

## A Peacekeeping Architecture for AWARS

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### INTRODUCTION

Since the fall of the Berlin Wall and the end of the Cold War, the U.S. Army has found itself engaged in a significantly increased number of deployments ranging from major theater warfare (MTW) in Desert Shield and Desert Storm, through small scale contingencies (SSC) such as Just Cause in Panama, to participation in stability and support operations (SASO) such as the deployments to Bosnia, Somalia, and Kosovo. It is the latter that are more frequent and, in the case of recent initiatives such as the Interim Brigade Combat Team, of more interest. In support of these changes, initiatives have been undertaken to improve and enhance Army models and simulations to facilitate analysis and experimentation, training, and materiel development. The Advanced Warfighting Simulation (AWARS) is such an initiative.

As currently configured, AWARS represents combat between military forces engaged in operations against each other. It is particularly effective in representing maneuver warfare in MTW, but is being enhanced to provide better support in studies, exercises, or training in the context of SSC and SASO. These latter missions are, in some sense, more complex than MTW. First, they are more likely to involve operations in urbanized terrain. Second, they are more likely to include civilians, refugees, terrorists, and subversives, requiring different rules of engagement (ROE) and rules for opening fire (RFOF). Third, the "terrain" may be complicated by features like seats of government, water purification, broadcast facilities, etc., that are critical in SSC or SASO but less important in MTW. AWARS must address these factors, among others, if it is to be useful across the full spectrum of Army missions.

Recent development work on AWARS has focused on enhancing the representation of direct fire engagements. That work emphasized the role of information and posited a set of behaviors that relate information to effectiveness in direct fire, line of sight, and exchanges of fire. This same emphasis is now being focused on peacekeeping. Many of the modeling issues that must be resolved for peacekeeping are common to those for military operations in urban terrain (MOUT). In particular, representation of terrain, movement of units under congested conditions, presence of non-combatants, intelligence and communications differences, use of nonlethal weapons, impact of operations on terrain and infrastructure, line of communication (LOC) security, and differences in consumption of supplies, are all aspects of this environment impacting command decisions and force structures.

Peacekeeping operations include deployment and sustainment, separation and control of combatants, force protection, security for non-combatants, and operations in urban terrain. These operations are characterized by different ROE, small-unit distributed operations, and the continual danger of escalation. Enhancing AWARS in this domain is a practical way to provide a desired capability and, at the same time, take the first steps to representing MOUT.

Key to developing appropriate representation of peacekeeping is the need to be consistent with the AWARS architecture (see Figure 1 for a summary of the current architecture). The AWARS model is primarily a time-step, cyclic architecture. Special events (penetration of air defense domes, reporting of time-sensitive critical targets, etc.) can be interjected between the time cycle boundaries, but at each cycle boundary, the model is brought completely to state. AWARS is designed for an optimum time cycle of one minute (however, other cycle times between 30 seconds to five minutes can be used). At each one-minute interval, all units are moved and the simulation is brought to geometric state. Then command and control (C2) and information processes are executed, bringing the unit missions status to state. The information processes also bring the common operational picture, represented by the situation maps (SITMAP) containing information about both friendly and enemy units to state. The SITMAPs are held by each command unit entity in AWARS. Following these processes, the attrition process is executed for all units, bringing losses to state.

Since AWARS is an object-oriented simulation, the approach adopted to represent peacekeeping operations involves defining actors or objects, interactions between actors, and associated parameters or data structures. The remainder of this paper describes the results of the initial phase of the design. Central to the approach is the selection of a paradigm loosely based on Maslow's Hierarchy of Needs<sup>1</sup> to provide a foundation for representation of the

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<sup>1</sup> Abraham H. Maslow. "A Theory of Human Motivation." Paper in *Psychological Review*, Vol 50. 1943. pp. 310-396.

behavior of non-combatants and a framework for military peacekeeping tasks, non-governmental organization (NGO) activities, and the actions of other actors (e.g., terrorists). In particular, the approach outlined below focuses on the following parameters: food, water, security, medical, shelter, and information. These parameters are then applied to the physiological and security levels of the general population in the peacekeeping area.

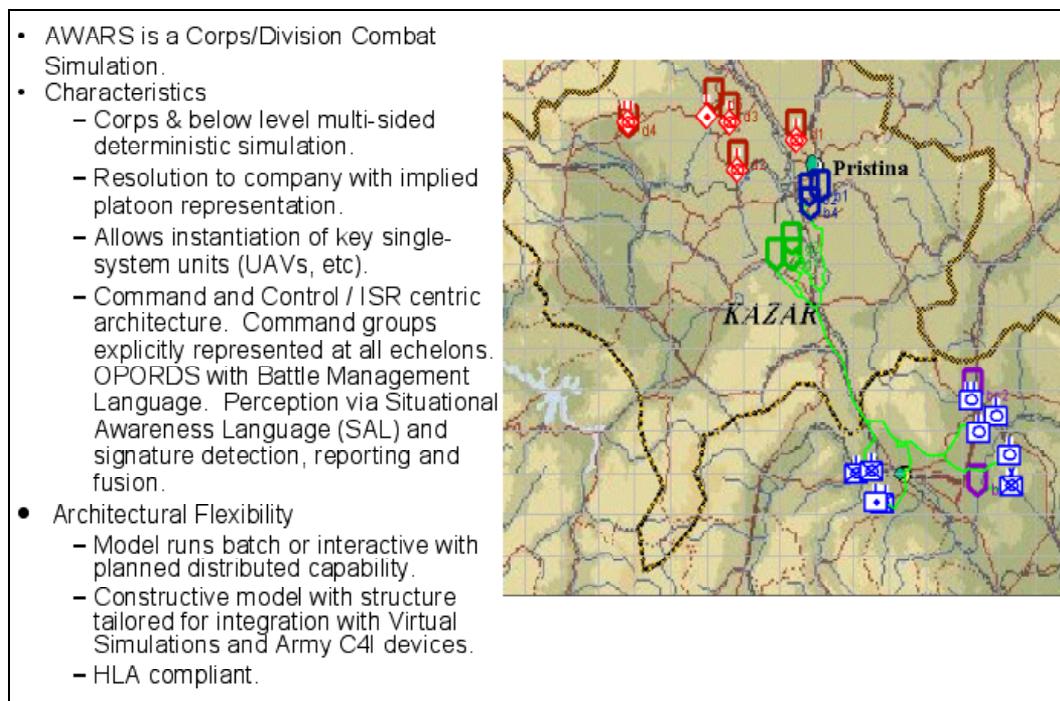


Figure 1: The AWARS Simulation Architecture.

While the effort expended thus far has been driven by representation of peacekeeping operations, it is worth noting that, in at least two ways, the approach described below enhances AWAR's capability to simulate conflict in MTW and SSC. First, refugees and non-combatants have been added to AWARS. (The presence of such entities on the battlefield is a major factor in conflicts, yet one that was not, and has not been, included in past and current models and simulations at the division and corps levels.) Second, "news agents" and the impact of their activities are explicitly represented to reflect the impact of information on civilian, non-combatant behavior and to facilitate analysis of the "CNN factor."

### THE GENERALIZED PEACEKEEPING ARCHITECTURE.

The AWARS peacekeeping model is being designed to provide insights into the basic question: "Does the Task Force Commander represented in AWARS have sufficient resources and agents (together with intrinsic — host country, NGOs, etc., — and other resources) to accomplish his mission and fulfill the basic Maslow needs of the civilian non-combatants? The basic Maslow needs of *physiological* support and personal *safety* are parameterized into the commander's ability to provide food, water, security, medical, shelter, and information (FWSMSI) to the civil population in the context of a war-damaged country infrastructure. The AWARS model is concerned with only the first two levels of Maslow

needs (*physiological* and *safety*). The higher three levels (*social*, *self-esteem*, and *self-actualization*) will not be played in the model.

The overall mission of the AWARS commander will be to satisfy the needs necessary for the lower two hierarchical levels and position his forces between belligerent forces to sustain the peace; satisfying the civilian needs will produce a “stable state” among the non-combatant actors and would be instrumental in keeping them at their indigenous locations. The inability to satisfy these needs may cause the non-combatant actors to become unstable and to move to other behavioral states (riot and refugee status), potentially resulting in a committing a larger portion of command resources to protect and support the refugees. This may ultimately lead to an outbreak of fighting as belligerent forces believe that the AWARS commander will not challenge them. The *physiological* and *safety* needs are parameterized in the following fashion for each of the non-combatants dependent on the peacekeeping force. The six parameters listed below drive the AWARS peacekeeping architecture. They will be referred to throughout the remainder of this document with the acronym “FWSMSI.” These values are specific to the area of operations or the theater in question.

- *Food*: pounds of food per person per day necessary to sustain life; pounds of food per person per day consumption for average housed people.
- *Water*: gallons of water per person per day necessary to sustain life; gallons of water per person per day under conditions of sufficient housing.
- *Security*: violent deaths per 1,000 people per day per 4 square kilometer (sq km) for urban area and violent deaths per 1,000 people per day per 10 sq km for rural area. (It is assumed that the perceived immediate safety of an individual has a cognitive range of 4 sq km in an urban area, while in sparser populated areas (countryside), individuals have a longer range of sensitivity to violent death.)
- *Medical*: outpatient visits per 1,000 people per day (any visit of less than a day is considered “outpatient”). Day-Hospital stays per 1,000 people per day. “Day-Hospital” is determined by:

*(average time of hospital stay) x ( the average people entering the hospital each day) /1,000.*

- *Shelter*: temporary housing units per 1,000 people. (A “temporary housing unit” is one where people can expect shelter from the elements and sanitation and not leading to disease.) Permanent housing units per 1,000 people (homes or apartments for long-term living). A third parameter also applied to this group: deaths per 1,000 people per day from exposure (includes losses from famine, exposure to weather, and disease).
- *Information*: it is believed that sense of security comes from not only knowing one’s own safety but also from the knowledge that others are well fed and secure “sense of community factor.” The primary role of information in AWARS will be to allow civilian non-combatants to develop this sense of security and to allow them to predict, on their SITMAP the stability of their food, medical, and shelter situations. In this case, the parameter is (in

conjunction with information placed in their SITMAP (see: Civilian Non-Combatants Actor): contacts per 1,000 per day. Examples of contacts include: seeing an authority figure, (e.g., a police car driving by); access to the media, or attending a meeting with others.

The current AWARS model is structured around Army battles and battle maneuver. To represent a peace sustainment operation, several software structures and functionalities must be added to the AWARS battle model. These include:

1. *AWARS Peacekeeping Actors*. These actors move about the peacekeeping space with goals and missions. Each have a situational view of the space and a C2 structure, and each interact with AWARS battle units.
2. *Simulation Peacekeeping Space*. This addition to the AWARS battle space is representative of the economic and civil infrastructure supporting the civilian population. This includes food/water production, housing, medical, communication, cultural icons, and refugee camps. This portion of the model is also focused on providing sustainment parameters for the civilian population.
3. *Peacekeeping Timing Architecture*. This architecture considers updates for the infrastructure/military unit production of the FWSMSI sustainment parameters. It also considers cyclic updates for the activities of several actors.

## THE PEACEKEEPING ACTORS

AWARS peacekeeping actors fall into five categories: 1. battle unit peacekeeping actor, 2. civilian non-combatants, 3. terrorists, 4. agents (media and press), and 5. facilitators. The following paragraphs provide a description of some of the characteristics, data structures, and interactions between and among these actors.

### BATTLE UNIT PEACEKEEPING ACTOR (BPKA)

The battle unit peacekeeping actor (BPKA) is the general unit structure already in AWARS. These actors have geometric boundaries, weapons, behaviors, SITMAP, communication, and C2 capabilities. These capabilities will remain in the general AWARS structure. All units in the Army force structure will fall into this category and includes those units that would normally support units in an AWARS battle (i.e., medical, judge advocate general (JAG), military police (MP), logistics, engineer, chaplain, etc.).

- Basic capabilities of BPKA. Each of the BPKA units are actually modified AWARS battle units. Figure 2 provides a summary of the new data structures that must be added to the current AWARS battle units. The production table for FWSMSI is shown in Table 1. Fundamentally, this table describes the ability of the battle actor to produce parameters (FWSMSI) to sustain the non-combatant actors at their desired Maslovian levels. Note that the data table

contains not only the data for the unit, but also a “radius of effects” for the operations of this unit. This “radius of effects” will be used in AWARS to measure the “area “of the non-combatant actors affected (the “area of effects” represents a circle around the location of the unit where the unit can provide support in one or more of the FWSMSI parameters). The “% capacity for unit survival” is the amount of the capacity required by the unit for its own sustainment. Note that some units will have no capacity in some categories and will be high in others. (An infantry unit will be high in serving a security role but may be unable to deliver medical support. Likewise, a medical unit will be high in outpatient visits but not efficient in supporting the information structure).

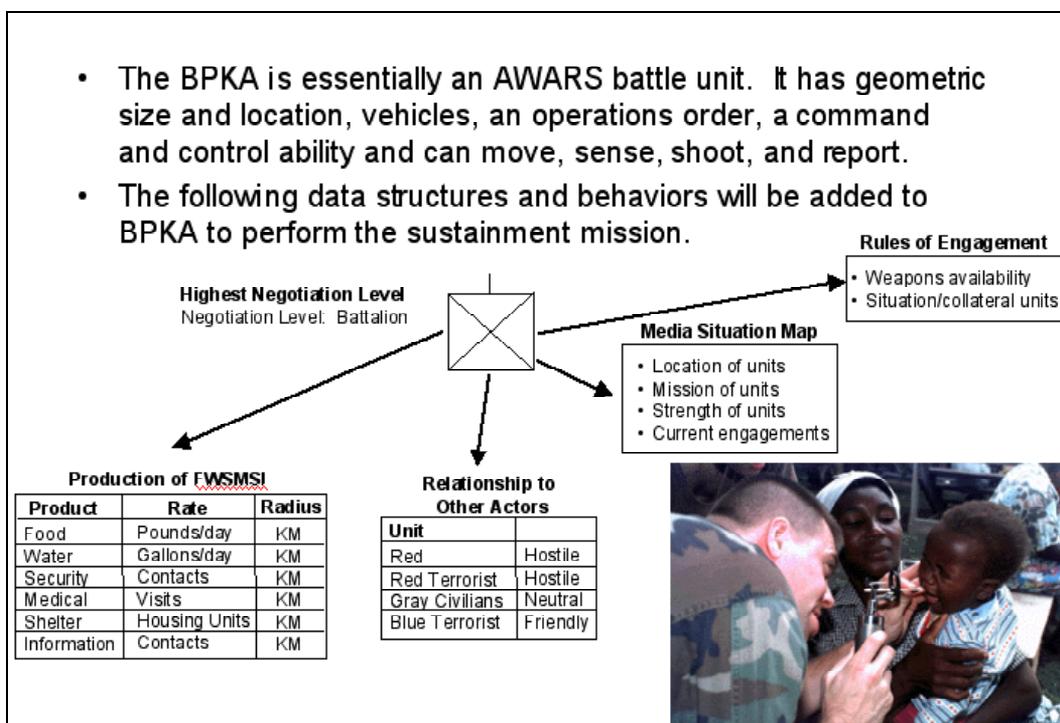


Figure 2. The Battle Unit Peacekeeping Actor (BPKA).

Product	Production Rate	Radius of Effect	% Capacity for Unit Survival
Food	lb./day	km	—
Water	gal/day	km	—
Security	deaths/1000/day	km	—
Medical	outpatient visits/ bed-day/hospital	km	—
Shelter	housing units built/day	km	—
Information	people contacted/ day	km	—

Table 1: Peacekeeping Database for Battle Peacekeeping Action Production Capacity.

- Relationships. Each AWARS battle peacekeeping unit will maintain a table defining its relationship with other actors, particularly to actors on other sides.

For every side portrayed, AWARS will maintain one of five types of relationships and each side will maintain the same relationship view of all actors of another side. Table 2 shows a typical table of relationships as initially defined and used in the DIAMOND simulation for an AWARS Blue battle peacekeeping unit. The relationships are hostile, uncooperative, neutral, sympathetic, and friendly.

<b>Red Battle Unit</b>	<b>Green Battle Unit</b>	<b>NGO</b>	<b>Green Civilian</b>	<b>Yellow Civilian</b>
HUNSF	HUNSF	HUNSF	HUNSF	HUNSF
X	X	X	X	X
H=Hostile; U=Uncooperative; N=Neutral; S=Sympathetic; F=Friendly				

Table 2: Relationships: Blue Battle Peacekeeping Unit (examples).

- Negotiation.** Each AWARS battle peacekeeping unit will have a parameter set defining its ability to negotiate with other units. In this case, the DIAMOND approach will be followed as closely as possible. Negotiation between two units will occur for access, alliances, human assistance, escort, support, and supplies (including demands and theft). Initially, the AWARS focus will be on “negotiation for access.” Each AWARS unit will carry a table defining its ability to negotiate with another unit for the goals defined above. Table 3 (taken from page 143 of DIAMOND documentation<sup>2</sup>) represents the unit table for negotiation. Note that the table describes the mission level of negotiation and the ability of the unit commander to negotiate. Also note that the unit has a further parameter defining the highest echelon with which it can negotiate. If a unit has a requirement to negotiate with another unit, the table will be checked to see if the unit commander can negotiate with its peer. If so, the time for negotiation will be randomly calculated and negotiations will commence. If the unit is required to negotiate at an echelon higher than its parameter indicates, then the unit must call its superior to negotiate. Figure 3 provides an overview of the negotiation process.
- Media SITMAP.** Some of the BPKAs will have attached (or in their area of operations) an agent actor. These actors represent the media and have an impact upon the attitudes and the perceived values of the civilian non-combatant’s Maslow parameters. Later discussion on agent actors will note that these actors provide a set of six message report types. These messages represent the status of both military and terrorist activity and are used by the non-combatant actors to predict the stability of their FWSMSI parameters. If the agent actor is not at the location of the incident being reported on, it will, as a starting point for its report, use the information from the media SITMAP kept by the BPKA headquarters (HQ). This SITMAP may be a mirror image of the intelligence SITMAP kept by the BPKA HQ (all AWARS HQ units keep an intelligence SITMAP). However, it may hold only information that the BPKA HQ has deemed “releasable” (i.e., loss numbers that favor the HQ unit’s side). It will be a scenario-input parameter in terms of “information

<sup>2</sup> DIAMOND Functional Specification, 1999.

management” as to what percentage factor should be applied to the battle SITMAP to develop the media SITMAP.

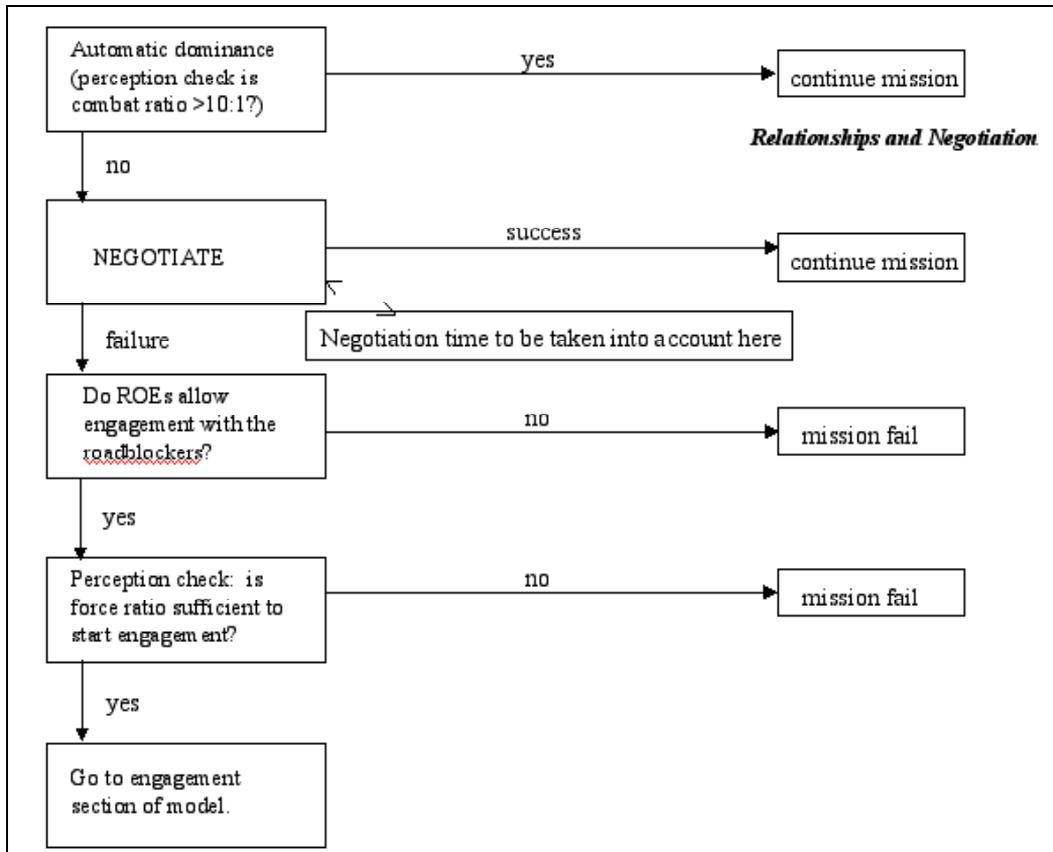


Figure 3: The Negotiation Process<sup>3</sup>.

High Mission Level	Relationship of Party 1 to Party 2				
	Friendly	Sympathetic	Neutral	Uncooperative	Hostile
Access	✓	✓	✓	—	—
Human Assistance	✓	✓	✓	—	—
Escort	✓	✓	✓	—	—
Support	✓	✓	—	—	—
Supply Request	✓	—	—	—	—

Level of Battle Peacekeeping Unit	Battle Actor	Terrorist Actor	Facilitator/Press Actor	Civilian Actor
Company	Battalion	—	—	—
Battalion	Brigade	—	Local Commander	Town
Brigade	Division	✓	Regional Commander	Region
Division	Corps	✓	Country Commander	Region
Corps	Corps	✓	Country Commander	State

Table 3: Unit Relationship for Party 1 to Negotiate with Party 2 (Note: highest levels of negotiation).

- AWARS BPKA will maintain a set of ROE governing response to their engagement by others in a direct fire battle.\* The ROE include the following firing regimes:
 

- 1. Weapons Hold:** If engaged, disengage and move to safety. No firing. Must request superior's release before return fire.
  - 2. Defensive Fire Only:** If engaged, disengage and move to safety. Limited firing to cover disengagement.
  - 3. Fire for Kill:** If engaged, may fire if first engaged by enemy.
  - 4. Weapons Free:** Fire when detecting enemy units.

\* Rules of Conduct will be added in later versions.



Figure 4: The Importance of Rules of Engagement to Battle Unit Peacekeeping Actors.

- Rules of Engagement (ROE). Each AWARS battle peacekeeping unit will carry a set of ROE (see Figure 4). These ROE will define the units that can be engaged, the conditions under which engagement can occur, and the firing categories that must be used. The firing categories are:
  - > *Weapons hold.* Units must immediately try to disengage and move to safety. Under no conditions should shots be fired. Unit must request release from superior before firing a shot.
  - > *Defensive fire only.* Units must immediately try to disengage and move to safety. Limited firing is allowed to cover disengagement. Fire must have been sustained for at least one minute before disengaging.
  - > *Fire for kill if engaged.* Units may fire and engage the enemy if engaged. Fire must have been sustained for at least one minute before disengaging.
  - > *Weapons free.* Fire when detecting other enemy units.
- The ROE apply as actions to the following two part rules: *Suppose unit U is about to fire on unit V. Then, if the unit V is of known side W and their relationship to U is X and collateral units are type Y, then the appropriate entry from Table 4 defines the ROE.*

<sup>3</sup> DIAMOND functional specification, page 147. Focus is on negotiation of a road block.

Collateral Units	ROE
Battle Action	D
Terrorist	D
Press	C
Civilians	B
Facilitators	B

Unit Sides/Type = Battle Actor/Blue

Table 4: Rules of Engagement for an AWARS Infantry Company.

- Missions/C2 of the BPKA.** Each of the battle actors must have missions as they relate to the other actors in the peacekeeping scenario and are scenario dependent. These missions may be anything from providing FWSMSI to local non-combatants to guarding a cultural icon. C2 of the battle actors will use the same infrastructure currently used to command the battle actors in the combat version of AWARS. In essence, each will have an operations order, each a SITMAP describing the state of subordinate and local threat units, and each will pass orders through battle management language (BML) and respond to superiors through situation assessment language (SAL). It will be necessary to modify BML and SAL to represent the peacekeeping situations.
- Activities Against the Peacekeeping Infrastructure.** The battle units can also take action against the infrastructure of the peacekeeping environment. These infrastructure elements are those objects producing the Maslow parameters (FWSMSI) (see further discussions on the peacekeeping environment). Figure 5 summarizes the primary functional interfaces between the BPKA and the other actors.

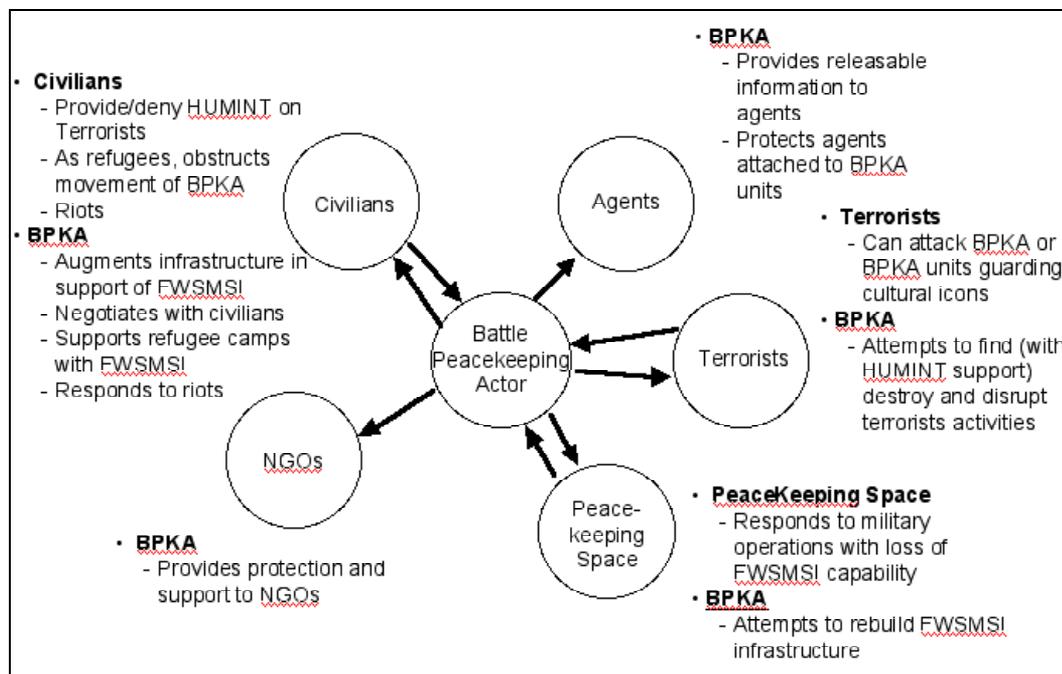


Figure 5: Primary Relationships of BPKA to other AWARS Peacekeeping Actors.

CIVILIAN NON-COMBATANT ACTOR

Civilians represent the local population in the peacekeeping area. They are basically consumers of FWSMSI. The civilian objects will initially be assigned as numbers of people in the AWARS four km squares. Civilian objects keep a SITMAP as shown in Table 5. The SITMAP represents the levels at which the values of FWSMSI are currently being maintained for that group of civilians. Within the information variable, there is another shadow set of the FWSMSI variables. In this case, it represents what the civilians believe the state of the FWSMSI parameters will be in 24 hours and in 72 hours. It is from these parameters that the AWARS civilian object decides in which state it is currently residing. Note that civilians maintaining a hostile uncooperative or neutral relationship with a BPKA will not turn terrorists in. A sympathetic civilian actor will notify of impending attack; a friendly will indicate impending attack and possible location of cell.

	<b>Currently Available</b>	<b>Projected (24hr) Available</b>	<b>Projected (72hr) Available</b>
Food	X	X	X
Water	X	X	X
Security	X	X	X
Medical	X	X	X
Shelter	X	X	X
Information	X	X	X

% Requirement available for 4x4 km area

<b>Possible Attitudes</b>	<b>Requirements</b>	<b>States</b>
Hostile	Food	Unthreatened
Uncooperative	Water	Threatened
Neutral	Security	Subject to Harassment
Sympathetic	Medical	Refugees – Displaced (in camps)
Friendly	Shelter	Refugees – Displacing
	Information	Docile
	Knowledge of Terrorist Activities	Discontented/Resisting
		Rioting

Terrorist activity in area: yes, Relationship to terrorists in 4x4 km sq.: friendly;  
Terrorist home station in area.

Table 5: Summary of Civilian Actor SITMAP Elements, Attitudes, and States.

- States of the civilian object. Figure 6 displays the possible states for the civilian object. A summary of each state and its impact on the BPKA is given in Table 6. From Figure 6 and Tables 6 and 7, it can be seen that “unthreatened” is the most stable state. In this state, the civilian population cares for itself by its own economic means. If significant damage has occurred in the country’s infrastructure, the BPKA units must supplement the loss of indigenous FWSMSI capability. From the unthreatened state, the civilian object moves to various states of instability until a refugee object is created from part of the civilian population. The refugee object then moves to “camp areas” (a scenario input to AWARS and another element in the peacekeeping

space). The single-headed arrows in Figure 6 indicate possible transitions between states. The double-headed arrows indicate required transitions to the temporary state of “riot” and then a return to the original state.

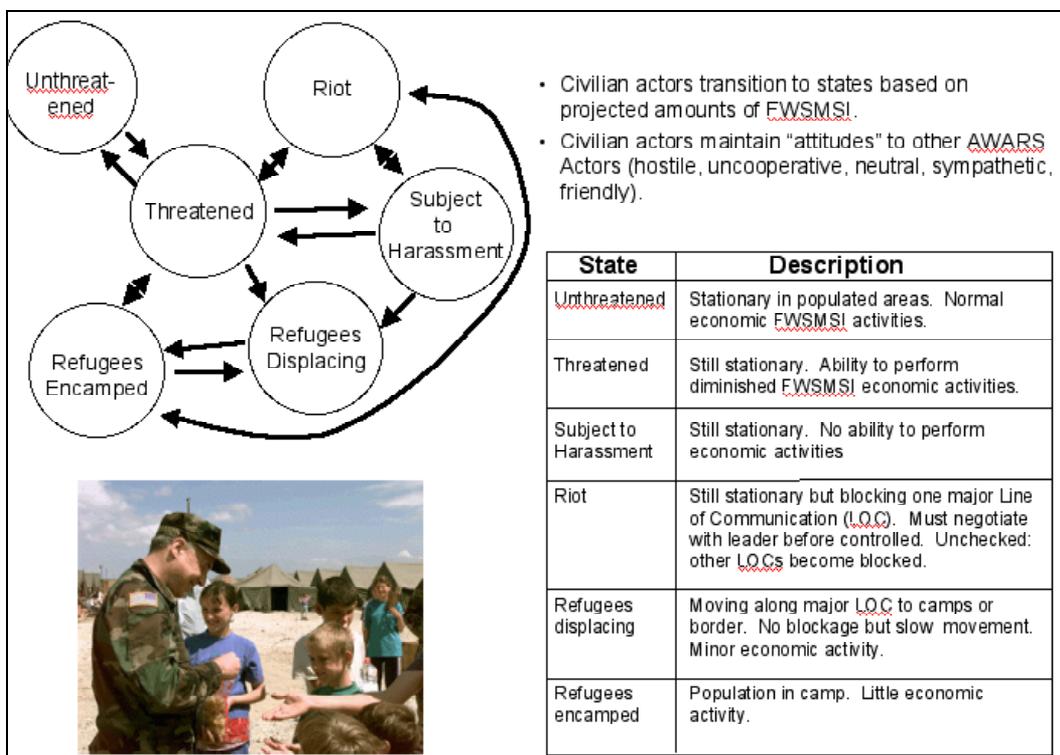


Figure 6: State Relationships of Civilian Actors.

The decision to move to a particular state is based on the perception of the values of the FWSMSI variables in 24 and 72 hours. In the AWARS architecture, the update rate for civilian objects state will be every 12 hours. This should be made on either a 12 or 24 hour basis. Populations may react much slower than the normal battle elements that combat simulations are accustomed to representing. The update rates for the perceived FWSMSI variables depend on the condition of the information infrastructure; if the population is covered by broadcast media (radio or TV) these updates are conducted three times daily (morning, noon, and evening news). If the population is not covered, these updates are conducted on a 48-hour basis. Finally, note that, while part of population maybe in a “riot” state, not all of the population is in that state. We will assume that the riot will occur at some flashpoint and that no more than 200-500 people will be involved. Historically, entire countries have not been known to riot *en masse*.

Further, the information map (see Table 5) has the element “knowledge of terrorists activities.” Terrorists objects will be associated with a particular civilian object. The object will be created by AWARS to perform a terrorists act. Having performed its act, the object will “hide” back in the associated civilian population. Table 5 notes that, depending on the attitude of the civilian object to the BPKA, it will report possible terrorist activities.

<b>State</b>	<b>Description</b>	<b>Maslow Requirement Level Satisfied</b>	<b>Impact on AWARS Battle Peacekeeping Actor (BPKA)</b>
Unthreatened	Civilians stationary in their populated areas performing normal cultural/economic activities.	physiological safety/security	BPKA must supplement any infrastructure (medical, food delivery, power plant reconstruction) damaged by war.
Threatened	Civilians stationary within populated areas. Ability to perform normal cultural/ economic activities diminished. (See table 7 for impacts on percent capacity to produce FWSMSI). Possible transition to riot.	physiological not safety/ security	BPKA must restore/supplement required levels of FWSMSI. Removal of threat and increased security will allow indigenous units of FWSMSI to return.
Subject to Harassment	Civilians still stationary within populated areas. Ability to perform normal cultural/ economic activities further diminished (see table 7 for impact on % capability to produce FWSMSI) Possible transition to riot.	not physiological not safety/ security	BPKA must restore/ supplement required levels of FWSMSI. Removal of harassing threat and increased security will allow indigenous levels of FWSMSI to return.
Refugees Displacing	Civilians move from populated areas along main LOCs. No ability to produce FWSMSI. Refugees have combined velocity of local vehicles (tractors, carts, etc.) and people walking. BPKA vehicles/ units can only move through at some velocity. Possible transition to riot.	None	BPKA must encamp/ protect refugees and supply minimal levels of FWSMSI for physiological purposes.
Riot	Taking violent action against authority.	Physiological security	BPKA must establish control.
Refugees displaced and Encamped	Civilians in local refugee camps. Some economic activity within camp and some ability to produce FWSMSI (see Table 7 for impact).	physiological partial safety/security	BPKA must protect camp and supply levels of FWSMSI necessary to meet Maslovian minimal levels for physiological safety/security.

*Table 6: State Description of Civilian Objects.*

It should be noted that the civilian object is primarily a consumer. It is the BPKA commander's mission to keep the population safe and satisfied with respect to FWSMSI. If this is not the case, the civilian population will become a series of refugee objects consuming even more BPKA resources. These civilian consumptions and transitions occur against a backdrop of terrorists and armed threat activity against the FWSMSI infrastructure and, in some cases, the civilians themselves.

Requirements	Unthreatened	Threatened	Subject to Harassment	Refugees Displacing	Refugees Displaced	Riot
Food	0%	0%	30%	80%	60%	80%
Water	0%	0%	20%	90%	70%	80%
Shelter	0%	0%	10%	100%	60%	80%
Medical	0%	0%	5%	80%	70%	30%
Security	0%	20%	40%	80%	80%	90%
Information	0%	20%	40%	70%	20%	90%

*Table 7: Percent Degradation of Indigenous Capability to Produce FWSMSI for Civilians in Various States. (Notional Data).*

- C2 of the civilian object. As previously mentioned, the civilian object is essentially passive, serving as a consumer with need levels that must be satisfied in order to maintain a stable unthreatened population. This is the AWARS peacekeeper's primary goal. The civilian object does not have as wide a range of missions/goals to perform the BPKA elements in AWARS. Much like the AWARS battle resolution object, the civilian object has some of the principal elements of C2. The overall goal/mission of the civilian population is to maintain its FWSMSI levels to satisfy the Maslow levels of *physiological* need and *security*. In cases where these levels are threatened or denied, the civilian object tends to move into a state to restore them or to lessen the threat. A summary of the primary interfaces between the civilian actor and other actors can be found in Figure 7.

The SITMAP. The civilian object has a SITMAP in which it monitors the state of the FWSMSI variables. This map represents the overall population's understanding of the projected state of these variables.

A chief negotiator/commander. The civilian object should have a chief negotiator (CN). For the purposes of this paper, it will be assumed that the CN has two roles, one to influence a rioting population back to stability and a second to negotiate with others for passage or local area support. This representation in the AWARS simulation software will need to be developed; simply times to quell a riot or time to negotiate passage maybe adequate. The CN's role does not parallel that of the AWARS BPKA commander where a "decision" is sent to subordinates in a BML context. Most messages flowing to the civilian object will be in the form of updates to the FWSMSI elements in the SITMAP as a result of battle or terrorists activity.

## TERRORISTS ACTOR

The terrorists object in AWARS is much like the AWARS resolution unit battle object. Terrorist activities will be injected into the AWARS game as events of the scenario. AWARS will simulate terrorist behavior through four phases. Figure 8 summarizes these phases.

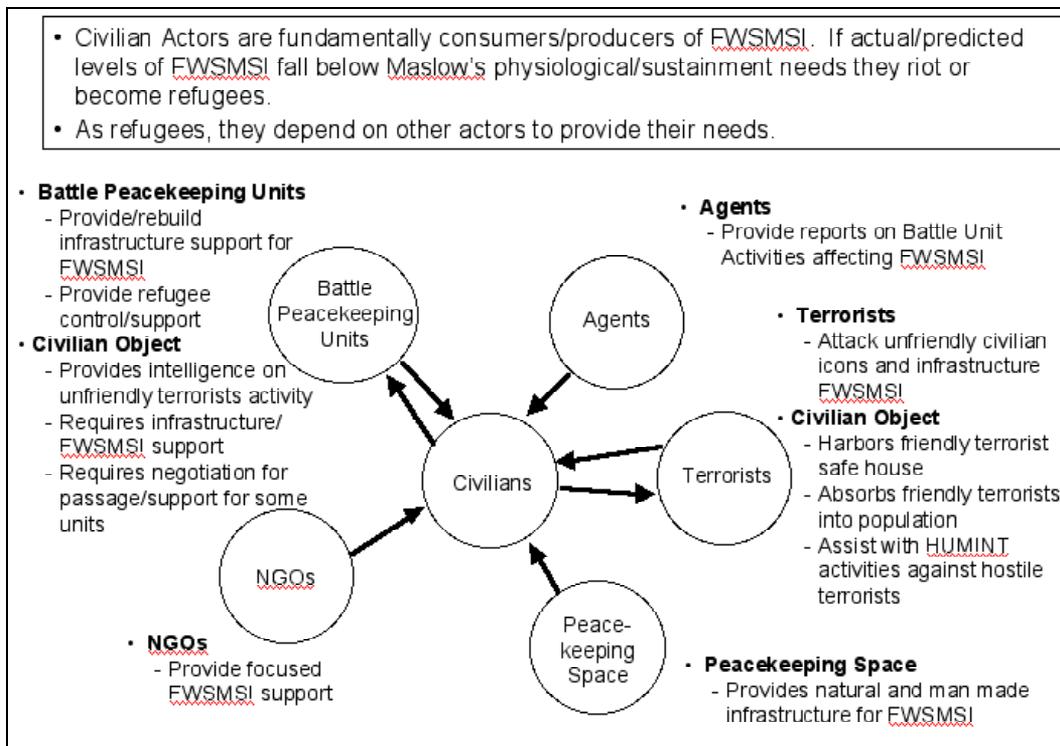


Figure 7: Primary Relationships of Civilian Actors to other AWARS Peacekeeping Actors

1. *Phase I:* Planning/coordination of the mission.
2. *Phase II:* Movement to mission area.
3. *Phase III:* The attack.
4. *Phase IV:* Disbanding into the civilian population.

The terrorist object will have dynamic properties in that it must be formed from a “terrorists home base object.” The terrorist home base objects may be placed anywhere within the AWARS terrain; however, they will normally be placed within a civilian population area. Once a terrorist event is about to begin, the terrorist object will be formed, move to mission objective, perform its mission and then move back to the nearest civilian object (or the terrorist home base object) where it will become “lost” or be assimilated into the civilian population. It should be noted that the terrorist object and the safe house object will present the necessary image intelligence (IMINT), communications intelligence (COMMINT), and electronic intelligence (ELINT) signatures consistent with the equipment and activities of their respective object. Terrorists will perform missions under one of the following categories:

- a. *Attack on infrastructure of the peacekeeping environment.* These infrastructure items include power plants, communications facilities, market places, cultural icons.
- b. *Attack on a BPKA.* This is normally in the form of an ambush.

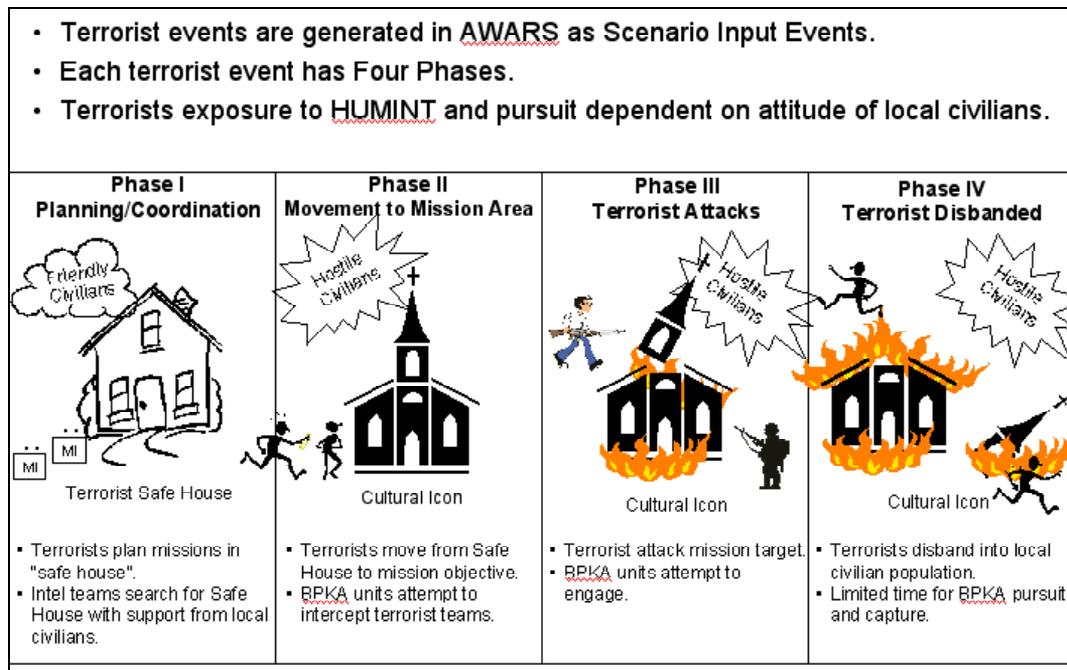


Figure 8: The Behavior Cycle of a Terrorist Actor.

- c. *Attack on one of the agent objects.* This represents an attack on NGO support staff.
- d. *Attack on civilians.* This represents an attack on a civilian group. It is a special attack in that the terrorists group will engage civilians without recourse by the target. Discussions of friendly response to terrorist objects moving to and from the civilian target are summarized in Figure 8
- Terrorist SITMAP. The terrorists will have a SITMAP representing the location of enemy and friendly forces and other peacekeeping objects. There will be no reference to the Maslow parameters in their SITMAP. Theirs will be a simple military mission with the ability to return to a predefined spot (either the safe house object or some other point) and disband.
  - Terrorist Relationship Attitude. In addition to the SITMAP, the terrorists and their safe house will have a relationship, attitude (see Table 2 for a description of relationship attitudes) to the civilian object within which they are geometrically located. This relationship attitude will help govern the human intelligence (HUMINT) signature of the terrorists group. Table 8 shows the data structure describing the time to determine probable safe house locations for HUMINT activities in a particular range of areas and the time to learn general missions types (attack infrastructure, attack BPKAs, attack agents, attack civilians). Once these localized missions are determined and assets have been deployed to monitor activities of the safe house, those AWARS objects within the localized area of the safe house will have an alert entry made on their SITMAP of probable terrorist attack. If the SITMAP of the defending unit registers a possible terrorists attack, then the standard direct fire engagement elements of line of sight, detection for targeting, etc., can be invoked for spotting the terrorists by intelligence observers friendly to the

target before the attack. The direct fire state (shown in Table 9) represents the maximum state achievable by those trying to defend the target. (The direct fire state is similar to those used in the direct fire portion of AWARS. Note, however, that ROEs for those defending the target also apply to governing their response). Table 9 also contains a section describing the number of minutes the terrorists group must remain intact before becoming an integral part of the general civilian population. In this case, the attitude is representative civilian object in the surrounding area where the attack occurred. The terrorists will be hidden in this group. Outside this period of time, other AWARS units can neither see nor engage the terrorist object.

<b>Relationships of Terrorist Base (Safe House) with Local Civilians</b>	<b>Time to Discover Presence of Safe House</b>	<b>Time to Pinpoint Location of Safe House</b>	<b>Time to Learn General Mission of Terrorist Group</b>
Hostile	24 hours	36 hours	48 hours
Uncooperative	36 hours	48 hours	72 hours
Neutral	36 hours	48 hours	72 hours
Sympathetic	48 hours	72 hours	144 hours
Friendly	72 hours	96 hours	168 hours

Table 8: Production Time of HUMINT Teams (Team is assumed to be three agents in 4x4 sq. km area).

<b>Defensive Firing State of Unit Against Terrorist Attack</b>						
<b>Time 2<sup>nd</sup> Echelon Superior Knows of Attack</b>	<b>Infrastructure Object</b>		<b>Battle Unit Actor</b>		<b>Agent Actor</b>	
	<b>With Civilian Object</b>	<b>With Military Group</b>	<b>With Civilian Object</b>	<b>In Military Compound</b>	<b>With Civilian Object</b>	<b>Exposed with Military Guard</b>
15 minutes +	Surprised	Organized	Organized	Focused	Surprised	Organized
5-15 minutes	Surprised	Surprised	Organized	Focused	Surprised	Organized
3-5 minutes	Surprised	Surprised	Organized	Organized	Surprised	Surprised
<3 minutes	Surprised	Surprised	Surprised	Surprised	Surprised	Surprised

<b>After Attack Time Terrorist Object Remains an Entity (Disband Time)</b>			
<b>Relationship of Absorbing (Local) Civilian Object to Terrorists</b>	<b>Mission Attack Type</b>		
	<b>Infrastructure</b>	<b>Battlement</b>	<b>Agent Object</b>
Hostile	10 minutes	10 minutes	10 minutes
Uncooperative	7 minutes	7 minutes	7 minutes
Neutral	5 minutes	5 minutes	5 minutes
Sympathetic	3 minutes	3 minutes	3 minutes
Friendly	2 minutes	2 minutes	2 minutes

Table 9: Exposure Database for Terrorist Target Before and After Attack.

- Impact: Once a terrorists group has made an attack, the impact will be both physical and perceptive on the target group. In particular, parameters of local objects for *security* will be significantly degraded to represent the

psychological impact of the terrorist attack. Further, if the target object is located in a civilian object or owned by that object (in the case of infrastructure attack) the *security* parameter for that group will also be degraded. The amount of degradation is shown in Table 10.

Mission Attack Type						
Relationship of Terrorist to Object Sustaining Attack	Infrastructure		Battlement		Agent Object	
	Within Civilian Object	Guarded	Within Civilian Object	In Military Compound	With Civilian Object	Exposed with Military Guard
Hostile	40%	60%	70%	80%	70%	80%
Uncooperative	40%	60%	70%	80%	70%	80%
Neutral	40%	60%	70%	80%	70%	80%
Sympathetic	30%	50%	30%	50%	50%	50%
Friendly	30%	50%	30%		50%	50%

Table 10: Percent of Degradation to Security Parameter of Group Suffering Terrorist Attack (Notional Data).

Figure 9 is a summary of the primary interfaces between the terrorist and other actors.

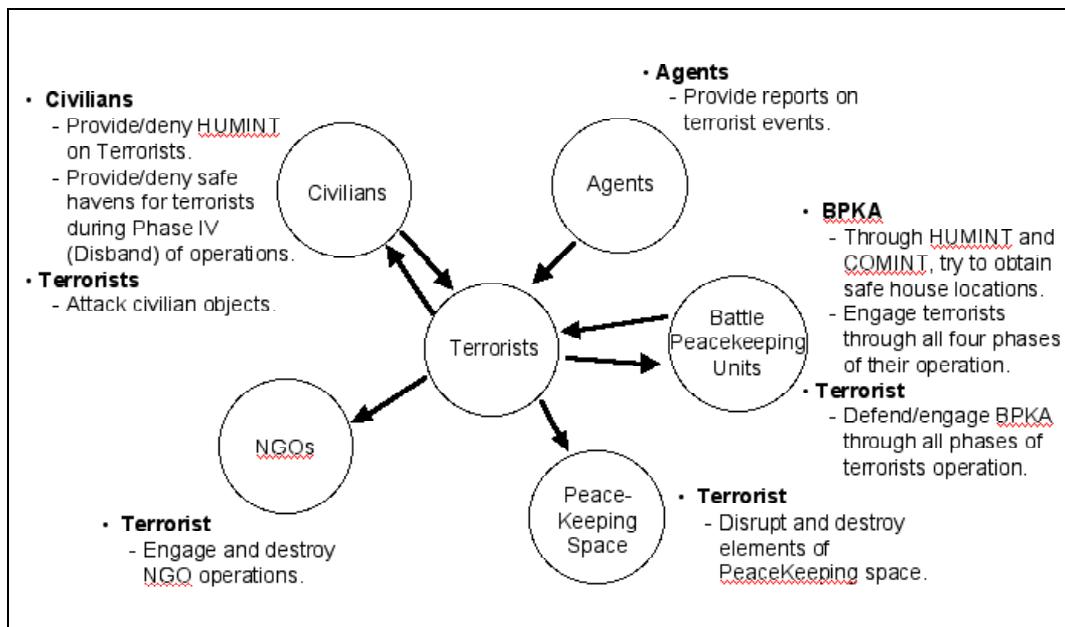


Figure 9: Primary Relationships of Terrorist to other AWARS Peacekeeping Actors.

### AGENT ACTOR OBJECTS

Agent objects are closely related to the *information* and *security* parameters of Maslow’s hierarchy. These objects primarily represent the news media. The objects have location (a point) and the number of news people at that particular location. These media actors “report” the current state of the peacekeeping effort. They produce message types (the media

situation assessment language (MSAL)) shown in Table 11. The six message types listed in Table 11 actually represent reports of the status and activities of other objects. Note that, in order for the media agent to report “ground truth” about an incident, the media object must be at the actual location of the event. If the object is not at the event location, it must take its information from the media SITMAP found at the headquarters of the battle object to which the agent object is attached.

Message Type	Location of Agent	Key Information Elements of Report	Affected MASLOW Parameters for Civilians
1. Report of Combat Mission by Battle Units	With Battle Unit or with HQ of Battle Unit	Losses of Friendly, Enemy, Civilians; Damage/Loss of Cultural Icons	Security, Information
2. Report of Attack by Other Terrorists or Battle Units on Infrastructure	Agent must have reached damaged site or HQ of Battle Unit responsible for protection of damaged site	% Damage to Site	Security, Information; MASLOW parameters affected by infrastructure
3. Report of Terrorist Activities	Agent must have reached terrorist engagement site or HQ of Battle Unit responsible for Protection of Damaged Site	Losses of Personnel	Security, Information
4. Report of Negotiation between Forces	At Negotiation Point of HQ of Battle Unit Responsible for Negotiation	Time of Negotiation, Type of Negotiation (Passage, Human Assistance, Escort Support, Supplies)	Security, Information MASLOW parameters affected by negotiation
5. Report of Civilian Unrest (Riot)	At Riot Point of Unit Responsible for Negotiation	Report of Riot or Refugee Movement	Security, Information
6. Report of Force Movement	With Forces Moving or at HQ Controlling Forces	Location of force, Projected final location of force, strength of force	Security, Information

Table 11: Media Situation Assessment Language (MSAL) Report Types.

Table 11 also contains the key information elements of the report and the affected Maslow parameters for civilians. Note that, at this point, mostly battle statistics are reported as well as the primary effect on the civilian objects and its impact on the *security* and *information* parameters. In cases where a loss of infrastructure is reported, the impact of this loss should be factored into the prediction of Maslow’s parameters of food, water, shelter, and safety predictions in the civilian SITMAP (see Table 5). Additionally, the media report affects the relationship of the civilian object receiving the report to the object, which is the subject of the report. These relationships (hostile, uncooperative, neutral, sympathetic, and friendly) affect negotiation and in the way civilians respond to terrorist objects.

- C2 of the agent objects. Agent objects are “commanded” by implication of their attachment. Most agents will be attached to one of the BPKAs. In this case, they may go only where the BPKA HQ allow; however, they also have

access to the information stored in the media SITMAP found at HQ of the BPKA to which they are attached. For attached agent objects, the BPKA must provide protection. The second group of agent objects will be “independent agents (IA).” In this case, the IAs are attached to none of the other units. They are free to roam about the battle space and can report anything that they observe. However, they have no access to a media SITMAPS (held by a BPKA) unless they negotiate for it (at this point the AWARS design may want to consider another type of negotiation — negotiation for information). Simply stated, “what they see is what they get to report on.”

- Agent activities. The agent objects will have a simple set of tasks: they will be told to move to a location (x,y) and “report.” Having reached (x,y), they will begin to file reports (of the types found in table 11) at regular intervals. Since the civilians are on a “three-cycle-per-day” series of assimilating these reports, the agents will report three times per day, in time for the media distribution of these reports. This structure assumes that all agents played in AWARS have access to the electronic broadcast media. Agents also maintain relationships in their database with other AWARS units and they use this database when in negotiation with other units for passage, support, and security.
- Agent vulnerabilities. Agents do not fight, they simply report. However, they can be engaged by any battle objects or terrorist objects. In this sense, the agent objects can be killed.
- Agents as consumers. Like the civilian population, the agents are consumers in the category of FWSMSI. Those agent objects attached to command battle units in AWARS will maintain a table describing their daily FWSMSI needs. Since agents will not “riot” as their civilian counterparts, the AWARS command groups will satisfy the needs of attached agents in first priority following the needs of their own soldiers. Hence, the attached agent object needs will be subtracted from the ability of the BPKA to produce support in the context of the FWSMSI for the civilian population. Independent agents will still be consumers, but their needs will be added into the general civilian population in which they are working.

Figure 10 gives a summary of the primary interfaces between agent and other actors.

#### FACILITATOR ACTOR

Facilitator objects represent NGOs such as the UN, Red Cross, and other humanitarian groups. These objects will have location and will be “attached” to different BPKA HQ in the AWARS game. This “attachment” does not imply a C2 capability; it simply implies a support responsibility by the AWARS commander of the BPKA unit.

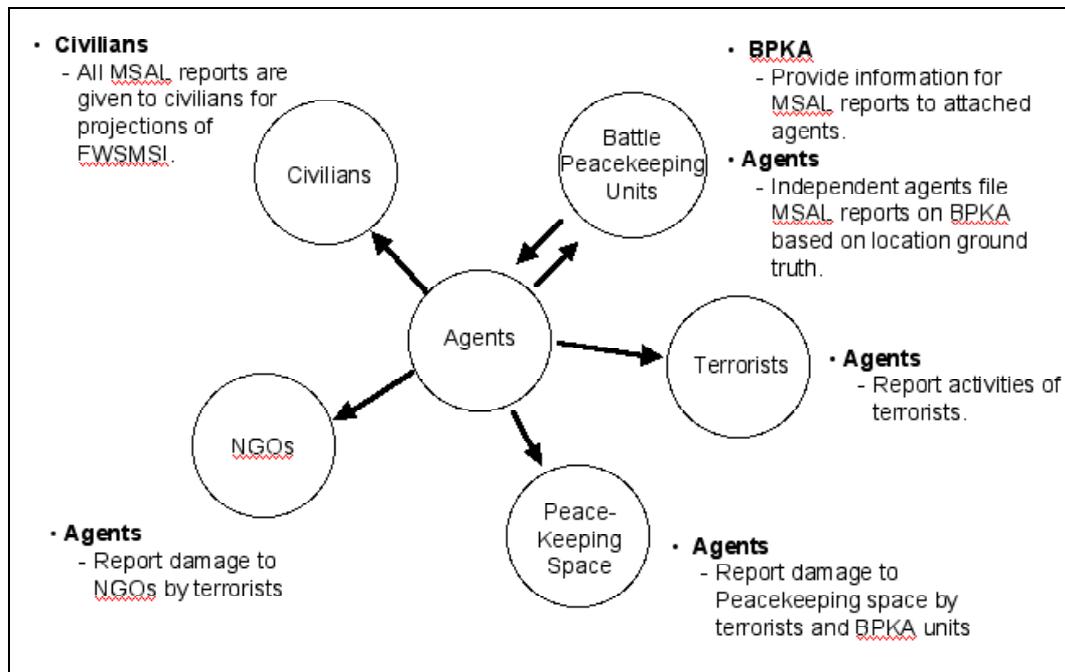


Figure 10: Primary Relationships of Agents to other AWARS Peacekeeping Actors.

- C2 of facilitator objects.** Like agent objects, facilitator objects are simply given a command to go a specific location and perform their function. There is no hierarchical command structure for the facilitators (no reporting; no assessing of their situation; no directing). Essentially, their presence at a particular place implies that they bring their support functions to that place. Their movement in the first development of the peacekeeping structure can be scripted as an event injected into the AWARS battle. Later, AWARS designers may wish to make the facilitator objects more reactive to the current need situation (much like a sensor that can be retasked to a different area of the battlefield).
- Facilitator activities.** The facilitators are relief organizations, hence they move to their predefined positions (x,y) and begin their activities. Each carries a data table describing their ability to provide the Maslovian needs (see Table 1 for an example). The facilitators also have a relationship with other units (see Table 2) and they can negotiate with other units for passage, support, and security.
- Facilitator vulnerabilities.** If facilitators have weapons, they will fight with appropriate ROE. While this will be rare, it should be possible for them to engage in a self-protective mode. They are, however, vulnerable to fires and some degradation of their capability to fulfill the Maslow parameters should be shown as they sustain attrition. This should be a linear effect of capability versus attrition (i.e., if half of the facilitators are killed, then half of their ability goes away). This can be refined once the AWARS code is finalized.
- Facilitators as consumers.** Like the civilian population, the facilitators are consumers in the category of FWSMSI. Those facilitator objects attached to command battle units in AWARS will maintain a table describing their daily

FWSMIS needs. Since facilitators will not “riot” as their civilian counterparts, the AWARS command groups will satisfy the needs of attached facilitators in first priority following the needs of their own soldiers and attached agent objects. Hence, the attached facilitator object needs will be subtracted from the ability of the BPKA to produce support in the context of the FWSMSI for the civilian population.

### THE AWARS PEACEKEEPING ENVIRONMENT

There are several additions that must be made to the AWARS battle environment so it can sufficiently represent the peacekeeping process. In particular, several static and dynamic objects must be added to the current AWARS battle environment. “Static objects” refer to those objects which must be added to the AWARS battle terrain environment. Currently, the AWARS battle terrain environment consists of two primary structures: a terrain network representing possible movement paths for the AWARS units and a tiled structure (overlying this network, representing both vegetation and line-of-sight parameters).

Objects that must be added to this environment are those representing the indigenous capability of the civilian population to sustain itself. These include objects representing agricultural and housing capacities. Other static objects include the man-made infrastructure for support (water production/delivery facilities, broadcast stations/communication towers, hospitals, villages/towns, power plants, and cultural icons). A second set of objects, “dynamic objects,” must also be added to the battle environment. The dynamic objects represent things that the AWARS battle commander may choose to build (or deal with as the result of actions of the opposing commander). They include temporary images of the static objects (food storage/ distribution point, water purification point, field hospitals, shelter) produced for relief activities. In some cases, facilitator objects can construct these dynamic objects. The dynamic objects also include refugee camps, terrorist’s safe houses, and checkpoints for negotiation. Table 12 provides a summary of these objects. It contains a short description of the interaction of a particular object with the AWARS peacekeeping actor objects and which highlights Maslovian parameters that the particular environmental object acts upon.

Each of the environmental objects (except terrorist’s safe houses and checkpoints for negotiation) have the same general characteristics. They all have a geographic position on the AWARS terrain and, in some sense, produce one or more of the Maslovian parameters (FWSMSI). In short, their production capability will be added to the FWSMSI totals on AWARS terrain tiles to support the civilian actors occupying these tiles. Each environmental object contains the attributes shown in Table 13. Note that all of the objects will have a location and a radius, which includes the primary facilities, represented by the object. Further, each of the objects will have a daily production rate of at least one parameter impacting the FWSMSI needs of civilians living within the influence of the object. For example, a water production object representing a water production facility will be located at some point (x,y) on the AWARS battlefield. The immediate grounds, holding tanks and buildings of the plant, will be located within the object radius. The “terrain squares affected by the object” represents those tiles on the AWARS terrain in which the production plant provides water. At the beginning of each 24-hour period in AWARS, the gallons of water produced by the plant will be uniformly divided among the squares and then added to the

Maslovian parameters for the civilian population located in those squares. In this sense, the plant will be servicing the civilians in its “AWARS square area” providing water to satisfy their needs.

Terrain Objects	Interaction with Peacekeeping Object	Interaction with MASLOW Parameters Affecting Civilian Objects
<i>Static Object</i>		
<b><i>I. Terrain features providing indigenous support for population</i></b>		
Agricultural support for 4x4 km sq	<ul style="list-style-type: none"> <li>• BPKA units can degrade capability</li> <li>• Terrorists can degrade capability</li> </ul>	Food: Basis for pounds of food per day produced by local population
Housing support for 4x4 km square	<ul style="list-style-type: none"> <li>• BPKA units can degrade/increase capability</li> <li>• Terrorists can degrade capability</li> </ul>	Shelter: Basis for housing units for 1,000 people. Impacts attitude of civilians toward destroyers/rebuilders
<b><i>II. Manmade infrastructure supporting population</i></b>		
Water production/delivery facilities (plants and resources)	<ul style="list-style-type: none"> <li>• BPKA units can degrade or increase</li> <li>• Terrorists can degrade</li> <li>• Agents can report</li> </ul>	Water: Basis for gallons of water per day
Broadcast stations/communications towers	<ul style="list-style-type: none"> <li>• BPKA can degrade or increase capacity</li> <li>• Terrorists can degrade capacity</li> <li>• Agents required for distribution of messages to civilian population</li> </ul>	Information: Basis of delivery of messages to civilian SITMAP
Hospitals	<ul style="list-style-type: none"> <li>• BPKA units can degrade or repair capability</li> <li>• Terrorists can degrade capability</li> <li>• Facilitators can utilize</li> </ul>	Medical: Basis for delivery of outpatient visits per day impacts attitude
Villages/towns (villages, food markets)	<ul style="list-style-type: none"> <li>• BPKA units can degrade or repair capability</li> <li>• Terrorists can degrade capability</li> <li>• Facilitators can utilize</li> </ul>	Food: Basis (with agriculture) of pounds of food per person per day impacts attitude
Power plants	<ul style="list-style-type: none"> <li>• BPKA can degrade or repair capability</li> <li>• Terrorists can degrade Capability</li> <li>• Facilitators can utilize</li> </ul>	Has indirect effect on water, medical, and information (see discussion on power plants)
Cultural icons	<ul style="list-style-type: none"> <li>• BPKA units can degrade</li> <li>• Terrorists can degrade</li> <li>• Facilitators can utilize</li> </ul>	No effect on Maslow parameters but major effects on attitude (see discussion on cultural icons)
<b><i>III. Dynamic objects related to battle/sustainment activities</i></b>		
Food storage/distribution point, water purification point, field hospital, shelter	<ul style="list-style-type: none"> <li>• BPKA units can construct or damage</li> <li>• Terrorists can damage</li> <li>• Agents can report status</li> <li>• Facilitators can construct</li> </ul>	Food, water, medical, and housing. Adjunct for all these parameters to indigenous capacity available; all affect attitude
Refugee camps	<ul style="list-style-type: none"> <li>• BPKA units can construct or damage</li> <li>• Terrorists can damage</li> <li>• Agents can report</li> <li>• Facilitators can construct</li> </ul>	Becomes basis for new source of food, water, medical to population
Terrorist safe houses	<ul style="list-style-type: none"> <li>• BPKA units can find and destroy</li> <li>• Terrorists requirement as basis for launch of activities</li> </ul>	None but impact on attitude
Checkpoints for negotiation	<ul style="list-style-type: none"> <li>• BPKA units stopped at checkpoints</li> </ul>	None

Table 12: Environmental Objects for AWARS Peacekeeping.

Attribute	Description
Location (X,Y)	The location (X,Y) of the center of mass of the object
Radius (meters)	The radius of a circular area covered by the object. This circle encompasses the primary facilities (buildings, stations) of the object when attacked by direct or indirect fire. It will be assumed that systems supporting object functionality are uniformly distributed throughout the circle.
Personnel	Number of personnel associated with the object.
Terrain squares affected by the object	Integer X: Number of terrain squares $\pm$ from location affected by the object. Integer Y: Number of terrain squares $\pm$ from location affected by the object.
Production capability	- Pounds of food per day produced/distributed across terrain area - Gallons of water per day produced/distributed across terrain area - Security: no element entry - Medical: Outpatient visits per day available to area affected. Hospital bed days available per day for affected area. - Shelter: Temporary housing units available per day. Permanent housing units available per day. - Information: Broadcast hours per day available to area affected.
Percent damage to facility	Current percent of damage to the facility. Currently applied linearly to the capability.
Residual capability	Percent capability after full destruction <sup>4</sup>
Self repair capability	Percent capability to reconstruct on a daily basis.

Table 13: Common Attributes of AWARS Peacekeeping Environmental Objects.

The “Percent damage to facility” for each object actually represents the percent degradation to the facilities production capability, given that it has been under attack. This factor will be applied linearly to the production capacity for each 24-hour time step. The “Residual capability” represents the level at which a facility can still provide support even when it is “destroyed.” No matter how heavy the damage, this represents the lowest level to which support can sink. Finally the “Self repair capability” represents the daily efforts of those who work at the facility to repair it. At the beginning of each 24-hour timestep, this percentage will be subtracted from the “Percent damage to facility” to represent the repair. The following paragraphs provide more details on each of the terrain objects.

- a. *Agriculture support.* This object is overlaid on the 4km square tiles. Its production capacity variable contains the “tons of food produced per day.” The primary degradation of an agricultural source will be military activity. For the present, the following rule set will be used: if a military unit moves through an agriculture area (off a main road), it will be assumed that production in the area covered by the movement of the unit through the area is degraded by 50%. If a battle occurs in the area, it will be assumed that the area covered by the both forces engaged in battle loses 100% production capability. In short, any 4km tile occupied by forces as they move through or fight in an agriculture area will lose 50% - 100% production. Because of growing season times and the relative short length of AWARS scenarios

<sup>4</sup> (See definition of Residual Capability – DIAMOND Volume 1: Entities, Terrain Environment and Facilities p28).

(months versus days), a damaged agriculture area will have no regeneration capability. As a first cut, it will be assumed that food produced in the agriculture area is distributed to the “AWARS square area.” Later, if a more complex structure is desired, a link between the agricultural area and food distribution objects (villages/towns) could be made before the Maslovian parameter is increased. For immediate purposes, it will be assumed that once the raw agricultural food is produced, it is processed and distributed.

- b. *Housing support.* This object is overlaid on the areas of 4km tiles holding civilian population. Its production capacity variable contains “housing units holding four civilians.” The houses are considered to be uniformly distributed throughout the circular area of the object, even though they influence the tiled area. Under artillery shelling, the standard lethal areas against stone or wood structures will be used (a possible data source is the Joint Munitions Effective Manuals (JMEM). Again, the affect of fighting in an area will be assumed to make the houses uninhabitable. This does not necessarily mean that the houses have been destroyed, rather, that no one can utilize houses in a free-fire zone. Direct fire battles mean that the area covered by the fighting forces is 100% lost to housing. It should also be noted that housing is one of those objects that should be tied to the attitude of the local populous. It will be assumed that destruction of housing by a force lowers the attitude (see Table 2) by one level and that building housing raises the attitude by one level. [*The relationship of attitude as positive in the creation of civilian support infrastructure and the degradation of attitude with destruction is pure supposition on the author’s part. This must be verified before completion of this architecture.*]
- c. *Water production /delivery facility.* This object has a small localized radius and a large affected terrain squares representing the water purification and distribution system. The production capacity variable is in 1,000 gallons per day. In this case, terrorists or military units can attack the water purification plant.
- d. *Broadcast stations/communication towers.* This object also has a small localized radius and a large affected terrain squares representing the broadcast station and tower (or simply a principal tower) and those squares in which civilians can receive information from this transmitter. The production capacity variable is in broadcast hours per day. Each broadcast tower will contain a linked list of agent objects. It is through this relationship that the media messages (see Table 11) can be distributed to the civilians. (Remember that civilian objects are assumed to listen to broadcast media three times a day; if the production capacity of the broadcast stations have four or more hours of time a day, it will be assumed that the messages are received by the civilian populations.) Anything less than four hours degrades the number of message linearly. If the broadcast media is destroyed, then the impact of no information on civilians will begin to affect their ability to project the Maslow parameters (see table 5) – if no broadcasts for 48 hours, Maslow parameters for 72 move to 24 hour projections.

- e. *Hospitals*. This object also has a small, localized radius and a large affected terrain squares, representing the hospital building and the area served by the hospital. The production capacity variable of the hospital holds two values: out-patient visits per day and hospital beds per day. If the hospital complex is attacked by artillery, the JMEMs data will again be used. [*The authors must verify the existence of this data. For immediate purposes, however, the capability of the hospital will be degraded linearly with the loss of the facilities under attack. As an aside, a hospital might be captured, causing its affected terrain area to change allegiance to a particular civilian and military group.*]
- f. *Villages/towns*. These can be thought of as command objects for other terrain peacekeeping objects. In short, villages and towns will have pointers to agricultural, housing, water, hospitals, power plants, cultural icons, and civilian population objects that comprise the village or town. At this point, the location of the (x,y) point of the village or town represents the location of the controlling group in that village or town. It is from this group that negotiations must be conducted for passage, support, or assistance. The localized radius represents the controlling facility of the village or town -- be it a city hall or a military complex. Finally, the radius or affected area tiles represents those over which the village or town has control.
- g. *Power plants*. These are support structures for the water, hospital, and communications modules. Power plants have an (x,y) location and a radius for the primary equipment. However, rather than a list of affected terrain squares they have instead a list of water, hospital, and communications objects they support. Power plants can be attrited or captured by terrorists or enemy BPKAs. If they are attacked, the JMEMs approach will be used and the percent loss of the power plant will represent a similar percent lost of the capability in each of the supported objects. The supported objects will lose only down to their residual percent, assuming that they have some localized power sources.
- h. *Cultural icons*. Cultural icons have a location but no affected terrain squares. Instead, they have pointers to the civilian objects they support. Cultural icons can be captured or destroyed. They represent strong religious or national identity symbols and, when lost to their supported population, the attitude of these civilian objects changes toward both the object destroying the icon and the object charged with protecting it. Specifically, the destructor object is branded "hostile" by these civilians and those protecting objects are branded "neutral" by the owners of the icon.
- i. *The dynamic objects related to battle/sustainment activities*. These have same characteristics as their static equivalent. However, as each of these is created for a particular population, the attitude of the population object changes.
- j. *Refugee camps*. These camps have a location and area; however, they do not have a set of affected terrain squares. The camps have a creation capability in all of the Maslovian parameters. If the camps are attacked, these capabilities will be degraded and will allow the refugees to move toward an unstable state.

Since refugee camps have a target population, a “crowded population target” beyond this level will result in instability.

#### THE AWARS PEACEKEEPING TIMING AND UPDATE ENVIRONMENT

The following paragraphs represent some first thoughts on how integrating these objects into the AWARS timing environment may be accomplished. As with any simulation, the key is to update the object state at a time rate, which represents the granularity of the object processes and the granularity of the processes of other objects interacting with a particular object. The objects fall essentially into three categories:

1. Objects that respond to their situation on almost a daily basis;
2. Objects that respond four to five times throughout the day; and
3. Objects (like the AWARS battle unit objects) that respond on a minute-by-minute (or event-by-event) basis.

Table 14 shows some update cycles for these three object categories. The idea behind the AWARS peacekeeping model is one of measuring the Army force structure’s ability to sustain the peace in the context of damaged infrastructure, belligerent forces, and terrorist activities. Since, for the purposes of this simulation, sustainment of the peace translates to protection and support of the civilian objects, focus should be on the update cycle for the civilian. Table 14 shows that this cycle should run 12 to 24 hours (12 seems a bit short, 24 seems a bit long). It is posited that once people decide to move into refugee status, it takes approximately a day before the effects of this decision are really noticed in the corps/division area. The status of the civilian infrastructure should be updated once every 12-24 hours to reflect this scenario (see I steps 1-4 in Table 14). This is actually retroactive in nature. It represents the ability of the infrastructure to repair itself in a day and the support added to it by other objects (BPKA, agent and facilitator objects). In short, it represents 24 hours of “work done” on the infrastructure. However, if a terrorist or a military unit attacks on one of the infrastructure objects has occurred within the last 24-hour time-step, it should not be upgraded. There should be at least a one-day waiting period for the self-repair to occur.

Having updated the infrastructure object’s capability, Table 14 then describes steps to represent the amounts of FWSMSI delivered to the civilian objects (see I step 5 in Table 14). Again, this should be done at the same timestep moment as the infrastructure upgrades. These steps are actually predictive in nature. In essence, they are saying the AWARS will simulate that the infrastructure will operate in its current condition over the next 24 hours. Category I is completed in Table 14 with three steps (6, 7, and 8) that update the status of the civilian objects in terms of their desire to become refugees and their attitude toward all other groups.

Category II in Table 14 represents those updates that occur throughout the day. First, the messages sent to each of the civilian objects for their 24-hour updates are processed. It may be necessary to process these messages more often than the 24-hour cycle because battle action throughout the period could destroy the communication towers. Further, the press objects will be reporting on battle progress making it a more dynamic process than 24 hours would provide. Consequently, at the end of each 6-hour interval, press reports will be queued up for later processing of impact on the civilian population. Also, in the second category, the

6-hour updates of the locations of agent (press) and facilitator actors are included. While the movement and facility setup of the facilitator actors could be done once a day, it should be noted that some of the agents must be co-located with the battle units on which they are reporting. Hence, their movement with these units must be updated more than once a day. If they are not co-located, then they can only send reports from the controlled information SITMAP that is located at the military HQ to which they are attached. Consequently, the functionality to move about the battlefield (in 6-hour updates) is required but not at the finer granularity of battle unit movement. Category II also includes the update of the location of refugees. Again, minute-by-minute granularity is not needed. However, the location of the refugees can form an impediment to the movement of Army forces and the commander as he tries to orient units about the battlefield. Hence, the refugee objects should be moved in 6-hour periods.

<i>I.</i>	Update status on 12- to 24-hour cycle for the following:
	1. Production status for road, water, security, medical for environmental objects (agriculture, housing, water production, broadcast stations, hospitals, powerplants, cultural icons).
	2. Add support from each environmental infrastructure object to FWSM of civilian objects SITMAP (see figure 4b)
	3. Determine medial agent messages arriving at each civilian objects (see figure 10 for message types)
	4. Determine number of violent deaths per 1,000 for last timestep.
	5. Add support to FWSMSI from AWARS BPKA and NGO actors to appropriate civilian actors.
	6. Based on information, create current and predicted levels of FWSMSI for civilian object SITMAP (see figure 4b).
	7. Update attitude of civilian objects to other AWARS BPKA terrorists and NGO objects.
	8. Create groups of refugees and place them on roads for displacement.
<i>II.</i>	Update status at 6-hour intervals:
	1. Update the number of messages sent to particular civilian objects by the media.
	2. Update location of agent and facilitator actors.
	3. Location of refugee objects.
<i>III.</i>	Update status at <15-minute interval:
	1. Status of BPK's knowledge of terrorist locations.
	2. Locations and activities of terrorist groups.
	3. Negotiation processes.

*Table 14:* Update Cycles for AWARS Peacekeeping Objects.

Category III in Table 14 represents those updates that should be factored in at the same update rate as the regular battle units in AWARS. There is some latitude in the time factor because of current uncertainty regarding the granularity of the AWARS battle unit. However, terrorists would be viewed as any other battle unit in terms of trying to find and engage them as they perform their mission.

## SUMMARY

This paper has described a conceptual architecture for simulating activities of a task-level force in a peace sustainment operation. The architecture has been focused on the Advanced

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Warfightings Simulation (AWARS) being developed by the TRADOC Analysis Center. AWARS is being developed to replace the Vector-in-Commander (VIC) and Eagle models. A conceptual basis for this architecture is the DIAMOND model (a theater-level peace sustainment model) developed by the United Kingdom Ministry of Defence. It should be noted that the AWARS architecture is a work in progress and that all of the databases presented in this document are notional. The authors are currently performing the research necessary to identify credible sources for these databases and credible algorithms to map civilian population behaviors to the Maslow states and the availability of FWSMSI. This effort is expected to be completed by the end of the second quarter of fiscal year 2002.

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