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THE USE OF A SIMULATED ENVIRONMENT TO OPTIMIZE THE SOLUTION IDENTIFIED PROBLEMS SPECIFIC TO MODERN MILITARY ACTIONS

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Abstract: *This article presents the implementation and testing of a solution for perfecting the skills of operationalizing a tactical task and developing the ability to react under stressful conditions, individual and collective resilience based on virtual reality for military personnel. Also, a distributed network was configured and tested for increased flexibility and quick setup during multiplayer simulation. The distributed network comes to complement the networks used up to now, namely the local networks.*

Keywords: virtual battlespace, network, virtual reality, multiplayer training

1. Introduction

Virtual reality is "*a concept that describes the interaction between humans and a simulated environment, implemented using computer technology containing computer graphics and artificial intelligence*" [1].
"*The purpose of using virtual reality instead of traditional training processes is to simulate battlefield conditions as realistically as possible and to save financial resources that could be directed to other educational processes*" [2,3,4]. Both the validation of the tested and proposed network and its functionality was done in an international context because "Land Forces Academy of Sibiu organized the Interoperability Common Module, a module included in the International Semester curricula as a subject for the Military Leadership degree programme and proposed to our partners under the framework of the European Initiative for the Exchange of Young Officers (EMILYO Programme). The module was attended by students from partner institutions, as follows: ➢ Theresian Military Academy, Wiener Neustadt, Austria; ➢ University of Defence, Brno, Czech Republic; ➢ Hellenic Army Academy, Athens, Greece; ➢ "General Jonas Zemaitis" Military Academy, Vilnius, Lithuania; ➢ "General Tadeusz Kosciuszko" Land Forces University, Wroclaw, Poland; ➢ Military University of Technology, Warsaw, Poland; ➢ Polish Air Force Academy, Deblin, Poland; ➢ National Defence Academy, Gori, Georgia; ➢ "Alexandru cel Bun" Armed Forces Academy, Chișinău, Republic of Moldova" [6]. Thus, the military students had the opportunity to perfect their command skills necessary for preparing and fighting in different tactical situations, in a versatile and dynamic operational environment, practicing troop

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management procedures in different specific missions and assuming the role of leader of a military structure at group or platoon level, perfecting the skills of operationalizing a tactical task and developing the ability to react under stress conditions, individual and collective resilience.

2. Materials and methods

The following hardware and software resources were used to achieve the objectives of this work:

- "VBS software application" [7].

VBS is "*simulation software that allows you to create and run any military training scenario imaginable. The VBS workflow guides the user through the Prepare - Execute - Evaluate stages, facilitating rapid and efficient skill improvement. In VBS, users create "Battlespaces" which are a collection of terrain edits, mission plans, scenario files, and after-action reviews. Each Battlespace is centered on a specific location on the virtual Earth. Scenarios can be modified in real-time and replayed in After-Action Evaluation for lessons learned. VBS scenarios can be fully constructive (AI controlled), fully virtual (human controlled) or a combination of both*" [8].

VBS4 provides a virtual environment for combat training, tactical training, experimentation and mission rehearsal, in land, sea and air. It features "*a content library, tactical scenario development tools, and action review capability that immerses users in a high-fidelity military virtual environment (including conventional insignia in accordance with NATO standards). It allows interoperability with external HLA / DIS networks and host computers using the CIGI protocol*" [8]. Features a DIS-enabled voice communication system and a mission planning tool for adding military markings to the scenario. The software includes over 14,000 models from the content library, terrain generation and modeling tools, over 2,000 documented script commands, real-time and offline tactical scenario creation and editing tools, an action review (AAR) with timeline and capabilities of Edit, locate targets and estimate their position using sighting equipment (binoculars, laser range finder and laser designators), maps and references to 3D terrain features [5].

- "*Desktop Workstation for setting up and running the VBS server.*

The workstation was installed in the training room to be used by the coach to create the tactical scenario to be simulated, but also to view, edit and record in real time the military actions performed by the players" [7].

- Router/switch for VBS multiplayer training.

"*The first step is to install and launch the VBS application. Using the application - VBS Launcher, which creates a suite of additional parameters and source code, allows users to easily connect*" [7]. VBS Launcher can be used to launch VBS on other computers on the network. The computers from
distance start VBS with parameters specified in VBS Launcher.

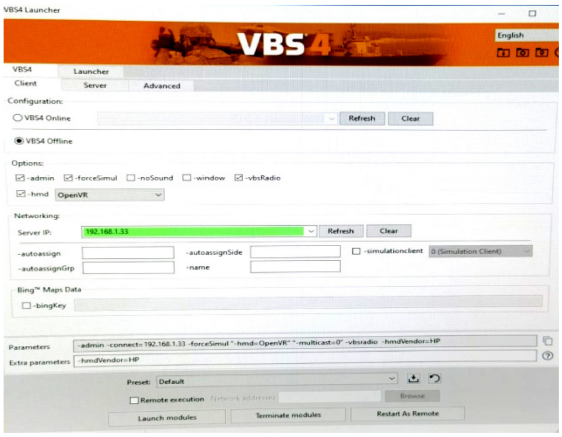


Figure 1: VBS Launcher Interface
Source: Author

Start VBS in either Administrator or User mode (not to be confused with Administrator/User modes Windows). Administrator mode allows full access to video, audio and difficulty settings and has an interface of more advanced setup.

In the next step, network settings allow administrators to control bandwidth limits for servers and clients by network.
Select Available Bandwidth to use from:
Between 100 Mbps and 1 Gbps for LAN-connected clients. Between 1 and 50 Mbps for customers connected to the Internet. It
Choose the computers to apply the value of use Apply to drop down:

- Client Only - Allows the server and all clients to use their own bandwidth setting. Requests administrator to set the value individually on the Server and each Client.
- Client and Server - Forces the server to use the value set on the administration client. Other customers use their own settings. Requests the administrator to set the value individually for each Client.
- Server and all connected clients – Forces the server and all clients to use the value set on the client by administration.

These settings affect the following configuration parameters:

- networkBandwidth (Available bandwidth setting).
- maxBandwidth (Available bandwidth setting).
- minBandwidth (1/8 of available bandwidth setting).
- networkBandwidthFor (Apply to set.

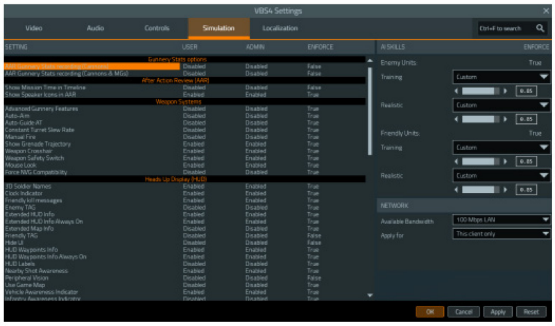


Figure 2: Network settings for players selection
Source: Author

Later, several training scenarios were set up like this:
High load training exercises. For even larger training scenarios with many participants and a very large number of simulation objects, Simulation Clients can provide additional computing resources to host the simulation and maintain performance.

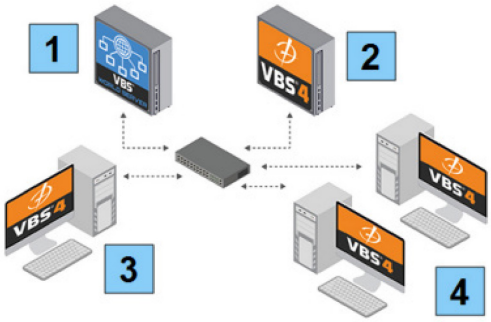


Figure 3: Heavy load training network.
Source: Author

Combined multi-room simulation.VBS Gateway allows to host different sets of simulation objects as part of a combined simulation where the managed entities appear as external entities in the other instances of the VBS.

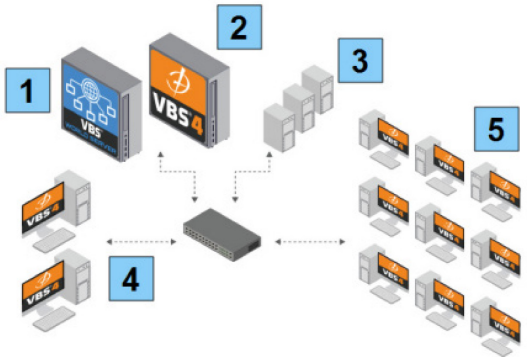


Figure 4: Combined multi-room simulation
Source: Author

Combined multi-product simulation. VBS Gateway allows VBS to participate in combined simulations with other HLA or DIS compliant simulation products, where entities managed by each product appear as external entities in the other products.

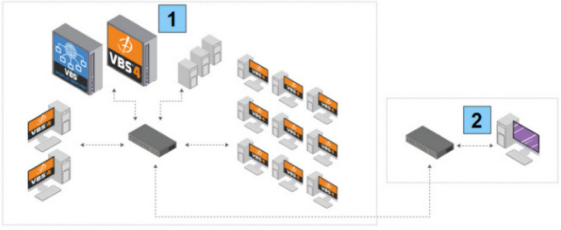


Figure 5: Combined multi-product simulation
Source: Author

3. Results and Discussions

Evaluating Goal Achievement From a technical point of view, in the run-up to the exercise, the following interconnection options were tested:

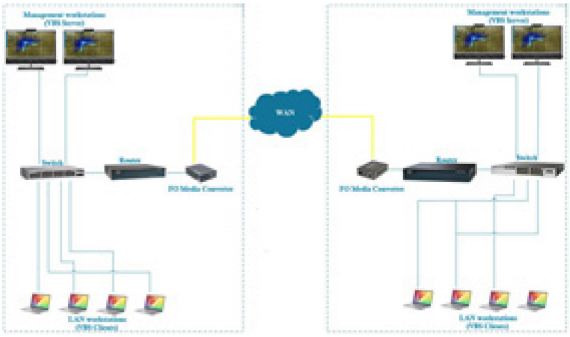


Figure 6: Distributed Integrated Simulation (network diagram)
Source: Author

➢ Direct connection with a VBS server; - Disadvantages: requires the same version of the simulation software and limits the number of computers used to 37. ➢ Direct connection with two servers in the two locations using the Distributed Integrated Simulation (DIS) standard; - Advantages: allows different versions to be used in the two locations; the number of workstations is not limited. ➢ Secure INTERNET connection with CISCO routers. - Disadvantages: increased vulnerability to cyber-attacks.

These variants were tested during an entire training module. The module ran in a modular format over two weeks. "*The module took place in a modular format for two weeks. The first week was a theoretical one and focused on the transmission and training of fundamental cognitive aspects with reference to aspects of NATO, Contemporary Operational Environment, Mission Command, Maneuvering Approach, tactical organizational structures (Platoon, Company), Tactics, Techniques and Procedures (TTPs) specific to sub-units within Full Spectrum Operations (FSO) and Troops Leading Procedures (TLP). The second week aimed to practice the theoretical background gained through Troops Leading Procedures (TLP) practice at the level of the platoon and virtual simulation of Courses of Action (COA) developed for different hypothetical scenarios using Virtual Battle Space (VBS) capabilities*" [6].

The activities carried out in the VTX (Virtual Training Exercise) were mainly focused on: ➢ Establishing the connection between the two locations; ➢ Testing different architectures for interconnecting the VBS application; ➢ Training students for TLP execution on specific mission at platoon commander level; ➢ Training platoon/company commanders within the AFT as O/C/I to be able to perform their appointed functions in the exercise; ➢ Preparing the scenario and introducing it into the virtual simulation system; ➢ Preparing and performing the informal after action analysis. "*After the mission, the cadets said they were satisfied with the way the system worked and wanted to use it in as many training activities as possible*" [7].

4. Conclusions

The system is functional and can be used by the military in the training process. All the options presented above are feasible for running a distributed virtual simulation training exercise. Depending on the training requirements and objectives, the optimal variant can be chosen, customized to the specifics of the exercise and the available material base.

The main contribution of this paper is a comprehensive study analyzing the unique challenges and potential solutions for distributed networks in different locations and long distances for military training. "*This work represents a preliminary step and research source for optimizing solutions for virtual reality using personalized and secure networks*" [7]. The initial implementation, reduced to integrating 2 remote locations with in-game users, can create high latencies as more players are introduced. However, with the

implementation of the network, training in "*virtual reality will be able to be developed, thanks to gigabit speeds, ultra-fast response times and the use of new MIMO - Multi-User Multiple Input Multiple Output technologies"* [7].

Acknowledgment

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