces
Soldiers on the ground in Afghanistan and Iraq are 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 run-time simulation database (Gugel & Miller, 2003). 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's 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**

PEACEKEEPING

Description

Peacekeeping operations (FM 100-20, 1990) are conducted with the consent of the belligerent parties to a conflict to maintain a negotiated truce and to facilitate a diplomatic resolution. The United States may participate in peacekeeping operations under the auspices of an international organization, in cooperation with other countries, or unilaterally. Peacekeeping operations may take many forms:

- Withdrawal and disengagement
- Cease-fire
- Prisoner-of-war exchanges
- Army control
- Demilitarization and demobilization

Peacekeeping operations support diplomatic efforts to achieve, restore, or maintain the peace in areas of potential or actual conflict. 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).

Stability Operations involve the use of military forces to affect 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.

How OneSAF Will Support the Simulation of Peacekeeping Operations

Military Police (MP) have become increasingly important in missions involving peacekeeping operations. OOS has worked with the Maneuver Support Center to pave the way for the implementation of a number of Military Police (MP) tactical operations in versions of the software after version 1.0:

- Maneuver and Mobility Support (MMS)
- Area Security (AS)
- Law and Order (L&O)
- Internment and Resettlement (I/R)
- Police Intelligence Operations (PIO)

Maneuver and Mobility Support (MMS): The MMS involves measures to support the commander's freedom of movement in his Area Of Responsibility. The security and viability of the area is the responsibility of the MPs. Specific MP MMS representations include river crossing operations, breaching operations, passage of lines, straggler control, dislocated civilian control, route recon & surveillance, and main supply route regulation enforcement.

Area Security: MPs protect the force and enhance freedom to conduct assigned missions. Specific Area Security representations include reconnaissance operations; area damage control (ADC); base/air-base defense (rear area security); response-force operations; and critical site, asset, and security.

Internment and Resettlement: MPs process and confine enemy prisoners of war and US military prisoners. Specific Internment and Resettlement representation include enemy prisoner of war and civilian detainee handling, populace and resource control (i.e., prisoner curfews, rations, and amnesty), and US military prisoners confinement.

Law and Order: MPs dedicate assets to conduct Law and Order operations. Specific representations include law enforcement, criminal investigations, and US customs operations. It is unlikely that OOS will be able to support these kinds of operations in the foreseeable future.

Police Intelligence Operations: MPs assist the commander in his intelligence preparation of the battlefield process by accumulating information. Specific representations include passive and active mode intelligence operations.

OOS will have a variety of capabilities to help simulate both stability and support operations. A number of unique behaviors have been developed that allow units to perform tasks in support of these operations.

Stability Operations

Stability operations (FM 3-0, 2001) promote and protect US national interests by influencing the threat, political, and information dimensions of the operational environment. They include developmental, cooperative activities during peacetime and coercive actions in response to crisis. Army forces accomplish stability goals through engagement and response. The military activities that support stability operations are diverse, continuous, and often long-term. Their purpose is to promote and sustain regional and global stability.

OOS behaviors for version 1.0 will be implemented at the entity, platoon, and company level. Platoons do not conduct stability operations, but they perform tasks in support of stability operations. In building OOS, the following stability operations were decomposed, and supporting company-, platoon-, and entity-level behaviors have been implemented:

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

Again, there will not be a "combat terrorism" behavior in OOS; however, the behaviors that companies and platoons would need to execute in support of "combat terrorism" will be implemented in OOS.

Support Operations

Support operations (FM 3-0, 2001) use Army forces to assist civil authorities, foreign or domestic, as they prepare for or respond to crises and relieve suffering. In support operations, Army forces provide essential support, services, assets, or specialized resources to help civil authorities deal with situations beyond their capabilities. The purpose of support operations is to meet the immediate needs of designated groups for a limited time, until civil authorities can 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 support. Army forces often conduct support operations as stand-alone missions. However, most offensive, defensive, and stability operations require complementary support operations before, during, and after execution.

The following are the Support Operations Army Universal Task List (AUTL) tasks that OOS will consider for decomposition and modeling:

- Support Operations
- Domestic Support Operations
- Foreign Humanitarian Assistance
- 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.

MID- TO HIGH-INTENSITY CONFLICT

Description

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 mid-intensity to high-intensity conflict situations. 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.

How OneSAF Will Support the Simulation of Mid- to High-Intensity Combat Operations

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.

Urban Operations

OOS will provide a robust ability to conduct urban operations. A large set of urban operations behaviors have been created. These behaviors allow the user to give orders to platoon and company formations that are

executed by individual entities in a doctrinally consistent manner. Most of the behaviors that are unique to urban operations center on enhanced dismounted infantry behaviors. Below is a partial list of those behaviors that will be available when version 1.0 is released:

- 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

An example of a mid-intensity combat behavior being built in OOS is the Platoon Assault a Building behavior. Every effort has been made to ensure that the behavior is as close to doctrinal as possible; however, several caveats need to be taken into account when looking at the flow chart of this behavior. Behavior documentation for OOS generally includes the kinds of information about assumptions, initial conditions, terminating conditions, etc. that are shown in the following paragraphs.

- The platoon is supported only by its organic weapon (the preferred method of entering a building is to use a tank main gun round; direct-fire artillery round; or TOW, Dragon, or Hellfire missile to clear the first room).
- Clearing a building from the top down is the preferred method; however, this task depicts the doctrinal technique for entering through a doorway at ground level and clearing interior rooms.
- This task is described in the context of high intensity combat, using overwhelming firepower to eliminate or neutralize all of a room's inhabitants as opposed to precision room clearing, using accurate, and discriminating fires in order to avoid killing noncombatants.
- The type of materials the building is made of will determine if a high explosive grenade can be used.

In addition to creating a large set of behaviors, a variety of Army Material Systems Analysis Activity (AMSAA)-validated and AMSAA-verified physical models are being implemented in OOS.

- Dismounted infantry mobility
- Individual combatant mobility steady state
- Vulnerability from direct fire weapons for dismounted infantry
- Vulnerability from indirect fire weapons for dismounted infantry
- A new, low-resolution model for weapons effects passing through interior walls of buildings and (perhaps) causing casualties in adjacent rooms

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. ADCSINT Threats has a variety of missions. The ones germane to this discussion are:

- Provide and approve/validate all threat portrayal in the context of an Operational Environment (OE) for studies, training, modeling, and simulations for TRADOC,
- Assess regional military and security issues as they apply to developments and training of Army and Joint Forces,
- Develop and approve threat portrayal for all testing of Army materiel,
- Create the threat model for training Army forces in an OE, including authoring OPFOR Field Manuals, and
- Accredit OPFOR forces in application of that model.

The TRADOC DCSINT and the director of the TRADOC Analysis Centers (TRAC) allocated resources to provide ADCSINT Threats personnel to participate in the knowledge acquisition (KA) development, validation, and verification of OPFOR

representations in the COE within OOS. ADCSINT Threats personnel work with the OOS conceptual modelers, systems engineers, and KA team to develop architecturally consistent and validated COE representations. They then participate in the verification of those COE behaviors through user testing. The ADCSINT Threats personnel coordinate their activities with the Center for Army Lessons Learned (CALL) and the Joint Readiness Training Center. ADCSINT has been a great asset for ensuring the threat representations are as accurate as possible and based on current lessons learned from the field.

As a result of the ADCSINT Threats involvement in OOS development, OOS will be delivered with a significantly more robust COE OPFOR representation than any existing entity-level simulation. These behaviors include modeling of improvised explosive devices, 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

An example behavior regarding COE opposing forces is the convoy reaction to an IED behavior. This behavior describes actions taken by vehicles in a military convoy when they become aware of the presence of an IED (Improvised Explosive Device). There are two scenarios of interest concerning IED's. The first is an Ambush-type situation, where observation and fires cover the IED. The second scenario is the hazard-type situation, where the IED is just sitting along the roadside. The following are steps to implement this process:

1. Determine the location of any visible or suspected IEDs along the convoy route. If the IED is spotted it can be marked by a smoke grenade. Visual identification can also be made if an IED has detonated. This may be an indication that more IEDs are in the area.
2. Engagement area is defined based on whether only one explosive device is utilized; if there are more than one IEDs connected together; and if the Engagement Area is covered by direct or indirect fire.
3. Vehicles in or forward of the Engagement Area will mark the IED with a smoke grenade.
4. Increase speed 25% and move out of the Engagement Area.
5. If taken under direct or indirect fire, execute Actions on Contact-Convoy Task Description (TD) (another behavior).
6. Vehicles able to halt at least 100 meters from the Engagement Area will execute Actions At Halt TD (another behavior) and if necessary back up at least 300 meters from the IED.
7. Set-up roadblocks to prevent civilian and military traffic from entering the Engagement Area.
8. Submit SITREPS to inform other members of the convoy and higher HQ of the location of the IED.

Enhanced Terrain 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. In addition, 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
- Support for subterranean structures

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. (Butler, 2002) 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

SUMMARY

In current operational situations, US forces are routinely asked to fight a highly lethal, mid-intensity battle and simultaneously execute humanitarian assistance and peacekeeping operations. OOS plans to provide the U.S. Army with an entity-level simulation to serve the training *and* analysis communities that supports variable levels of fidelity and supports high resolution synthetic environments. OOS has been architected with the requirements of the contemporary operating environment in mind from its inception. While not all of the behaviors described in this paper will be available in version 1.0 in March of 2006, the foundation will be laid to grow the simulation in these areas over time and in response to the user community's needs.

ACKNOWLEDGEMENTS

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