To make combat training seem more like real warfare, the Air Force is harnessing new technology that lets groups of airmen half a world apart practice together on virtual battlefields, all without leaving home.

This advantage no longer accrues only to a few pilots operating networked cockpit simulators. The concept is rapidly expanding to permit the exercising of large, massed joint forces at the theater-war level.

Distributed Mission Operations, (DMO) as this type of networked training is known, pulls in participants from all US services and, increasingly, allies and permits them to “game” and rehearse highly complex campaigns, using a mix of local, distant, and virtual players.

Plans called for the concept to go through a major tryout at Nellis AFB, Nev. The layout for this special Red Flag exercise included on-scene and remote players as well as “constructed”—that is, simulated—allies and enemies generated on computers.

Planners consider this exercise a “Virtual Flag,” the purpose of which would be to test the training state of the art and identify lessons for future exercises.

The benefits of distributed training are many. Air Force operators not only receive more realistic training but also practice more closely the kind of networked warfare that is sure to characterize future operations, with thousands of inputs and factors. It may spell the end of “set piece” wargame scenarios that contain few if any surprises.

However, “the training value of it is just one aspect,” according to USAF Lt. Col. Bruce VanSkiver, chief of exercises and training innovation for the Joint Staff. The DMO structure, he said, will permit “test and evaluation,” whether the item to be tested is a new tactic or a new weapon or technology.
Because operators won’t always have to move people and machines thousands of miles to train, the service will save time and money, though that’s not the primary consideration, VanSkiver said.

**Synthetic Battlespace**

Already, flights of F-15s from Langley AFB, Va., can fly virtual missions, via simulators, alongside F-16s based at Shaw AFB, S.C., all of them vectored to their targets by E-3 AWACS crews seated at station simulators at Tinker AFB, Okla., and using data supplied by E-8 Joint STARS operators hundreds of miles away, VanSkiver said. They can all talk to each other as if they were flying in the same airspace.

As VanSkiver explained, “You can now have the whole synthetic battlespace developed, without anybody leaving home, and you can do that on call, whenever you choose to set the architecture up.”

The DMO concept emerged a few years ago from Air Combat Command, said Orris Hambleton, a contractor who heads the “live-virtual construction” effort under VanSkiver.

“Their idea was just to link the simulators together, so they could fly together,” he said.

However, the idea soon attracted high-level attention. It was picked up and given major emphasis by Gen. John P. Jumper, Air Force Chief of Staff, who thought it promised great benefits to the warfighting community. He became an enthusiastic backer, said VanSkiver, and now takes quarterly briefings on the project.

“The grand vision—on just the Air Force side of it—is to be able to tie disparate nodes together,” said VanSkiver. These nodes can be simulators, aircraft in flight, or even an entire combined air operations center (CAOC). At some point, said VanSkiver, the training concept will “begin to migrate ... into the joint and ... coalition side.”

A DMO charter was signed late last year, and a roadmap for both hardware acquisition and conceptual advances is now in the works.

At Jumper’s insistence, the Air Force extended ACC’s idea of linking simulators for more realistic fighter training missions, taking it into other areas. That way, said Hambleton, aircraft operators “can, essentially, fly and fight or train to fight in a synthetic battlespace, without the complications of all the safety-of-flight issues of live-fly exercises.”

The new training technique reduces some of the stress on Air Force members and their families, in that big exercises can be run without elaborate deployments.

“It’s very hard to bring all those people together without disrupting their home life,” Hambleton noted. “They don’t have to leave home. They can [train] in their local simulators.”

From the beginning, said VanSkiver, Jumper’s goal was to produce an Air Force capability to practice with other services and allies and to serve as a tool for training flag officers. Jumper demanded “a Capstone event ... where we do live, virtual, and constructive play, in a robust manner,” VanSkiver said.

Capstone is a course for newly minted general officers.

According to VanSkiver, the DMO concept is quite new, having emerged only about two years ago. However, he added, it has acquired great momentum in the past 12 months.

**Two Realities**

In setting up the DMO architecture, two realities became apparent.

First, the Air Force saw that the effective preparation of CAOC crew members required a training effort bigger than anything the Air Force had produced to date. It wasn’t enough to simply run a big exercise such as Red Flag, which can involve dozens of aircraft flying a wide variety of missions. Even with so much live-fly action taking place over hundreds of miles of land and airspace, the standard Red Flag “just does not put any strain on an air operations center,” said Maj. Bill Otter, chief of DMO on the Air Staff.

What was needed was a way to simulate hundreds of independently acting entities, introduce surprises, and put some heavy stress on a battle plan, the point of which would be to push CAOC officers to their limits and see how they react. The DMO, when joined with exercises such as Virtual Flag, can do that by creating virtual threats, allies, and problems.

Second, planners saw that there was a need for today’s aircrew members to practice in a complex, fast-changing, and crowded battlespace. The DMO architecture gives aircrews a much closer picture of what it’s like to fly in a modern war, where data pings and calls are coming in from many sensor aircraft, fighters, tankers, unmanned aerial vehicles, and ground units.

Exercises at Nellis mix Red Flag—the live-fly element—with Virtual Flag and Blue Flag, which are command and control events.

“One of the things that DMO is allowing us to do is mix and blend those flags to a great extent,” Hambleton noted. “With Joint Red Flag, for
instance, all three of those flag elements will be exercised” at once.

According to VanSkiver, the most recent Joint Red Flag provided “the first demonstration of what is now called an ‘integrator event,’ where we exercise that operational slice, the command and control, to where the CAOC is stood up, the Navy plays, the Marines play to some extent, and the Army plays. ... We’re able to fuse all those different nodes together into one ... fight.”

All of this adds new breadth and depth to realistic combat training, particularly in the joint arena, which is not available now without scheduling and organizing a “very complex sort of live-fly exercise, where we bring everybody to the same range and fly aircraft,” Hambleton said.

VanSkiver said, “We can replicate day in and day out those complex scenarios that you just can’t do anywhere else.”

Much of the DMO architecture is coordinated and piped through the Distributed Mission Operations Center, or DMOC, at Kirtland AFB, N.M.

The Air Force is working on these kinds of integrated exercises as part of its effort to meet the Pentagon’s “Training Transformation” initiative, which seeks to bring into the mainstream joint training among the services.

Setting ROE

One of the challenges at the exercise is setting the rules of engagement governing how real, simulated, and remote elements will interact.

“We still have a lot of work to do on exactly how to work the ROE between live-fire aircraft,” Hambleton said. Participants from different locations have different geography and weather with which to contend. For now, live and remote players must be “carefully separated,” he said.

The nation has experienced great strides in simulator technology. Pilots in two fighter simulators now “see” each other as if they were actually flying together. Because the terrain around the simulated bases is so true-to-life, and because things such as local air traffic pattern procedures are specific to particular bases and ranges, pilots easily slip into the belief that they are somewhere else.

The quality of simulation makes it possible for pilots to train safely for flight leadership upgrades and use combat skills they might get to employ only rarely in a real aircraft.

ACC is trying to determine just how much actual flying time can be dropped in favor of simulator time. Much of the funding for simulations and the setup of the DMO architecture has, in fact, been diverted from ACC’s flying hours budget.

VanSkiver said that ACC is constantly adjusting its calculus of the correct ratio between simulator time versus live-flying time. Much actual flying time—such as performing an uneventful air combat patrol or transiting to a practice area—does not provide training of the same quality as that found in a stressful simulation of all-out combat maneuvering.

Simulation can be more beneficial than the real thing for some operators. An AWACS mission specialist, who spends much of his or her time inside a windowless fuselage, scarcely feels a difference between a live-fly mission and a simulated training mission.

In an actual mission, the AWACS operator might only have to deal with a few calls from fighters,
whereas high-fidelity simulation with scores of participants will tax the operator’s abilities and provide a more thorough training experience, Otter said.

The major challenge confronting the use of DMO is the distance—specifically, the distance over which electromagnetic communication waves must travel, Hambleton explained. Long distances can create unacceptable delays, which, in coordinating aircraft operations, is measurable in hundredths of a second.

“Pure physics gets in the way” of using satellites to move the data of simulations, VanSkiver said.

He noted that, even at the speed of light, signals must travel out to a satellite at geosynchronous orbit 26,000 miles up, along with encryption and decoding at both ends of the transmission. “Now you have real issues [affecting] distributed training in any kind of realistic fashion,” he said.

**Primary Network**

The DMO architecture runs over a commercially obtained network not owned by the Defense Department.

“The primary network that we use has got a variable bandwidth, up to whatever we need,” said Otter. The Air Force pays only for the amount of bandwidth it uses. In the future, though, the DMO architecture will use the Global Information Grid, the in-development, terrestrial network of communications connections. (See “The Network Way of War,” March, p. 26.)

“As we transition to the Global Information Grid”—which the Pentagon is setting up to address issues of bandwidth and security—“we’ll see many of these issues begin to go away,” VanSkiver said. The GIG will be able to move so much data so fast that it will be akin to using the Internet.

This will also resolve “many” security issues, he added, because access to the grid will be tightly controlled.

Right now, there is “some risk” involved in using commercial networks to carry the electronic traffic of simulations. Someone able to get into the simulation can not only observe it but also record the action for later analysis, VanSkiver noted.

Another goal is to create virtual battlefields in many places around the world. Technology is advancing rapidly. Soon, all of the “connectivity” equipment needed to plug in to an exercise will reside on an aircraft or ground unit. “Virtual ranges” are already appearing.

Otter said the use of virtual battlefields for mission rehearsal has generated much favorable comment. One Air National Guard unit, he said, took special note of a rehearsal for a mission flown in Operational Iraqi Freedom. It was, in the view of unit members, highly realistic and predictive of the actual event. “They said it was just as if they were in the sim,” Otter reported.

The DMO roadmap now in the works is starting with the compilation of a pan-Air Force inventory of all simulators and training devices, to assess the general level of complexity and modernity of the equipment. Most major commands already have some new gear. Air Mobility Command has C-17 simulators; ACC has up-to-date sims for all its fighters and bombers. Air Force Special Operations Command also has simulators for its disparate equipment.

One issue will be how much a particular command can participate in big wargames. In the case of AFSOC, the command routinely uses simulators for training and mission rehearsal and can’t spare the machines to contribute to larger training events.

“When you do DMO-type training, in an exercise or a synthetic battlespace, that takes training time away from their primary function, and it becomes very difficult for them to do,” according to VanSkiver. “So, we’re going through that exercise now, to determine what those offsets are going to be in terms of the training value for full mission rehearsal and mission qualification, versus [the] primary flight training [for which] they’ve been designed ... in the past.”

VanSkiver said a key future challenge will be finding a way to incorporate allied nations into the major virtual exercises. A big problem is the machine-to-machine interface. Allied and US technologies are dissimilar. Another problem: security. There is a question about who decides what data can be released.

So far, only Canada and Britain can “play” in Virtual Flags, but more nations should be added soon.

VanSkiver said that his group, in building the DMO roadmap, asked the major commands to voice their own visions of the future of DMO. Some commands demonstrated lots of imagination. Others did not. The trick will be to coordinate these ideas into a scheme that works for everyone.

As VanSkiver explains it: “We want the aircrews and the mission crews and the command and control nodes to be able to do those simulated events exactly the way it happens in the real world, without limitations.”