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UNITED STATES AIR FORCE RESEARCH LABORATORY

SECURITY FORCES DISTRIBUTED MISSION TRAINING TECHNOLOGY DEVELOPMENT

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PREFACE

This technical paper documents a presentation at the Fall 2000 Simulation Interoperability Workshop (SIW), which was held in Orlando FL, 18-22 September 2000. The research was performed for the Air Force Research Laboratory, Human Effectiveness Directorate, Warfighter Training Research Division (AFRL/HEA) under subcontract to USAF Contract No. F41624-97-D-5000, and Work Unit 4924-B2-06, Distributed Mission Training for Force Protection. The Laboratory Contract Monitor was Dr Joseph L. Weeks, AFRL/HEA.

Security Forces Distributed Mission Training Technology Development

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ABSTRACT: *The global strategic environment and national security strategy demand that the United States military be ready for engagements in major theater wars (MTWs) and small-scale contingencies (SSCs). MTWs are wars such as Desert Shield and Desert Storm. SSCs are a diverse collection of military activities below the level of MTW. In support of national security strategy, the USAF has adopted an expeditionary aerospace force concept for providing light, lean and lethal force packages consisting of combat and combat support elements tailored for specific global commitments. Challenging training requirements are implied by this concept. It requires geographically-separated, combat and combat support elements to rapidly merge at deployment sites and function as cohesive teams. Due to limited funding, there is little opportunity for combat support elements, like security forces, to train together as teams prior to deployment. The combination of limited training funds and the AEF concept implies a need for a distributed training system for security forces. In addition, current security forces training is largely aimed at supporting MTWs. Additional training is needed to prepare for the diverse collection of activities associated with SSCs. The goal of the Security Force Distributed Mission Training (SecForDMT) project is to conduct research and development of distributed mission training and advanced distributed learning technologies for application to security forces sustainment training in leadership and decision-making skills associated with SSC engagements. Development of these technologies will require extensions to the current DIS/HLA standards.*

1. Statement of the Problem

The global strategic environment and national security strategy demand that the U.S. military be ready for engagements in major theater wars (MTWs) and small-scale contingencies (SSCs). MTWs are wars like Desert Shield/Storm. SSCs are a diverse collection of military activities below the level of MTWs which include disaster relief, humanitarian assistance, search and rescue, peace operations, arms control, military support of civil authorities, strikes, raids, enforcement of sanctions, counterdrug operations, foreign internal defense, support to insurgencies, evacuation of noncombatants and hostage rescue [1].

Like other U.S. military services, the US Air Force is increasingly being called on to take part in Small Scale Contingencies (SSCs), previously known as Operations Other Than War. These missions require USAF Security Forces to protect air base assets and personnel while complying with restrictive SSC Rules of Engagement (ROEs), focused on "countering the threat

with minimal force." Typically for SSCs, there is a greater sensitivity to casualties as compared to MTWs. SSCs may come to resemble police work, requiring that those involved receive specialized training [1]. Air Force Security Forces are currently trained for active defensive operations in MTW conditions. Since MTW training assumes a large-scale conflict with few noncombatants in the area of operations, security forces personnel need more training in the decision making process associated with judgmental use of force in support of restrictive ROEs. Compounding this problem is the fact that in an expeditionary deployment, the Security Forces at the expeditionary air base will come from multiple locations and will receive limited opportunities to train as a team before deployment.

1.1 SSC ROEs

Estilow lists 28 SSC missions taken from various doctrine documents [2]. He then categorizes these missions based on risk of engaging in combat during each mission. He submits that the highest risk of mission failure is in the moderate-risk-of-combat missions (which includes Peace Operations) because "they present a politically alluring but dangerous mix of peaceful intent with volatile environment. These missions are most susceptible to an ends-mean dysfunction". The authors of this paper submit that the reason for the low risk of failure in high-risk-of-combat missions is because these missions are most similar to the MTW training they have received and the measures of success are more military than political. In moderate-risk-of-combat missions, success is defined in more political terms and USAF security forces have limited opportunities for training for these types of missions. Consequently, SecForDMT concentrates on moderate-risk-of-combat SSC missions.

1.2 AEF Deployment

In support of national security strategy, the USAF has adopted an expeditionary aerospace force (AEF) concept for providing light, lean and lethal force packages consisting of combat and combat support elements tailored for specific global commitments. Plans for AEF deployment call for the creation of air expeditionary wings (AEWs) consisting of combat and combat support elements. These AEWs will be on alert to respond quickly to contingencies as tasked by the Joint Chiefs of Staff. Elements of AEWs would be created from forces located at geographically-separated locations. Once notified of a mission, these disparate combat and combat support units would deploy to a contingency site with minimal time available for training as a unit.

1.3 Limited Training Opportunities

One of the critical combat support elements is security forces. Air Force security forces (previously known as security police) represent the second largest career field in the Air Force. Consequently, the cost of frequently transporting large numbers of security force personnel to regional training centers for team training is prohibitive. Current Air Force policy calls for training at regional training centers once every three years. Resources for conducting this type of training at home stations are quite limited. Shlapak and Vick of RAND [3] state: "If the Security Police are going to conduct small-unit operations off-base, they will need additional infantry training. During our visits to Security Police field locations, air-base-defense specialists repeatedly told us that they simply do not get to practice their craft often enough."

To further investigate security forces training needs, interviews were conducted with subject matter experts. Analyses of interview and questionnaire results indicated that the conduct of SSC and MTW missions are quite similar but the major difference is in the decision-making process required to follow ROEs in SSCs. Subject matter experts interviewed confirmed the hypothesis that security forces personnel are trained for MTW tasks and then deployed to SSC missions. Security Forces personnel trained to use weapons for MTW would be able to use these weapons effectively in SSCs. The key difference between SSC and MTW environment is in the decision-making process required to follow restrictive ROEs. Security Forces need training on when to use lethal or less-than-lethal weapons to counter hostilities with minimal force. Too much force could lead to the killing of host nation citizens or other collateral damage and becoming a lead news story. Too little force could lead to killing of air base personnel or loss of critical assets and becoming a lead news story. Both of these results lead to reduced support for the mission by the American people.

1.4 Need for Teamwork Skills Training

Table 1 contains skills listed in order from slowest to fastest degradation rate [4]. The five skills with the fastest degradation rate are those required for effective decision-making and teamwork. What the Air Force needs is an affordable tool for conducting decision-making and teamwork skills training three-to-four times per year as opposed to once every three years. This is the target of the training system being developed on this project.

Table 1
Skills Listed in Order of Degradation Rate

Attitude Learning (slowest degradation)
Gross Motor Skills
Steering/Guiding
Detecting
Making Decisions
Recalling Bodies of Knowledge
Situational Awareness
Recalling Procedures
Voice Communications for
Coordination (fastest degradation)

2. Approach

The Air Force Research Laboratory in combination with McDonald Research Associates has initiated an effort to research and develop technologies for an innovative and cost effective distributed training system to support USAF Security Forces missions in SSCs. The system will utilize distributed mission training and advanced distributed learning technologies to train security forces in leadership, decision making and teamwork prior to deployment. The name chosen for this advanced technology development project is Security Forces Distributed Mission Training (SecForDMT).

2.1 Data Collection

This effort began with an extensive literature search, beginning with doctrine documents from the Joint Chiefs of Staff and SSC doctrine from the services. Since the Army had devoted more senior personnel time and effort to SSC concepts, the majority of documents came from the Army War College. These documents emphasized the fact that the measures of success in SSCs are more political while measures of success in MTW is primarily tactical.

The authors obtained a list of Air Force Security Forces personnel critical tasks and administered questionnaires to subject matter experts at Air Combat Command Security Forces Headquarters, Air Force Security Forces Academy and Silver Flag Alpha regional Security Forces Center. As stated above, the subject matter experts confirmed the hypothesis that Air Force Security Forces receive little training in SSC tactical decision-making. These experts also emphasized that in SSCs, Air Force Security Forces must work well with Joint Forces, Non-Governmental Organizations (NGOs), and Host Nation Officials. And above all, they must recognize the rights and perceptions of host nation citizens.

2.2 Requirements

2.2.1 Tasks for Training

After completion of the literature search and interviews, a decision was made to concentrate on the following perishable skills in Table 2. These types of tasks are conducted by Squad Leaders and above. Since home station bases have firing ranges and marksmanship trainers to maintain trigger pulling skills of fire team members, marksmanship was eliminated as a learning objective for system design input.

Table 2
Skills to Be Emphasized in SecForDMT

Voice Communication Among
- Flight Leader
- Flight Sergeant
- Radio Telephone Operators
- Squad Leaders

Maintaining Situational Awareness
- Host Nation Citizens
- Threat Forces
- Blue Forces

Decision Making for SSC ROEs
Recalling and Applying Procedures
Mission Planning
Coordination With
- Other Security Forces
- Joint Forces
- NGOs
- Host Nation Officials

2.2.2 Affordability and Accessibility

Since the training system must support a large number of participants, it is imperative that each training station be affordable. Table 3 contains a list of the number of training stations required to simulate an air base defense force from the squad leaders up to the Ground Defense Force Commander and staff. In addition, SecForDMT must be accessible to security forces personnel with little impact on other training assets such as the distributed mission trainers used by pilots.

2.2.3 Fidelity and Instructional Support

If this training system were a video game, it would be classified as a Real Time Strategy Game as opposed to a First Person Shooter. Consequently, there is no need for a high fidelity display of targets for a shoot, don't shoot decision. These decisions are typically made by fire teams, who will be simulated. In the real world,

Table 3
Air Base Defense Training Stations

Function	No. Of Training Stations
Headquarters	3
Squadrons	6
Flights	36
Heavy Weapons	3
Military Working Dog Teams	4
Role Players	5

the opposing force (OPFOR) is generally detected by fire team members, and squad leaders can only see a limited number of the OPFOR from their location. Consequently, the simulation will provide squad leaders with limited views of the OPFOR based on the simulated eye point from the fighting position currently occupied by the squad leader.

The training system could be operated by instructors at the regional training centers. Since this will be only a part time duty, the system must be easy to learn and simple to operate. The system will be designed to be operated by one or two instructors depending on size of exercise. An instructor will be responsible for commanding the exercise (e.g., start, pause, stop) and controlling computer generated forces (CGFs). The controller interface will consist of a Plan View Display that will depict the locations of OPFOR, BLUFOR and non-combatant CGFs. In the majority of cases, instructors will select pre-stored scenarios designed to support various instructional objectives. The capability to control CGFs at a more detailed level will be provided for cases in which available scenarios do not support new instructional objectives.

An instructor will be responsible for monitoring trainee decisions and operating automated training feedback systems. The instructor will have the same interface as the exercise controller to view entity locations and movement and to listen to communications occurring during a training exercise. The instructor will be responsible for monitoring actions and communications that reflect trainee decisions and to record trainee responses during the training exercise. Data logger and audio recordings of what happens will be the basis of trainee feedback. The instructor will have access to various automated functions to capture data logger and audio files to persistent data storage. These functions include time marking beginning and ending points of the exercise segments for replay during after action reviews. These replays will consist of the movement of entity icons on the plan view display and stealth and synchronized audio files which capture communications between squad leaders, RTOs and flight leader. Automated feedback functions will also include snap shots of two- dimensional and three-dimensional views available to squad leaders, maneuver history of combatants and perception snap shots of the flight leader's view of OPFOR and BLUFOR positions.

2.2.4 Distributed to Home Station

Because a primary goal of SecForDMT is to minimize the cost of transporting personnel to regional training centers, the system must be designed such that trainees can remain at their home installation and participate in team training exercises with personnel located at other installations.

2.2.5 Standards

The Air Force has already developed a number of simulations for distributed mission training and SecForDMT must be designed such that these simulations (e.g. Close Air Support) can plug and play as needed. Consequently, SecForDMT will be DIS/HLA compliant.

2.2.6 Classified Exercises

At first, it was assumed that SecForDMT exercises would be classified. This has tremendous implications in terms of training system accessibility and bandwidth limitations. After some discussion with subject matter experts, it was decided that training exercises that used generic terrain data bases and did not replicate the actual terrain of the planned deployment site, would not be classified. This decision had a favorable impact on projected system affordability and accessibility

2.3 Technology Options

2.3.1 T-1 vs. Internet

One of the highest priority design requirements is affordability. These exercises will not be conducted on a continual basis and a T-1 line would be hard to justify. Air Force security forces have ready access to the Internet, and are experienced in the use of internet browsers and email. Security Forces personnel are taught to minimize transmission time through the use of brevity codes. Initial indications are that these brief communications can be transmitted using DIS/HLA protocols within the bandwidth of a normal internet connection. Since the stealth display will only have to provide a limited view of the OPFOR, entity state

information requirements should be within the capabilities of an internet connection. The Internet was chosen as the most affordable approach for connecting geographically separated SecForDMT training stations and instructors.

2.3.2 Host Computers

The target system will be a Pentium III or equivalent with limited upgrades in memory, image generator cards and communications capacity.

2.3.3 Computer Generated Forces

As stated above, fire teams, will be simulated in SecForDMT. There are a number of alternative computer generated forces (CGFs) available for fulfilling this task. The primary considerations are that the CGFs provide valid simulations of fire team behaviors and that they be easy for instructors and squad leaders to operate. The authors evaluated the strengths and weaknesses of JCATS, ITEMS, ModSAF and VR-Forces. JCATS simulates individual combatants but has evolved from Janus, which is optimized for platoons and above. The National Research Council report on Modeling Human and Organizational Behavior states that "Currently, no human behavior representation is included [in JCATS], and all tactics and play are specified by the human players"[5]. It was decided that JCATS would require too much detailed control and require too many instructors to produce valid simulated behavior. ITEMS does not currently model individual combatants and a decision was made that creating this capability would require too many project resources. ModSAF was originally designed for training rather than analytical applications and the DISAF variant supports simulation of individual combatants. These computer generated entities can execute a number of rudimentary commands and fairly complex behaviors can be developed by the use of scripts. A drawback to ModSAF is that it has evolved over a number of years and the code is complex and difficult to understand. The CGF community is evolving toward the development of OneSAF which will base much of its functionality on ModSAF. Once ModSAF evolves to OneSAF, it will be an extremely powerful tool for this application. However, a decision was made that OneSAF would not be mature enough to fulfill the goals of SecForDMT over the next three years. In addition, DISAF source code is not available, so project personnel would be unable to create the required behaviors such as challenge and surrender. VR-Forces is a newly developed Commercially available CGF tool similar to ModSAF. It does not currently have dismounted infantry behavior implemented, but does have a convenient application programmer interface for creating these behaviors along with simplified user interfaces. Since this tool comes with support from its developer, the project staff decided it could create the desired behaviors and interfaces more quickly and easily with VR-Forces than with other CGF tools. A decision was made to use VR-Forces on SecForDMT in order to meet the project goals of demonstrating initial capabilities at the end of the first year.

3.0 Development Plans

SecForDMT is a four year program. The first year was devoted to developing project requirements. Detailed system design and development will begin in FY2001.

3.1 SecForDMT Concept

Distributed mission training and advanced learning technologies can be applied to fulfill the training requirements discussed above. Figure 1 shows the personnel in a standard security forces flight. Figure 2 illustrates our proposed training system technology test bed. The system is designed as a learning environment for leadership and decision-making (squad leader to flight leader) as opposed to trigger pulling. Friendly fire teams, OPFOR and non-combatants will be modeled in the computer. The flight leader and flight sergeant will communicate with the squad leaders via simulated tactical radio/telephone messages over the Internet. If desired, additional layers may be added up to the base defense operations center (BDOC).

When the instructor selects an exercise, the trainees would be notified to review the matching Operations Order (OPORD) on the screen or print out the MS Word document. The flight leader would prepare an OPORD for squad leaders or use the pre-stored version. The OPORD would contain squad missions, intelligence and ROEs. Squad leaders would then use simple menu entries to select fire team personnel, assign weapons and sensors to them and place fire teams in battle positions. Squad leaders would use menu commands to set ROE in keeping with the OPORD.

Originally, the researchers assumed that the defense planning process would be done quickly so trainees could quickly move to decision making problems within the scenario execution phase. However, subject matter experts were very strong in their beliefs that the site defense planning process consisting of allocating resources, selecting fighting positions and placing personnel and weapons in optimum positions was

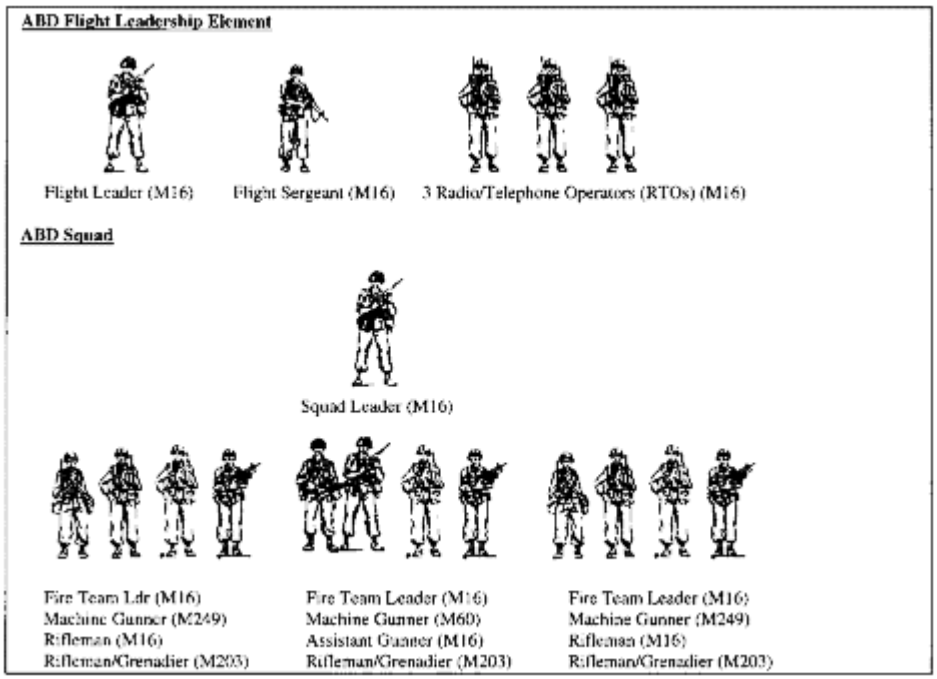

Figure 1
Security Forces Flight

where security forces flight leadership had the greatest impact. Consequently, considerable effort will be expended in developing technology that allows flight leaders, flight sergeants and squad leaders to make decisions associated with site defense planning.

Once defense planning is completed, the instructor would start the exercise and simulated OPFOR would begin penetration of air base defenses. In some scenarios, there would be host nation citizens entering the base as vendors or in the line of fire. Simulated fire teams would begin to detect OPFOR CGFs and send Situation Reports (SITREPS) to the squad leaders' screens. Depending on ROE, simulated fire teams may engage the OPFOR with lethal or less-than-lethal weapons. Squad leaders would send SITREPS to the flight leader via voice communications. The flight leader would report to higher echelons and possibly issue Fragmentary Orders (FRAGOS) that modify some parts of the original OPORD. Squad leaders would implement the FRAGO by directing fireteam CGFs. OPORDS, SITREPS and FRAGOS would be transmitted by selecting the appropriate message from the standard signal operating instructions.

The Air Force has developed a portable electronic intrusion detection system known as the Tactical Automated Security System (TASS). TASS includes infrared and microwave sensors in addition to typical magnetic, seismic and trip wire sensors. Sensors can be placed in likely avenues of approach and the TASS system will alarm when an intruder is detected. SecForDMT will simulate elements of the TASS system. In actual use, an alarm would first be displayed on hand-held TASS annunciators kept at squad levels. If the alarm is not manually canceled at the squad level, it would automatically transfer to the flight command post. If it is not canceled there, the alarm automatically transfers to the BDOC. SecForDMT will simulate these TASS alarms and display simulated TASS information on the appropriate screens.

Some air base defense assets are under direct control of flight leaders in flight command posts and other assets are under the control of the ground defense commander in the base defense operations center. Students participating in the role of ground defense commander would use menu selections similar to those used by squad leaders to issue orders to heavy machine gun crews, mobile reserve forces, military working dog teams and mortar teams for fire support. The outcome of the exercise would be modeled by the BLUFOR and

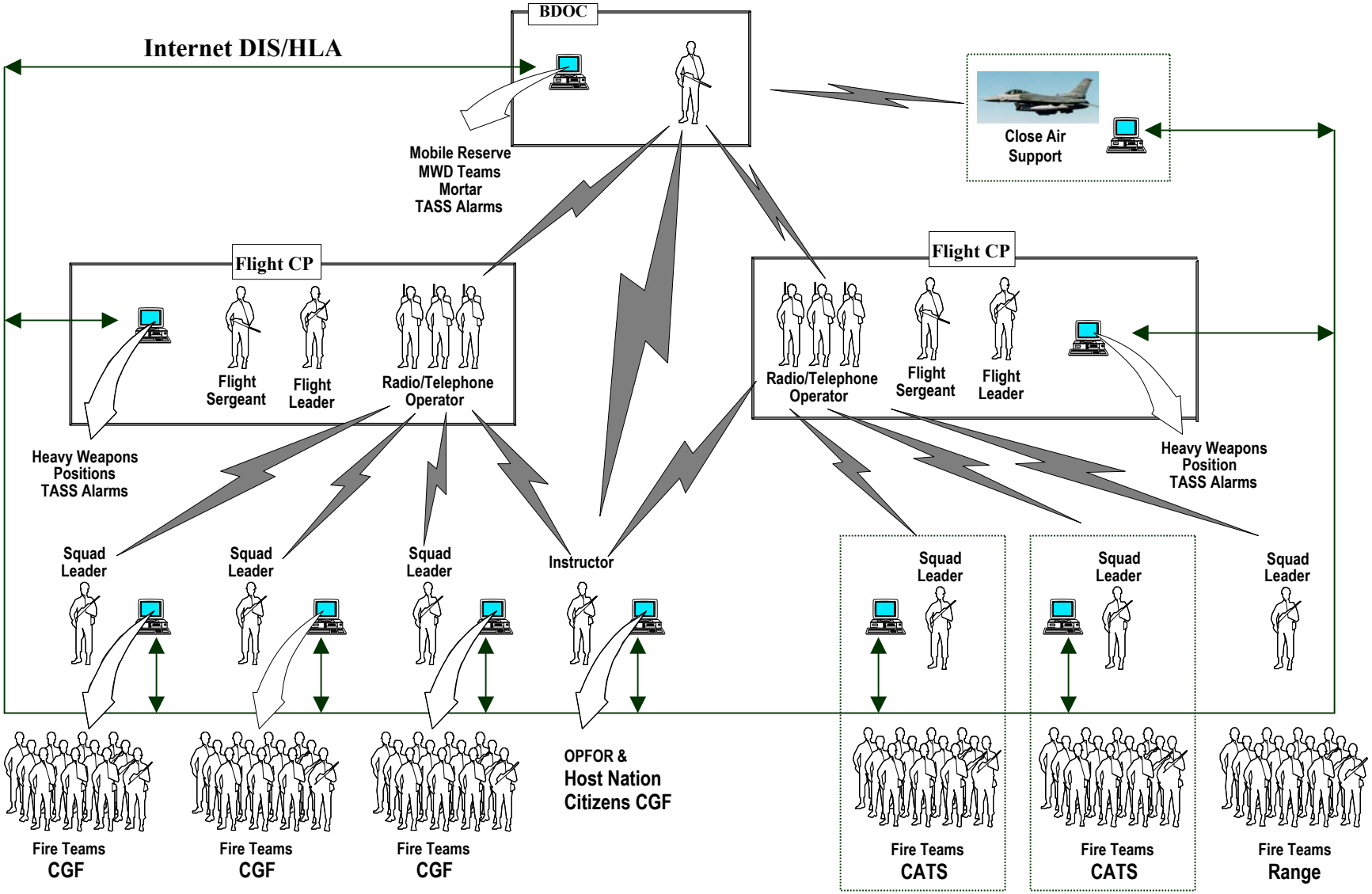

Figure 2
SecForDMT Concept

OPFOR CGFs based on selected ROEs and weapons. The instructor will evaluate the performance of trainees and use a plan view display (PVD) to conduct after action reviews (AAR).

3.2 User Interfaces

In the real world, the flight leader depends on radio/telephone communications via the Radio/ Telephone Operators (RTOs) for receiving SITREPS and issuing OPORDS/FRAGOS. Consequently, the flight leader will not have a display of the battlespace during the exercise. They will have a stealth display and map display for use during pre-exercise planning and post exercise AAR. The simulated map will present standard symbols to depict the locations of high value assets, adjacent sectors, the assigned sector and planned locations for defensive fighting positions and weapons within the assigned sector (as positioned by the squad leaders). The flight leader will not have knowledge of the locations and movements of OPFOR or dynamic reactions of BLUFOR to OPFOR. RTO trainees will have an interface consisting of screens depicting Scope Shield II and hot loop radio base stations. RTOs will have simulated radio/telephone communications with squad leader and will be the conduit for information from squad leaders to the flight leader and for decision/orders from the flight leader to squad leaders. RTOs will have simulated radio/telephone communication capability with the base defense operations center through which the flight leader will send status reports and requests for resources. RTOs will also have simulated radio/telephone communication capability with flight command posts at adjacent sectors for coordinating cross sector patrols. RTOs will have to select the correct radio frequencies and plug in the appropriate telephone connections on the simulated communications consoles (depicted on the computer display) in order to communicate.

The learning environment would be used for sustainment training in a constructive mode most of the time. A combined constructive and virtual simulator training mode would be available to increase the realism of training. The system will include both simulations and simulators. Operation of the constructive simulation (ModSAF) would be regarded as operation in the constructive mode. Operation of both constructive simulations and virtual simulators would be regarded as operation in a combined constructive and virtual mode. Virtual simulators will be adapted from combat arms trainers (CATS) already purchased by the USAF for marksmanship training. These virtual simulators are designed for HLA-compliant, distributed applications but have not been exploited for this purpose.

In the constructive mode, the interface for the three squad leaders will include a simulated map depicting the assigned sector and adjacent sectors, as well as a constrained stealth view or moving eye point. In the pre-exercise planning phase, squad leader trainees will be able to use the stealth view to "Walk the terrain" in a virtual mode to determine the best locations for fighting positions. They will then place these fighting positions and weapons on a simulated map and email the map to the flight leader.

During the exercise, the moving eye point will be constrained to realistic representations of what a squad leader could view from the occupied location on the battle field and will have movement rates constrained by the maximum speed of a dismounted mode of travel. The constrained eye point will allow squad leaders to see fire teams and OPFOR CGFs within line of sight. Squad leaders will react to OPFOR CGFs or to reports of OPFOR from fire team leader CGFs. Squad leaders will communicate with fire team leader CGFs by menu selection that mimics radio/telephone communications. The CGFs that simulate fire team leaders will communicate with the squad leaders trainees by text display and voice generation. Squad leaders will communicate by radio/telephone with the flight leader through RTOs to provide situation reports.

In the combined constructive and virtual mode, a 12-lane combat arms marksmanship trainer (CATs) will be operated as three separate CATS nodes that will be the interfaces for the three fire team leaders and their fire teams. In each case, CATS includes back wall screens on which visible battlefield terrain and OPFOR CGFs will be displayed as computer generated imagery (CGI) identical to that shown on the stealth displays in the constructive mode. The CGI will consist of visible battlefield terrain corresponding to the terrain depicted in the two-dimensional map presented to the flight leader. Squad leaders will react to OPFOR CGFs appearing as CGI. Squad leaders will directly communicate with fire team leaders and their fire teams located in the CATS simulator. Squad leaders will communicate by radio/telephone with the flight leader through RTOs to provide situation reports.

3.3 Technical Challenges

The major technical challenge of this project is to modify the behavior of ModSAF to match the required behavior of Air Force security forces in SSCs. ModSAF is currently designed more for MTW tasks. When threats come into range, they fire. On this

project, we will modify ModSAF to include the types of SSC behaviors contained in Table 4.

Many of these new behaviors will require extensions to the current DIS/HLA protocol and RPR FOM, such as the transmission of challenges (via Radio PDU) and entity states for surrender.

The second major task will be to modify the user interfaces for ModSAF such that Security Forces personnel and instructors can concentrate on the real world tasks simulated in SecForDMT as opposed to the operation of ModSAF. User interfaces will be closely modeled after standard operating procedures, OPORDS, SITREPS and FROGOS.

Additional technical challenges consist of adapting existing applications for automated training and feedback to provide instructional support.

Table 4
Behaviors to Be Added to ModSAF

- Challenge
- Surrender
- Capture
- Move POWs to rear
- Incorporate less-than-lethal weapons into ROEs
- Employ less than-lethal weapons
- Model host nation citizens with varying levels of hostility
- Model effects of less than-lethal weapons on host nation citizens based on level of hostility
- Model effects of less than-lethal weapons on terrorists
- Model collateral damage on host nation citizens and facilities when engaging OPFOR
- Develop robust capability for BLUFOR CGFs to generate SITREPS based on their perception of the OPFOR and non-combatants

4.0 Conclusions & Recommendations

The USAF AEF operational concept has created challenging training requirements for security forces. Distributed mission training and advanced learning technologies have superior potential for addressing these training requirements at greatly reduced costs for the USAF.

5. References

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