C4ISR Technical briefing


TRACEWELL SYSTEMS

Faster in the field

The military needs to rapidly process complex information in the field. **Matt Tracewell**, of Tracewell Systems, describes how deployable computer blade technology could be the answer.

In the field, the U.S. military's most valuable weapon may be its data center. The immense quantity of data obtained from flyovers must be analyzed by high-performance computers to spot locations where improvised bombs may have been planted or to recognize changes that could indicate the presence of enemy combatants. Much of that work is done by computers called IBM BladeCenters, which are housed at fixed regional headquarters. A blade system is a single chassis containing multiple server circuit boards, or blades, with individual blades often dedicated to

specific applications. Plugging multiple blades into a single chassis provides a unified source of power, cooling and connectivity for the blades. When a new or updated capability is required, instead of adding a new server and rack unit, users can simply install another blade in the enclosure or "hot swap" a new blade. This capability saves the time and cost of replacing an entire server chassis, rewiring and configuring the server, ensuring compatibility and avoiding unanticipated differences and logistics problems that contribute to risk.

The blade approach was a huge breakthrough. In the past, high performance computing was done by connecting multiple off-the shelf processors, each with a single motherboard, cooling fan and power supply. The blade technology provides enormous reductions in size, weight and power and reductions in cabling and interco nects.

The capabilities of IBM blade servers were adopted first by Wall Street financiers and scientists at the Los Alamos National Lab in New Mexico, who use blade servers to simulate nuclear weapons tests. Blade computers are processing intelligence collections for U.S. forces, including those in Afghanistan.

As powerful as the Blade Centers are, U.S. forces have discovered that they cannot always wait for data to be transported back to headquarters for storage and processing by the blade technology. The analysis and human decisionmaking must be carried out much closer to the point where the intelligence answers are needed. In mid-2009, Tracewell took up the challenge of adapting a slice of a Blade Center for field deployment on aircraft and on ground vehicles.

In a meeting with prime contractors, we learned that a U.S. customer who wishes not be identified was searching for a way to process complex information in the field instead of at a fixed data centers.

At play was a classic hardware - software battle, with a government need driving a discussion about the art of the possible. The software experts said algorithms could solve the analytic problem if the algorithms had enough computing horsepower behind them. One of the prime contractors said the only way to do that would be with the IBM blade technology.

The blade technology was too big and heavy to deploy, so the contractors were trying to come up with a custom computer that would provide equivalent performance. They were having a terrible time because of the expense of developing such a customized system.

We listened to the problem and decided to see whether we could take the blade technology and package it to withstand the vibration and heat of mobile operations in planes or ground vehicles. We licensed the blade technology from IBM and started the project in our factory in Westerville, Ohio, where we manufacture rugged, deployable computers for unmanned aircraft, ground stations and submarines.

INNOVATION

We decided to apply the philosophy of disruptive technology to produce a deployable version of the IBM blade technology, called the Rugged Blade System.

The disruptive philosophy called for taking standard equipment and using it in unconventional ways to gain an advantage over a competitor or enemy.

We started by looking at the techniques used in existing rugged computing products, such as those found in tanks, Humvees or aircraft. Some of these customized solutions were designed by Tracewell, but they could not be directly applied to protecting a blade system. We could not change the chip selection, digital conne tors or form factor for the blade server boards. The whole point was to keep the deployed blades identical to those at the fixed sites. There was an enormous gap between the readily available ruggedization techniques and what would be needed to make a blade system survive in a deployed environment.

We realized, however, that some of the techniques could be applied in new ways to protect the blade system. For conduction-cooled computers, engineers often use devices called wedge locks to firmly hold together metal frames that create a conduction path to cool circuitry. The second benefit of the wedge locks is that they make devices vibration tolerant. Instead of using wedge locks to cool the Blade system, we saw that we could use them to secure the blades — the server boards — to protect them from vibration.

To improve the Rugged Blade System's thermal performance, we use a heat-sink, air cooling technique that includes heat pipes. Heat pipes are very efficient but also delicate if not properly implemented. They are hollow copper tubes filled with porous copper and deionized water that acts as a heat wick. When a circuit heats the air around it, the hot air heats one end of the pipe, the water vaporizes and liquid water is sucked through the wick. Heat is almost instantly transferred from one end to the other. Using heat pipes was a big advantage because heat pipes are lighter than cooling systems based on solid copper, for example. Weight is a major constraint for deploying computer systems on Humvees, airplanes or in the tight quarters of submarine or small surface vessel.

The systems use fans and filters to keep out dust.

We now have versions of the

U.S. DEFENSE DEPARTMENT

Military and civilian personnel monitor the range during Empire Challenge 2010 at Fort Huachuca, Ariz., where Tracewell Systems Rugged Blade System, like the one in the photo at left, was evaluated alongside conventional servers.

Rugged Blade System with three or five blade slots. The units are small enough to fit in the back of an aircraft and can be transported on a Humvee to a field tent. The blade architecture is powerful enough that it allows a single unit to replace the multiple transit cases that previously had been required.

TRUST

A major challenge presented to us was to work quickly. We were put on contract by our first customer in August 2009 and delivered our first product in January 2010. This was possible largely because of the direct connection between our engineering facilities and our factory floor. We can design a new component, analyze the design for stress and thermal dynamics, and immediately download the design to the manufacturing floor for rapid machining and fabrication. We used this technique to weave best of breed techniques into the Rugged Blade System and present the technology to our customers.

Those customers are engineers at the major prime contractors, and they are "show me" people. An engineer can examine our hardware and immediately recognize the techniques and technologies we have applied. For cooling, an engineer can see that we use a heat sink construction that normally would not be used in a deployed application because of mechanical limitations. The engineer also can see that we add wedge locks, which gives us the vibration tolerance that allows us to use the heat sink.

Because these techniques are familiar, they generate trust — but not blind trust. Our system was tested at the Empire Challenge intelligence sharing demonstration at Fort Huachuca, Ariz., in August. Military evaluation personnel ran a stack of conventional servers and rack systems alongside our ruggedized blade center. When the air conditioning failed in the evaluation tent, the conventional computers quickly became overheated and failed, but our system continued to perform. The evaluation report from the Empire Challenge team noted: "Throughout the exercise, the Rugged Blade System performed to specification, even when subjected to high temperatures due to a lack of air conditioning. The Tracewell Rugged Blade System chassis and IBM blades, despite high temperatures and less than optimal work conditions, provided a high level of service."

The challenges for us, are not over, however. We are preparing to add new features to the Rugged Blade System, including additional form factors, high speed switching and power supply options. In some locales, the 220-volt system that the powerful servers usually require is not available. As a result, Tracewell is devising a method to use multiple redundant 110-volt feeds to power the system.

Overall, we believe the Rugged Blade System could have great value to soldiers using the Distributed Common Ground System Army (DCGS), the service's deployable intelligence processing computers and network. Today's DCGS system consists of PCs in transit cases that are connected together inside a tent or other shelter. One of the greatest challenges these soldiers face is unplugging the computers and reconfiguring them when they move to a new site. Transitioning to blade technology would solve the interconnection problem.

The system also would be vastly easier to upgrade or repair. Part of the value of the blade technology is that IBM is following a road map of ever-increasing horsepower for its processors. As each processor type is improved, IBM brings it to market in a timely fashion. Soldiers would be able to unplug the old blade and plug in a new blade.

There is a whole user community that is being awakened to the blade technology. This community by and large was not aware of the blade technology because the technology has not been relevant to deployments until now. ■

Matt Tracewell is executive vice president at Tracewell Systems Inc., in Westerville, Ohio, a designer, manufacturer and integrator of ruggedized computer components. He oversees research, design, engineering services and manufacturing.