# Multi-National Distributed Training Exercise to Evaluate Massively Multiplayer On-Line Gaming Technology

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## ABSTRACT

The United States (US) Army Research, Development and Engineering Command Simulation and Training Technology Center (STTC), as a cooperative research effort with the United Kingdom's (UK) Land Warfare Center, will be conducting experimental training exercises to evaluate Massively Multiplayer On-line Game (MMOG) technology. The goal is to run three exercises over the next 24 months, starting with a ground exercise and working toward a Close Air Support exercise. The first exercise, which will be conducted in July 2008, will contain several scenarios focused on Assaults, Hostage Negotiations, and Non-combatant Evacuation Orders. The purpose of these exercises is to conduct cooperative research activities that will enhance the technologies, processes, and strategies for applying distributed simulation to Coalition training. The exercises will be conducted in a distributed fashion, where both the US and UK Soldiers will be participating in the training experiment from their respective locations. Exercise control, role players, and after action review will also be distributed over the World Wide Web. Several technical research topics will be explored including: bandwidth constraints, network latency, network security, and scalability. In addition, the United States Army Research Institute will conduct formative evaluations, evaluating task performance, training strategy, and leadership feedback.

## ABOUT THE AUTHORS

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## INTRODUCTION

Massively Multiplayer On-line Games (MMOGs) and virtual worlds such as Second Life have become popular with World of Warcraft alone drawing over 10 million users ("World of Warcraft," 2008). This type of on-line environment provides large terrain areas, large numbers of entities/players, and provides a persistent virtual world. Players can enter the virtual world by logging into a server using an internet connection and creating an avatar. An avatar is a graphical character that represents the player in the virtual world and is controlled by the player's actions. Players are encouraged to modify their avatars appearance and are provided with editing tools to change facial features, hair, clothing, etc. to create a unique appearance.

These types of environments emphasize interaction among players through the use of voice chat, text chat, and animated gestures, and through manipulation of objects in the environment. Dynamic objects within the virtual world can be created, moved, carried, placed, removed, operated, or modified. The persistent nature of virtual worlds means that the environment and objects within the environment exist continuously and indefinitely, and evolve over time whether or not a specific avatar is logged into the environment. And while on-line First Person Shooter games are normally limited to 16-32 simultaneous players over the internet, virtual worlds often have 100's to 1000's of participants at any given time. In addition, virtual worlds provide large-scale geographic areas, often up to continent-sized worlds. These large worlds provide various types of terrain and typically reflect the real world in order to enhance realism and immersion.

Virtual worlds have been called the precursor to the 3D Internet and are predicted to revolutionize the way we use the internet for commerce, collaboration and business ("IBM and Linden Lab," 2007). With capabilities to collaborate and view information in 3D as well as share presentations and video, these virtual worlds are being used for more than just entertainment. Businesses are not only marketing their products in these worlds, but holding meetings there as well. And several universities, such as the University of Ohio are holding classes in Second Life ("Education", 2007).

In prior research, virtual world technology has shown the potential to support training for common urban operations involving traffic control points, building searches, Improvised Explosive Devices (IEDs), patrols and building rapport with the local population. Under The Technical Cooperation Program (TTCP), made up of the US, UK, CA, AS, and NZ, we have begun to explore how the unique capabilities of virtual worlds may be used to support training for Coalition Warfare operations. Through a series of distributed simulation exercises, we will explore various strategies for maximizing interoperability between the virtual world environment and other simulators; define an architecture that supports training with our coalition partners in a distributed simulation environment; and conduct technology demonstrations and structured user assessments. In this paper, we will discuss prior research in using virtual world technology for military training, followed by a discussion of the first planned distributed exercise between the US and UK to begin to evaluate the technology for coalition warfare training, including data collection, and finally conclusions and future work.

## RELATED RESEARCH

In 2003, the U.S. Army Research, Development and Engineering Command – Simulation and Training Technology Center (RDECOM-STTC) and the Army Research Institute (ARI) began research to determine how virtual world technologies could be used to improve how our military trains to win. Starting with a commercial virtual world called *There* (www.there.com), RDECOM-STTC worked with the game developer to develop a prototype web-based, training simulation for ground forces. The prototype virtual environment was developed to:

- support individual and small unit training;
- represent the conditions in the Contemporary Operating Environment (COE) including dense urban environments;
- provide Soldiers the capability to learn and practice up-to-the-minute Tactics, Techniques and Procedures (TTPs);
- support training for Security & Stabilization Operations (SASO), including crowd control/protestors, requests for humanitarian relief, unauthorized entry, and direct insurgent attacks including IEDs.

Since *There* was a commercial on-line, social networking environment, major modifications were made to support military training for the types of asymmetric warfare being encountered in the COE of Southwest Asia. Exploring the strengths of virtual worlds, training scenarios focused on urban warfare where Soldiers interacted with the civilian population such as checkpoint operations, building searches, patrols, and IED attacks in populated areas (see Figure 1).

**Figure 1. Soldier Interactions in a Virtual World**

Additional modifications included implementing a Distributed Interactive Simulation (DIS) network interface (IEEE 1278.1) that supports interoperability with other military simulation systems and was used to populate the environment with Non-player Characters (NPCs) generated by the Army's constructive simulation, OneSAF Test Bed (OTB). OTB provided the artificial intelligence so the virtual world would be more realistic, full of civilians and other NPCs without having to use large numbers of costly human role-players. The Crowd Federate, developed by Old Dominion University, was also integrated to evaluate its capability to provide realistic crowd behaviors that could be easily controlled by a human operator. In addition, insurgent behaviors such as snipers and suicide bombers were added to OTB that could be used in the training scenarios, funded by the Technical Support Working Group (TSWG).

Several experiments were conducted by RDECOM-STTC and ARI using Soldiers to evaluate the usability and potential effectiveness of the virtual world for military training. One experiment involved using the virtual world during a force protection exercise at Ft. Riley (Stahl, Long, & Grose, 2006). The results of these experiments showed that the virtual world technology does have the potential to support training (Singer, Long, Stahl, & Kusumoto, 2008).

## MULTI-NATIONAL TRAINING EXERCISE

Recently, in cooperation with the United Kingdom (UK), the STTC and ARI expanded this research to explore virtual world technology for distributed Coalition Warfare (CW) training. For the first US-UK exercise to be held in July 2008 there will be approximately 56 trainees including a Platoon Minus (two Squads) from both the US and UK working together to execute a Non-combatant Evacuation Order (NEO), involving the evacuation of US and UK embassies. Civilian clutter and insurgent forces will be provided through 12 role-players and over 40 NPCs generated by OTB. As a result, we will have approximately 100 avatars/NPCs in the virtual world consisting of a combination of Soldier trainees, role players, and NPCs.

### Scenario Generation

Prior to each exercise, a Training Support Package (TSP) is developed. The TSP identifies the training objectives, including the tasks, conditions and standards. Since the virtual world is a free flowing environment, the scenario is carefully crafted to put the Soldiers in the situation where they will need to perform the tasks to be trained under the specified conditions. A "Road to War" document is developed that will provide the Soldiers with a storyline that includes an explanation of the current military environment and recent events, to put the mission in context. Based on the tasks, the scenario is developed to include a Master Scenario Event List (MSEL) that defines the events and conditions that are needed to train each task. As the MSEL is developed, a list of required objects, e.g. checkpoint signs, jersey barriers, etc. and characters will be identified. For live role-players, a character profile will be developed. This will include what the character looks like: male/female, adult/child, type of clothing worn: civilian (traditional or modern) or uniform (military/police), etc. It will also provide some background as to the intentions and goals of the character and suggested dialogue. A Character Matrix will be developed that indicates, for each event in the MSEL, the person who will play each character as well as login ID and any inventory items the character should have. To minimize the cost of the exercise and the number of live role-players required, scenario designers will use the matrix to determine when a single person can play multiple parts. Teleport locations will also be identified that will be used to move Trainee avatars to the scenario starting point and enable role-players to move quickly between various locations to support MSEL events.

Any changes to the environment will also be identified. Using the game's Scene Editor, rooms can be set up with furniture and other items. These items can also be tagged as searchable by the Trainees, with an associated JPEG or text file that will pop up showing what it contains. Clutter, such as trash piles, rubble, and parked vehicles, can be placed in the environment as needed, as well as IEDs. For our experiments, we are currently using the U.S. Army's OTB to provide civilian clutter, as well as Opposing Forces (OPFOR). The CGF-generated civilians can be given random routes to wander around and will also react to gun fire and detonations from IEDs. Under a separate research effort for the TSWG, AI Implant was integrated with the OTB to create insurgent behaviors, such as suicide bombers, snipers, IED emplacers, etc. Using the strengths of the 3D virtual world, these insurgent characters are given visual attributes, driven by OTB/AI Implant, to provide some indication of their hostile intent, such as carrying a shovel, sniper rifle, video camera, etc., or wearing a suicide vest under a jacket. For example, an insurgent could be placed on a rooftop with a video camera, capturing an insurgent attack for propaganda purposes.

**Distributed Mission Planning**

As the exercise will include US Soldiers in Orlando, FL and UK Soldiers in Warminster, England, mission planning will also be done in a distributed fashion using the capabilities of the virtual world. The US and UK Commanders and staff will meet in world in a virtual staff room to review the Operations Order. Providing critical background information, in-country briefings will be given by role-players using PowerPoint briefings and video files, viewed in the virtual staff room. In addition, maps and virtual satellite photos can be provided on virtual staff room's walls as texture maps. As plans are discussed using the Voice over IP (VoIP) capability, a virtual laser pointer can be used to point to key items being discussed. Once the plans are completed, the Commanders can brief their units.

**Exercise Conduct**

Once planning is completed, the US and UK units will be taken to the equipment staging area, where they will find their vehicles, etc. In their avatar's inventory, they will find their standard load of weapons and equipment required for the scenario. Soldiers can bring items out of inventory for use, or put them away, as needed. Role-players will also have items in their inventories to support their roles, e.g. weapons, video cameras, IEDs, vehicles, etc., to execute the events in the MSEL and drive the scenario forward. In addition, the role-players will have access to various teleport points that will allow them to move quickly to different locations. To play various roles, they can also change their avatar's appearance by changing individual personal characteristics, e.g. hair color, shirt, etc., or they can use saved "quick sets" that have all of the characteristics defined for a given character, e.g. an Iraqi Policeman, paramedic, etc.

**Distributed Exercise Control**

The US and UK Commanders will take turns being in charge of conducting the exercise as the Exercise Director and will monitor the exercise as it unfolds from the Exercise Control (EXCON) area. To view the trainees' actions, the EXCON personnel can log in as an invisible avatar and use the "free Cam" view to fly quickly to any place in the virtual world and watch events from any angle or height. EXCON personnel can monitor the Trainees' radio channels and will also have private radio channels that will be used for coordination between the US and UK EXCON personnel as well as to cue and provide guidance to the role-players. Strict radio discipline will need to be enforced to ensure that too many people aren't talking at the same time and that the role-players and OTB operators acknowledge communications from the Exercise Director. This is critical in coordinating actions among the role-players and the OTB operators as well as coordinating the timing of the events. EXCON may also need to make changes on the fly to the scenario, depending on the actions of the Trainees. A Plan View Display (2D view) will also be available by either zooming out overhead using the virtual world view or by looking at the OTB display.

**Distributed After Action Review**

Upon completion of each scenario, After Action Reviews (AARs) will be conducted to review the Trainees performance. The discussion will help the Trainees reflect on the exercise and their actions and decisions, what they did well and where they could improve. Since the US and UK have different Tactics, Techniques and Procedures (TTPs) and potentially different methods of conducting an AAR, we will conduct a US-only and a UK-only AAR, followed by a combined AAR. It will be interesting to see what the differences will be between the US and the UK AARs and the combined AAR due to culture and protocol issues.

ARI's Dismounted Infantry Virtual After Action Review System (DIVAARS) will be used to support the distributed AAR. DIVAARS allows the instructor to record the exercise and bookmark events of interest as the scenario unfolds. Afterwards, DIVAARS can be used to playback the recorded exercise for review. The replay will appear on each of the trainees' screens, with the instructor being able to display events from any angle and to jump forward to any event of interest. The display can also be annotated by the instructor. Using VoIP capability, the instructor will be able to discuss the exercise with the trainees. The virtual world environment also has a record and playback capability that will be used during the distributed AAR. A virtual laser pointer is provided so the instructor can point out things in the virtual world, as they are discussed. The capability of the virtual world to display PowerPoint presentations and videos will also be used.

## DATA COLLECTION

While three exercise events are currently scheduled, the data collection effort for the first exercise is the only one that is currently developed to any great detail. The expectation is that the same type and scope of information will be collected in each of the following exercises, with appropriate alterations providing improvements in addressing issues that arise during the first exercise. As currently planned, the same UK unit (with some of the same personnel) will be participating in both the first and second exercise events. This will obviously enable data collection of Trainee improvements over widely separated events and times, similar to the expected application of these types of systems by units.

**Task Performance**

Based upon the coalition mission selected and tasks performed within that context, subtasks and actions have been extracted from U.S. Army training materials. The standard approach to measurement is observation and evaluation by a subject matter expert, who judges whether the Soldiers performed adequately or need further training for adequate performance (referred to as go/no go). We will be implementing a system developed to support direct computer-based scoring for evaluating unit performance across varied scenarios, called Measuring Learning & Performance in Collective Training Exercises. (McGilvray, Leibrech, & Lackaby, 2008). The system supports easy entry of anchored five point scale evaluations of subtasks, activities, and procedures performed by groups of Soldiers during training exercises. This system is still in the developmental stage, and will be supplemented with more standard checklists for critical tasks performed during the missions.

Following the mission exercises, questionnaires will be administered to the trainees and trainers for the different military groups. These questionnaires will address the perceived benefit of the exercise, usefulness of different aspects and features of the simulation system, and evaluations of training effect. The training effectiveness material will include self-evaluations by the trainees, peer evaluations of other team members, and trainee gains as evaluated by the trainers.

Since there are only two scenarios used during each exercise event, there will be limited information about the incremental improvement of the Soldiers. The collected observational measures will be analyzed for indications of changes through repeated situational responses. Questionnaires will be administered to address the trainer's opinions of the potential training effect from repeated application of multiple scenarios.

**Training Strategy**

The training strategy implemented in the missions is a relatively standard "rehearse and stress" approach, in this case requiring joint efforts with military forces from other nations. The approach presumes a minimum level of knowledge and competency on the part of the trainees, and a flexible exercise controller that adjusts the events in order to press the trainees in applying that knowledge and demonstrating their competency in performing mission tasks. The events can be speeded, overlapped, and made more threatening or deadly by the addition of opposing forces. The training value is provided through after action reviews (using systems described above), enabling both guided and discovery learning to be fostered in the trainees.

There will be no opportunity within these exercises to attempt comparative evaluations, but a structured interview will be conducted with the trainers and exercise controllers. The type of data collected will attempt to establish the potential range of mission types that could effectively be conducted, whether different strategies could be implemented that might expand the approaches available to unit trainers, and the support required by unit trainers in order to effectively employ these types of systems.

**Leadership Feedback**

As noted above, two different systems will be implemented for the AAR. These systems will be employed for the two scenarios by different exercise controllers, one US and one UK. Given the limited scenarios and time available, obviously no statistical comparison will be possible. However, much can be gained from observation of and interviews with the exercise leaders. We expect to obtain feedback about the detailed supporting features of the two different AAR systems directly from observations of planned and actual use. Structured interviews will address the ease of use, potential effects in training, and suggestions for improvement or altered application.

## CONCLUSIONS AND FUTURE WORK

While the exercises will not be conducted prior to this paper being completed, we have already performed some preliminary testing on-line and have gained experience in developing the training scenarios. In initial testing in March 2008, we had 3 clients in the UK and 5 clients in Orlando logged into the server in California along with OTB generating 80 NPCs from Orlando. The initial tests showed that the training environment has the potential to support the exercise with a combination of 100 avatars and NPCs in the virtual world. Bandwidth did not appear to be an issue, but there were some issues with clients that had less than a 256MB graphics card. As for collaboration, most of the discussion during scenario development was done in the virtual world. The scenario designers from the US and UK met in world and performed terrain walks, discussing each event in the MSEL, including where it would occur and how it should be performed. There were also discussions on how the US and UK may react to certain events, which highlighted potential differences in Standard Operating Procedures. For example, a sniper on the side of the road shooting at the US – UK mounted patrol may be handled as a simple, isolated case of self-defense. On the other hand, it could result in a request to change the current Rules of Engagement (ROE). These are just some of the lessons learned so far. Currently, we have two exercises scheduled prior to the 2008 I/ITSEC Conference. At that time, we should have much more to share.

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