Order Code RS22857
April 9, 2008



CRS Report for Congress

Avatars, Virtual Reality Technology, and the U.S. Military: Emerging Policy Issues

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Summary

This report describes virtual reality technology, which uses three-dimensional user-generated content, and its use by the U.S. military and intelligence community for training and other purposes. Both the military and private sector use this new technology, but terrorist groups may also be using it to train more realistically for future attacks, while still avoiding detection on the Internet. The issues for Congress to consider may include the cost-benefit implications of this technology, whether sufficient resources are available for the communications infrastructure needed to support expanded use of virtual reality technology, and whether there might be national security considerations if the United States falls behind other nations in developing or adopting this new technology. This report will be updated as events warrant.

Virtual Reality and Web 2.0

Virtual Reality (VR) technology enables Web content that is interactive and user-generated. However, VR technology goes beyond traditional Web pages, and allows users to operate in three-dimensions of space, simulated within the computer. VR is part of what is known as Web 2.0, a second-generation method of using Web technology to create communities, or social networks, where instead of passively viewing content, each user can dynamically create and modify and share Web content. Thus Web 2.0 technology allows users to collaborate and create self-organizing communities that can (1) increase the value and power of peer relationships and (2) simultaneously disrupt traditional real-world methods for hierarchical control over information flows.[1]

Early examples of 2-D Web 2.0 social network communities include YouTube, LinkedIn, and Wikipedia. Similar Web 2.0 tools were developed and used by junior military officers during Operation Iraqi Freedom to create notes about observed enemy movements and then quickly share this information among multiple unit commanders.

[1] Don Tapscott and Anthony Williams, Wikinomics, Penguin Group, New York, 2006.

Initially, senior military officials became concerned about security and their loss of control over classified information flows.[2] However, unit commanders convinced DOD leadership of the value of peer-controlled sharing information about insurgents' adaptive movements, which resulted in an officially sanctioned system now called Cavnet, which allows fast access to knowledge acquired on the ground in combat.[3] Other social networking sites now sanctioned by the military include "Companycommand" and "Platoonleader," both accessible via password.[4]

Many businesses now use different 2-D Web 2.0 tools to accelerate innovation, and several large corporations have also established simulated presences inside commercial 3-D VR worlds to expand real-world sales. Several government agencies, including the Centers for Disease Control and Prevention, the National Oceanic and Atmospheric Administration, and at least one member of Congress have experimented with setting up their own presences in VR environments.[5]

Simulation and Military Training

Modeling and computer simulation have traditionally been used to train military pilots and tank crews. In many cases, the trainee steps into a simulator device, which is surrounded by screens that generate a 3-D image completely controlled by high-powered, computerized artificial intelligence. However, new VR tools go beyond many traditional limitations and now allow multiple participants to freely interact with each other in the similar 3-D computerized environment. In many cases, computer networking capabilities have dramatically increased to the point where users can now run complex 3-D VR simulations in the field using a laptop connected to the Internet.[6] Training with VR allows large numbers of personnel to interact in a simulated face-to-face environment with other distant military units through the Internet (or through the classified network known as SIPRNET), and with first-responder units, civilians, and even medical personnel units, providing a training experience that is increasingly effective, but at a much lower cost than would be required for assembling these personnel for a real-life face-to-face training exercise.

VR technology offers a potentially effective and economically efficient tool for training military personnel to better deal with dynamic or potentially dangerous situations. VR participants use self-designed computer images called avatars that look and act like real people, and operate in virtual world environments that can have almost any

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[2] PBS Frontline, *Innovating and Improvising*, [http://www.pbs.org/wgbh/pages/frontline/shows/company/lessons/].

[3] PBS Frontline, *Innovating and Improvising*, [http://www.pbs.org/wgbh/pages/frontline/shows/company/lessons/]. William Matthews, *Helping Info Flow Freely Insurgents Outdo U.S. Military, Says U.S. 3-Star,* Defense News, January 28, 2008, [http://integrator.hanscom.af.mil/2008/January/01312008/01312008-14.htm]. Wikipedia, [http://en.wikipedia.org/wiki/CAVNET].

[4] Dan Baum, *Annals of War: Battle Lessons*, The New Yorker, January 17, 2005.

[5] Trudy Walsh, *Get a life: Congress, NOAA test the water in a virtual world*, GCN.com, February 19, 2007, [http://www.gcn.com/print/26_04/43147-1.html].

[6] Kathleen Hickey, *Virtual training gets real*, Government Computer News, November 19, 2007, p. 16.

combination of simulated characteristics — a busy checkpoint in downtown Baghdad, or a subway tunnel in downtown New York under chemical attack by terrorists. The resulting interactions can be unpredictable and can seem highly realistic to the individual operators involved. Some of the avatars can simulate local citizens and, when operated by real-life actors, can demonstrate culturally correct gestures, show facial expressions, and communicate emotions, which military personnel trainees must interpret correctly during these virtual world encounters.[7] For a more detailed discussion of the effects of virtual reality on trainees and operators, see "Your Guide to Virtual Worlds," at [http://www.pbs.org/mediashift/2007/10/digging_deeperyour_guide_to_vi.html], a website that is affiliated with the PBS media enterprise.

Intelligence Operations

The intelligence community has started exploring for how VR communities might become actual battlefields in the future, complete with cyber weapons for launching attacks against terrorists or other enemies. Intelligence officials point out vulnerabilities, because vendors for many commercial VR communities do not keep records of conversations between avatars, or monitor how VR areas are used, some of which can be protected by strong passwords. However, other officials also think this level of concern is unwarranted, and that fears of threats to national security in VR are overblown. They also indicate that, even though some users may engage in clandestine activity, some VR products employ electronic tools that automatically look for risky behavior by avatars.[8]

The intelligence community has also indicated that it may initiate a study of the behavioral characteristics found in virtual worlds, to identify emerging social, behavioral, and cultural norms. The lessons learned would be used to help automatically detect suspicious behavior and actions of individuals operating in virtual worlds that might pose a threat to national security.[9]

Communications Infrastructure

Some experts expect that virtual reality and virtual worlds will have the same impact on business and government entities as has the Internet itself. However, U.S. communications infrastructure and acquisitions methods are relatively old, and many Asian countries are well-networked with advanced equipment that may offer advantages that could allow them to establish the global standards for VR technology.[10] China, for example, has begun construction of a virtual world called HiPiHi, reportedly with

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[7] Michael Peck, Soldiers Learn Hazards of War in Virtual Reality, National Defense, February 2005, [http://www.nationaldefensemagazine.org/issues/2005/Feb/UF-Soldiers_Learn.htm].

[8] Robert O'Harrow, *Spies' Battleground Turns Virtual*, Washington Post, February 6, 2008, p. D1.

[9] Office of the Director of National Intelligence, description of Project Reynard, *Data Mining Report*, February 15, 2008, p. 5.

[10] Press release, *Gartner Says 80 Percent of Active Internet Users Will Have A "Second Life" in the Virtual World by the End of 2011*, April 24, 2007, [http://www.gartner.com/it/page.jsp?id=503861].

infrastructure that will support up to 75 million simultaneous users.[11] Some observers note that any country that succeeds in dominating the VR market may also set the technical standards for the rest of the world, and may also own and operate the VR servers that give them unique access to information about future global financial transactions, transportation, shipping, and business communications that may rely on virtual worlds.

Some U.S. military and state government communications systems rely on commercial products and leased communications lines for training for homeland defense operations.[12] However, a research survey in 2007 found that "American companies are not poised to be the leaders in embracing Web 2.0 technology in coming years. If anything, they're looking like laggards. Leading the way are Indian firms, 80% of which plan to increase their investments in Web 2.0 over the next three years, compared with 69% of Asia-Pacific firms, 65% of European firms, 64% of Chinese firms, 64% of North American firms, and 62% of Latin American firms."[13] These observers question whether the United States could adequately protect the security of its assets if future VR communications standards and servers were controlled by another country, or possibly an adversary country.[14]

DOD Programs

The military is reportedly planning to build a virtual world called "Sentient Worldwide Simulation," which will "mirror" real life and automatically follow real-world events in real time. Some virtual world scenarios are also used to train medical personnel for mass casualty events. To do this, VR hospital rooms are designed to duplicate actual civilian or military facilities, and are populated with individually controlled avatars for nurses and physicians, which interact with avatars of National Guard members and first responders who must also locate and transport avatars of patients with different injuries. Other uses include therapy treatment for military veterans suffering from Post-Traumatic Stress Disorder (PTSD). The treatment objective is to help veterans deal with troubling experiences in Iraq or Afghanistan by immersing them back into the sights and sounds of simulated past battles. To provide a treatment, the therapist can manipulate effects the patient sees in a simulation to best suit the needs of the patient. The repeated treatments are intended to gradually reduce the experiences that trigger the trauma, and the memory

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[11] Personal conversation with U.S. State Department officials, 2008.

[12] Personal conversations with National Guard officials, 2007. For example, "Guardnet" runs over a Wide Area Network (WAN) that is leased from a commercial carrier. It supports data, voice, and video for National Guard homeland defense and remote combat readiness training, as part of the Distributive Training Technology Project. Geoff Fine, National Guard Units Train Without Leaving Home, National Defense, February 2003, [http://www.nationaldefense magazine.org/issues/2003/Nov/National_Guard.htm].

[13] Two views of Web 2.0 in business, [http://www.roughtype.com/archives/2007/03/american_ compan.php]. How businesses are using Web 2.0: A McKinsey Global Survey, [http://www.mckinseyquarterly.com/article_abstract_visitor.aspx?ar=1913&l2=13&l3=11& srid=9&gp=1].

[14] Ramsey Shaffer, Baxter Technology Group, personal communication, January 30, 2008.

of the event may become tolerable. Early results from trials reportedly suggest that virtual reality therapy is well-suited to a generation raised on video games.[15]

"Urban Resolve" was a distributed training simulation carried out in 2006 by U.S. Joint Forces Command (JFCOM), Joint Experimentation Directorate, simultaneously at the U.S. Army Topographic Engineering Center at Fort Belvoir, Virginia, and at the Space and Naval Warfare Systems Command facilities in San Diego, California. The training exercise used virtual world technology to help develop skills in urban warfighting operations for future joint force commanders. The scenario, which involved more than 2 million individually simulated objects interacting in Baghdad in the year 2015, pitted a U.S.-led coalition force against an adversary operating in an urban environment.

JFCOM is also planning to run a series of experiments in another virtual reality training exercise, called "Noble Resolve," which involves homeland security scenarios that protect against a possible nuclear attack by terrorists. In one simulation, a nuclear bomb will explode, and the virtual world will enable evaluation of collaboration among local, state, national, and international officials. Government officials are seen as directing first-responder and law-enforcement operations alongside military personnel in a realistic VR environment. According to the trade press, JFCOM officials have also indicated that they plan to build intricate VR simulations of many cities, with the final goal of creating a fully functioning virtual model of the entire world, which will be known as the Sentient Worldwide Simulation. This reportedly will become a "synthetic mirror" of the real life that will automatically follow real-world events in real time.[16]

The Training and Doctrine Command (TRADOC) Project Office for Gaming (TPO Gaming) is a new Army organization intended to integrate video game graphics into training simulations for soldiers and small-unit leaders. The new office plans to develop an Army simulation tool kit, scheduled for deployment between 2010 and 2015, that allows end users to build and customized their own training scenarios without needing a contractor to do it for them.[17]

Operational and Cost Areas

VR is not always the best choice for military training. For example, VR simulators are usually located in comfortable environments, with air conditioning to cool computer equipment, so the operators never get tired from running with a large backpack, or wet and cold, or otherwise physically stressed as they would in a real-world training exercise. However, VR offers the following advantages: (1) the training mission can be repeated numerous times; (2) worst-case and emergency scenarios can be simulated without the risk of injury to trainees; and (3) real military equipment is not used in VR, so costs for equipment maintenance and fuel are eliminated. VR is increasingly seen as a useful way

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[15] Virtual Iraq — VR Based Therapy for Post-Traumatic Stress Disorder, Defense Update, 2005, Issue 3, [http://www.defense-update.com/products/v/VR-PTSD, htm].

[16] Josh Rogin, *JFCOM brings virtual world closer to home*, FCW.com, April 4, 2007, [http://www.fcw.com/online/news/98147-1.html?type=pf].

[17] Michael Peck, *Constructive Progress*, Defense News, December 3, 2007, p. 32.

to supplement or reduce the number of real-world exercises needed to adequately train military personnel.

Policy Issues

Some experts expect that global commerce will come to rely heavily on VR. In a world where banking, transportation control, communications, and other global commerce are arguably conducted in VR, they question how the United States will defend its national assets if global VR standards are dominated by China, or if a majority of VR servers are physically located in and operated by China.

Right now, the U.S. military does training in VR. Some ask whether a day will come when the U.S. military might also conduct actual war fighting operations in VR to defend U.S. assets and national security. Should research be funded to develop exploits specific to VR that can be used by DOD?

How does the U.S. communications infrastructure to support VR compare with that of China, or with other countries?

To what extent could VR help the intelligence community track possible terrorist activity?

How do the costs and benefits of VR compare to the cost and benefits for traditional military training exercises? Have there been evaluations of VR effectiveness? What are the implications of the expansion of this technology to other military activities?

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