PHOTO BY TONY ROMERO

The integrated battlespace is here. Future Combat Systems – the Army's modernization program that will link soldiers, manned and unmanned ground and air vehicles, and sensors – is becoming a reality.

Left: U.S. Army Sgts. 1st Class John Jones and Tak Cheung confer at the FCS System of Systems Integration Lab in Huntington Beach, Calif. Both are inside wireframes, participating in the recent IMT-0 test event. Wireframes represent manned ground vehicles. Each seat is a "warfighter-machine interface" that allows the participant to take part in virtual combat.

Virtual Virtuosity

By Jay Spenser

Earlier this year, the Future Combat Systems program successfully tested modernization concepts that the program is scheduled to deliver to the U.S. Army. But this debut exercise wasn't held at a proving ground where new hardware was put through its paces. Instead, Integrated Mission Test Zero (IMT-0), took place in virtual battlespace. Its success marks a milestone as the FCS program advances toward deployment.

Initial deliveries of components for integration into the current force are scheduled for 2008, and initial operating capability of the full systems complement for 2015. FCS is a system of systems that will link soldiers and 18 separate military platforms – manned and unmanned ground vehicles, unmanned air vehicles and other components – via a distributed information network. The result will be new capabilities for the Army, which will field FCS-equipped Brigade Combat Teams (BCTs) that are more versatile, capable, survivable, supportable and deployable than today's forces.

The backbone of FCS is the System of Systems Common Operating Environment (SoSCOE), an infospace middleware that will link these Army BCTs with one another, their remote assets, external knowledge centers and Air Force, Navy, Marine Corps or foreign friendly forces. The result will be an information-rich battlespace that will dramatically reduce the confusion and uncertainties that have characterized warfare over the ages.

FCS engineers conduct a test at the Boeing FCS lab in Huntington Beach, Calif.

"Every day we are breaking new ground and demonstrating the power of this network-centric approach," says Dennis Muilenburg, Boeing vice president and general manager, Future Combat Systems. "In partnership with our Army customer, we are on track to deliver leading-edge networked capabilities to our 21st century soldiers."

With so many individual platforms connected and enabled by the expansive SoSCOE network, so many potential roles and strategies for these platforms and so many possible combat situations and scenarios, FCS presents an engineering challenge of truly enormous scope. Not surprisingly, so did conducting the first-ever integrated test of this network-centric system of systems.

Digital battlescape

IMT-0, the culmination of FCS Integration and Verification Phase Zero (IV0), was conducted at the FCS System of Systems Integration Laboratory (SoSIL) in Huntington Beach, California. At this state-of-the-art facility, engineers and technicians began their test preparations by harnessing massive computing power and leveraging U.S. Government modeling and simulation tools to create an extensive three-dimensional digital battlefield and gave it realistic terrain, weather, electronic jamming effects and

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Left: Boeing FCS systems engineers Jacob Ford and Eve Ford confer during a test at the Boeing FCS lab in Huntington Beach, Calif.

Right clockwise:

Alonza Chubbs, an engineer with Science Applications International Corporation (SAIC) participates in an FCS team exercise. He is sitting at the controls in the FCS System of Systems Integration Lab in Huntington Beach, Calif.

Boeing engineer Jerry Jones is one of the FCS experts taking part in the virtual test.

Eve Ford at one of the monitors in the lab during the test.

Below: Boeing engineer Bill Demarest.

Future Combat Systems Spin Outs

Beginning in 2008, the U.S. Army will start receiving selected FCS capabilities that will improve its current forces. FCS program Spin Outs are planned for Fiscal Years 2008, '10, '12, and '14. They will transfer FCS advancements in networking, unattended sensors, precision munitions, unmanned air and ground vehicles and other FCS technologies to current Army forces.

The idea of early delivery arose after the program began.

"Soldiers fighting today need these advanced FCS capabilities as soon as we can safely deliver them," says Val Bring, Boeing FCS program director for Spin Outs and production. "Spin Outs deliver them to the warfighters sooner. They also reduce overall program risk by providing real-time feedback from their operational evaluation and use."

These Spin Outs will give the Army valuable experience in network-centric operations, facilitate the fielding of future-force FCS Brigade Combat Teams and create a learning laboratory – the Army's Evaluation Brigade Combat Team – in which FCS program stakeholders can capture technical and operational lessons.

Unattended ground sensors (UGS), are among the FCS technologies identified for early fielding. A tactical version (T-UGS) features magnetic, acoustic, radiological, visual and seismic monitoring of threats to provide the unit commander with early warning of battlefield threats. A companion urban-warfare version (U-UGS)

will provide ongoing intrusion detection and imaging in previously cleared buildings and other areas.

Current-force Army systems such as the Abrams tank, Bradley Fighting Vehicle and Humvees are slated for Spin Out upgrades. The mature FCS systems and components they will receive will enhance crew situational awareness and improve force protection and lethality. With each Spin Out, network-centric functionality and capabilities increase in the current force, culminating in the delivery of systems for a complete FCS Brigade Combat Team in 2014.

For FCS One Team engineers, the challenge is to take future capabilities intended to operate as part of an integrated whole and modify them to work within the current force structure. The Evaluation Brigade Combat Team will help meet these challenges by spearheading the Army's implementation of FCS Spin Outs and participating in core FCS verification and testing.

"The Spin Out strategy struck a chord with the Army, Office of the Secretary of Defense and Congress because it is a win all around," said Col. Russ Hrdy, U.S. Army program director for Spin Out development. "The warfighter gets future capabilities much earlier than planned, while the FCS program gets another tool for ensuring that this complex program will work when delivered."

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other required elements.

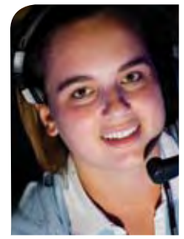
Into this virtual battlescape, SoSIL engineers loaded and integrated software models depicting many of the FCS platforms now under development, including the Infantry Carrier Vehicle, Non-Line of Sight Cannon, Class IV Unmanned Air Vehicle, Small Unmanned Ground Vehicle and Unattended Ground Sensors. Adding to the challenge, IMT-0 would require the simultaneous operation of a great many examples of each of these platforms.

In every case, the FCS One Team member responsible for developing the actual combat system also provided its software model. There are 23 first-tier suppliers on the "best of industry" One Team, which includes the Army and is led by Boeing and its partner, Science Applications International Corporation, who serve as Lead System Integrator. The FCS program is valued at more than $20 billion for the entire System Development and Demonstration Phase spanning 2003 to 2014.

In addition to accurate simulation models, IMT-0 also ran actual program software, including SoSCOE Build 1. Together these elements allowed FCS to be simulated with enormous fidelity.

The human element

The final ingredients needed for FCS's virtual debut were human beings. This simulated combat engagement pitted friendly Blue Forces (Army and allied) against hostile Red Forces. More than 40 trained FCS experts – including eight active-duty Army soldiers – "crewed" 18 digital vehicles and otherwise played roles on the Blue Forces side of the conflict. More than a hundred others participated peripherally. Another 20 trained program personnel helped computers conduct the Red Forces side of the conflict.



Most of the human role-players participated from enclosures, called wireframes, that represented and controlled the vehicles roaming IMT-0's digital battlefield. For coordination, the seats in these wireframes are arranged in the same relative positions that Army crews will occupy in the manned FCS ground vehicles now being developed. Before each wireframe seat is a warfighter-machine interface, the evolving FCS control and display technology that allowed human beings to take part in virtual combat.

"We needed real people on both sides of the exercise for two reasons," says Frank De Mattia, Boeing FCS site lead and senior program director in Southern California. "One was to obtain a better understanding of how future battles will be fought. The other was to benefit from the views and opinions of the warfighter."

Integrated excellence

IMT-0 began on Jan. 23, 2006, and ended the following Feb. 1. Each morning began with a half-hour situational review during which the day's test objectives, procedures, schedule and particular challenges were discussed. The role-players and test conductors then manned their stations and the exercise resumed. Late in the day, the participants gathered once again to discuss what had occurred relative to what had been anticipated.

The System of Systems Integration Lab's Test and Operations Control Center was IMT-0's nerve center. From there, One Team engineering leaders followed the nine-day exercise with rapt attention. What they saw validated a new concept of warfare.

"IMT-0 – the climax of IV0 – was a resounding success," says Todd Nicholson, Boeing FCS project manager for IV0. "This simulated exercise confirmed that we are maturing technologies, retiring program risk, and have the right processes in place to design, develop and integrate FCS across a very large distributed team."

Countless insights were gleaned immediately from the test, and more continue to emerge as data is analyzed. IV0 is drawing to a close, but four more integration and verification phases are scheduled, with each leading to delivery of FCS capabilities. The knowledge gained at every one of these phases will directly benefit the program and its customer, the U.S. Army.

FCS will begin delivering technology Spin Outs to the current force beginning in 2008. The program is on track for full deployment in 2015.

In the field

Along with virtual testing, field exercises are also under way that are advancing FCS toward implementation. At the Boeing FCS compound in California, a walled parking lot is home to a fleet of modified Humvees. These unusual looking military vehicles have been stretched and equipped with warfighter-machine interfaces that allow them to represent different manned FCS ground vehicles in military exercises.

Eight of these Humvees recently left California to participate in the U.S. Air Force's Joint Expeditionary Force Experiment 2006 at Nellis Air Force Base in Nevada. The Force Experiment, a major spring exercise, will explore emerging military tactics, techniques and procedures in joint operations that seamlessly integrate FCS vehicles, software and networking.

In the fall of 2006, Army troops and more FCS Humvees will participate in Experiment 1.1, an FCS exercise that seeks to deploy part of an operational Brigade Combat Team on a mock battlefield. Hand in hand with integrated simulations like IMT-0, these 2006 field trials are leading the Army toward a more capable and flexible future force structure.

"This is a critical year for proving out FCS capabilities," says Maj. Gen. Charles Cartwright, U.S. Army program manager for FCS (BCT). "Together we are meeting the challenge." ■